PRELIMINARY DRAINAGE REPORT

GRANDVIEW RESERVE FILING NO. 1

El Paso County, Colorado

PREPARED FOR:
D.R. Horton
9555 S. Kingston Court
Englewood, CO

PREPARED BY:
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DATE:
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PCD Filing No.: PUDSP2110

ENGINEER'S STATEMENT

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

01/22/2024

Brady A. Shyrock, PE #38164
For and on behalf of Galloway & Company, Inc.

Date

DEVELOPER'S CERTIFICATION

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

By: _____

1/24/24

Date

Address: D.R. Horton
9555 S. Kingston Court
Englewood, CO

EL PASO COUNTY CERTIFICATION

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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I. Purpose

The purpose of this Preliminary Drainage Report is to identify on and offsite drainage patterns, locate and identify tributary or downstream drainage features and facilities that impact the site, and to identify which types of drainage facilities will be needed and where they will be located. This report will remain in general compliance with the approved MDDP prepared by HR Green, dated November 2020.

II. General Description

The project is a single-family residential development located in the Falcon area of El Paso County, Colorado. The site is located in a portion of the South half of Section 21, the North half of Section 28, Township 12 South, Range 64 West of the 6th Principal Meridian, County of El Paso, State of Colorado. The subject property includes Eastonville Road to the west, which was studied separately in the "*Eastonville Road Preliminary Drainage Report*", by HR Green, September 2023 (**E-PDR**), and is currently in review with El Paso County. The project site is bounded by undeveloped land proposed as future development to the east, and undeveloped land within the Waterbury Development to the south. A Vicinity Map is included in **Appendix A**.

This preliminary drainage report is the basis for the drainage facility design in conformance with the previously approved MDDP for the site prepared by HR Green, "*Grandview Reserve Master Development Drainage Plan",* HR Green, November 2020 (**MDDP**). The site consists of approximately 189.479 acres and includes 565 dwelling units.

For upstream offsite runoff analysis, the basis for drainage concepts and calculations are derived from the approved "*Revision to: Master Development Drainage Plan, Meridian Ranch, El Paso County, Colorado*", Tech Contractors, July 2021 (**MR-MDDP**).

The existing soil types within the proposed site as determined by the NRCS Web Soil Survey for El Paso County Area consist of Columbine gravelly sandy loam (hydrologic soil group A) and Stapleton sandy loam (hydrologic soil group B). See the soils map included in **Appendix A**.

III. Drainage Criteria

Hydrology calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

The drainage calculations were based on the criteria manual Figure 6-5 and IDF equations to determine the intensity and are listed in Table 1 below.

Table 1 - Precipitation Data

Return Period	One Hour Depth (in).	Intensity (in/hr)
5-year	1.50	5.17
100-year	2.52	8.68

The rational method was used to calculate peak flows as the tributary areas are less than 100 acres. The rational method has been proven to be accurate for basins of this size and is based on the following formula:

Q = CiA

Where:

Q = Peak Discharge (cfs)
C = Runoff Coefficient
i = Runoff intensity (inches/hour)
A = Drainage area (acres)

The runoff coefficients are calculated based on land use, percent imperviousness, and design storm for each basin, as shown in the drainage criteria manual (Table 6-6). Composite percent impervious and C values were calculated using the residential, streets, roofs, and lawns coefficients found in Table 6-6 of the manual.

The 100-year event was used as the major storm event. The 5-year event was used as the minor event. The UD-Inlets v5.01 spreadsheet was utilized for the sizing of the proposed sump inlets.

The UD-Detention v4.04 spreadsheet was utilized for the design of the proposed on-site water quality ponds, Ponds A, B, C, D, E, and Eastonville Pond.

IV. Existing Drainage Conditions

The site is contained fully within one major drainage basin; the Gieck Ranch Drainage Basin and is tributary to Black Squirrel Creek. The site generally drains from north to south with an average slope of 2% outside of the channel. The rational method was used to analyze the individual basins within the site because their size permits it.

OFF-SITE FLOWS

There are two (2) major drainageways that currently convey existing on & off-site flows through the site to the southeast; These are the Gieck Ranch Tributary #1 (Hereon referred to as Channel A), located centrally through the site, & Gieck Ranch Tributary #2 (Hereon referred to as Channel B), located along the northeast portion of the site. Both drainageways generally flow to the southeast towards Highway 24, before crossing via existing drainage structures. These drainageways are analyzed in the report titled “Grandview Reserve CLOMR Report,” Prepared by HR Green. This report is still in review – a discussion will be included in the report about the difference between FEMA flows and the Meridian Ranch MDDP. Subsequent Final Drainage Reports will be revised as necessary to incorporate any changes from the CLOMR report.

Existing upstream tributary analysis (the areas west of Eastonville Road) was performed as part of the **E-PDR** and includes basins EX1, EX2, EX3, EX4, EX5, EX6, and EX7. See the **E-PDR** in **Appendix F** for reference. A description of critical design points from the **E-PDR** that enter the site are summarized below.

Channel A: enters the site via an existing 18” (Public) CMP under Eastonville Rd. The flows at this point are associated with **Design Point 4** of the **E-PDR** and correlates to **Design Point G06** of “*The Sanctuary*

Filing 1 FDR (Meridian Ranch)", Tech Contractors, August 2022; Per the **E-PDR**, the total upstream tributary area is 832.7 acres, and Channel A flows entering the existing pipe culvert at **Design Point 4** are: Q_5 = 22.4 cfs, Q_{100} = 491.0 cfs.

Channel B: enters the site via an existing 24" (Public) CMP under Eastonville Rd. The flows at this point are associated with **Design Point 1** of the **E-PDR** and correlates to **Design Point G18** of "*The Sanctuary Filing 1 FDR (Meridian Ranch)",* Tech Contractors, August 2022; Per the **E-PDR**, the total upstream tributary area is 321.5 acres, and Channel B flows entering the existing pipe culvert at **Design Point 1** are: Q_5 = 28.3 cfs, Q_{100} = 365.2 cfs.

Design Point 3: off-site flows enter the site via an existing 24" (Public) CMP crossing Eastonville Rd. from the Falcon Regional Park. The off-site flows are associated with **Design Point 3** of the **E-PDR** and correlates to Design Point G16 of "*The Sanctuary Filing 1 FDR (Meridian Ranch)",* Tech Contractors, August 2022; Per the **E-PDR**, the total upstream tributary area is 131.3 acres, and flows entering the existing pipe culvert at **Design Point 3** are: Q_5 = 6.1 cfs, Q_{100} = 112.1 cfs.

Design Point 5: off-site flows enter the site via an existing 18" (Public) CMP crossing Eastonville Rd. The off-site flows are associated with **Design Point 5** of the **E-PDR**; Per the **E-PDR**, the total upstream tributary area is 22.35 acres, and flows entering the existing pipe culvert at **Design Point 5** are: Q_5 = 7.0 cfs, Q_{100} = 43.3 cfs.

Design Point 6: off-site flows enter the site via an existing 18" (Public) CMP crossing Eastonville Rd. The off-site flows are associated with **Design Point 6** of the **E-PDR**; Per the **E-PDR**, the total upstream tributary area is 3.05 acres, and flows entering the existing pipe culvert at **Design Point 5** are: Q_5 = 1.2 cfs, Q_{100} = 6.9 cfs.

ON-SITE FLOWS

While the **MDDP** shows a total of 22 basins that were analyzed as part of the overall Grandview Reserve development, for the purposes of this report, 7 of the Basins within the MDDP will be used for analysis. These Basins include A1, B1, B2, C1, B3, and the two off-site Basins situated to the northwest of Eastonville Road. See **Appendix G** for reference.

For a more in-depth analysis of existing tributary conditions as it pertains to this phase of development, an existing basin map has been prepared. The existing conditions drainage map can be found in **Appendix E** and basins are described below.

Basin ES-1 (16.37 AC, Q_5 = 3.5 cfs, Q_{100} = 24.7 cfs): Located on the southwest portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the southeast before channelizing and eventually out falling into Channel A at **DP X1**.

Design Point X1 (Q_5 = 4.7 cfs, Q_{100} = 31.6 cfs): Located on the southern portion of the site, this design point accounts for the total combined flows from **Basins EX6, EX7, & ES-1**. Flows from this design point are conveyed off-site to the south, via a naturally formed channel, and discharges into the existing Channel A.

Basin ES-2 (46.05 AC, Q_5 = 7.5 cfs, Q_{100} = 53.7 cfs): Located in the southwest portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the Channel A at **DP X2**.

Design Point X2 (Q_5 = 36.9 cfs, Q_{100} = 588.0 cfs): Located on the southern portion of the site, this design point accounts for the total combined flows from **Design Point 4, 5, & Basin ES-2** and represents the

total existing Channel A flows at that point. Flows from this design point are conveyed off-site to the south, via the existing Channel A.

Basin ES-3 (64.30 AC, Q_5 = 10.0 cfs, Q_{100} = 71.5 cfs): Located in the central portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the southeast before channelizing and eventually out falling into Channel B at **DP X3**.

Basin ES-4 (2.68 AC, Q_5 = 0.6 cfs, Q_{100} = 4.4 cfs): Located on the eastern portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the east into Channel B at **DP X4**.

Basin ES-5 (26.15 AC, Q_5 = 5.0 cfs, Q_{100} = 35.5 cfs): Located in the north central portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the southeast before channelizing and eventually out falling into Channel B at **DP X5**.

Basin ES-6 (31.26 AC, Q_5 = 6.5 cfs, Q_{100} = 46.5 cfs): Located on the northern portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the southeast before channelizing and eventually out falling into Channel B **(DP X6)**.

Design Point X6 (Q_5 = 40.9 cfs, Q_{100} = 523.8 cfs): Located on the northeast portion of the site, this design point accounts for the total combined flows from **Design Point 1, 3 & Basin ES-6** and represents the total existing Channel B flows at that point. Flows from this design point are conveyed off-site to the southeast, via Channel B.

Design Point X7 (Q_5 = 56.5 cfs, Q_{100} = 635.2 cfs): Located on the southeast portion of the site, this design point accounts for the total combined flows from **Design Points X3, X4, X5 & X6** and represents the total existing flows from the site and upstream off-site flows contributing to Channel B. Flows from this design point are conveyed off-site to the south, via Channel B.

V. Four Step Process

The Four Step Process is used to minimize the adverse impacts of urbanization and is a vital component of developing a balanced, sustainable project. Below identifies the approach to the four-step process:

1. Employ Runoff Reduction Practices

This step uses low impact development (LID) practices to reduce runoff at the source. Generally, rather than creating point discharges that are directly connected to impervious areas runoff is routed through pervious areas to promote infiltration. The Impervious Reduction Factor (IRF) method was used and calculations can be found in **Appendix D.**

2. Stabilize Channels

This step implements stabilization to channels to accommodate developed flows while protecting infrastructure and controlling sediment loading from erosion in the drainageways. Erosion protection in the form of riprap pads at all outfall points to the channel to prevent scouring of the channel from point discharges. The existing channel analysis and design for the Gieck Ranch Tributary #2 (Channel B) were completed by HR Green. A copy of the CLOMR Report is included in **Appendix G** for reference – the CLOMR Report is currently still in review. Final design values will be revised as necessary in subsequent Final Drainage Report submittals.

3. Provide Water Quality Capture Volume (WQCV)

This step utilizes formalized water quality capture volume to slow the release of runoff from the site. The EURV volume will release in 72 hours, while the WQCV will release in no less than 40 hours. On-site water quality control volume detention ponds will provide water quality treatment for all of the developed areas, prior to the runoff being released into either of the major drainage ways. Refer to WQCV Plan in **Appendix E.**

4. Consider Need for Industrial and Commercial BMPs

As this project is all residential development and no commercial or industrial development is proposed, there will be no need for any specialized BMPs which would be associated with an industrial or commercial site.

VI. Interim Drainage Conditions

In the interim condition, overlot grading operations will be taking place within the Grandview Reserve Subdivision in preparation for the ultimate proposed condition. While this activity is taking place within the proposed subdivision, no activity is anticipated west of Eastonville Road, including the construction of Eastonville Road. Removal of existing drainage infrastructure will take place with the construction of Eastonville Road in the future. The proposed development lies completely within the Gieck Ranch Drainage Basin and consists of six (6) larger basins (EA, A, B, C, D, & E) which have been broken down into fourteen (14) smaller sub-basins for the Interim Condition. Site runoff will be collected via swales and diverted to one of the eleven proposed temporary sediment basins. All necessary calculations can be found within the appendices of this report.

OFF-SITE FLOWS

Existing upstream tributary analysis (the areas west of Eastonville Road) was performed as part of the **E-PDR** and was discussed earlier in the report under **Section IV – Off-Site Flows**. These design basins remain the same as the existing condition during the interim phase and discussion of them are not included in this section.

ON-SITE FLOWS

Basin A-1 (2.29 AC, Q_5 = 0.7 cfs, Q_{100} = 5.0 cfs): Located on the northwest corner of the site, East of Eastonville Rd. In the interim condition, Sub-basin A-1 will remain un-developed. Runoff from this basin will sheet flow from the northwest to the southeast. Sheet flows will then be captured by a proposed 4’ bottom x 2’ deep trapezoidal swale (Swale A-1) and conveyed east directly into Channel B at **DP 8** as to not interfere with the early grading efforts to the south and mitigate any potential erosion that runoff from this basin would cause.

Basin A-2 (3.96 AC, Q_5 = 1.2 cfs, Q_{100} = 8.8 cfs): Located along the northwest property line, East of Eastonville Rd. In the interim condition, Sub-basin A-1 will remain un-developed along Eastonville Rd & a temporary diversion swale will be put in place to convey existing off-site flows from **Design Point 3** through the site to Channel B, as they had in the existing condition. Runoff from this will be captured in an existing roadside ditch on the east side of Eastonville Rd. Flows are then conveyed to an opening in the existing earthen berm adjacent to the east side of the roadside ditch where flows will then be captured by a proposed 10’ bottom x 3’ deep trapezoidal swale (Swale A-2) and conveyed east directly into Channel B at **DP 10**.

Basin TSB-A1 (10.67 AC, Q_5 = 3.3 cfs, Q_{100} = 23.3 cfs): Located at the northern portion of the site, Basin TSB-A1 consists entirely of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the southeast where it is intercepted by proposed TSB-A1. From there, treated runoff is discharged to the proposed Swale A-2 in **Basin A-2**.

Design Point 10 (Q_5 = 10.6 cfs, Q_{100} = 144.2 cfs): Located at the northern portion of the site, this design point accounts for the total combined flows from **Design Point 3** from the **E-PDR** and **Basins A-2** & **TSB-A1**. Flows from this design point are discharged directly into the existing Channel B.

Basin TSB-A2 (4.56 AC, Q_5 = 1.4 cfs, Q_{100} = 10.1 cfs): Located at the northern portion of the site, Basin TSB-A2 consists of future residential lots, future roadways, and future amenity facilities. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the southeast where it is intercepted by proposed TSB-A2 at **DP 11**. From there, treated runoff from TSB-A2 will be discharged downstream directly to **Basin TSB-A3**.

Basin TSB-A3 (13.72 AC, Q_5 = 3.9 cfs, Q_{100} = 28.2 cfs): Located at the north-central portion of the site, Basin TSB-A3 consists of future residential lots, future roadways, and future amenity facilities. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the southeast where it is intercepted by proposed TSB-A3 at **DP 12**. From there, treated runoff from TSB-A3 will be discharged downstream directly to existing Channel B.

Design Point 12 (Q_5 = 5.4 cfs, Q_{100} = 38.3 cfs): Located at the east-central portion of the site and to the south of Design Point 7, this design point accounts for the total combined flows from **Basin TSB-A2** & **TSB-A3**. Flows from this design point are discharged directly into the existing Channel B.

Basin TSB-B1 (14.03 AC, Q_5 = 4.1 cfs, Q_{100} = 29.4 cfs): Located at the northwestern portion of the site, Basin TSB-B1 consists of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the south where it is intercepted by proposed TSB-B1 at **DP 13**. From there, treated runoff from TSB-B1 will be discharged downstream directly to **Basin TSB-B2**.

Basin TSB-B2 (14.48 AC, Q_5 = 4.2 cfs, Q_{100} = 30.1 cfs): Located at the central portion of the site, Basin TSB-B2 consists of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the southeast where it is intercepted by proposed TSB-B2 at **DP 14**. From there, treated runoff from TSB-B2 will be discharged downstream directly to existing Channel A.

Design Point 14 (Q_5 = 8.3 cfs, Q_{100} = 59.5 cfs): Located at the south-central portion of the site, this design point accounts for the total combined flows from **Basin TSB-B1** & **TSB-B2**. Flows from this design point are discharged directly into the existing Channel A.

Basin TSB-C1 (11.26 AC, Q_5 = 3.2 cfs, Q_{100} = 23.0 cfs): Located at the eastern portion of the site, Basin TSB-C1 consists of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff

from this basin will sheet flow to the south where it is intercepted by proposed TSB-C1 at **DP 15**. From there, treated runoff from TSB-C1 will be discharged downstream directly to **Basin TSB-C3**.

Basin TSB-C2 (11.92 AC, Q_5 = 3.5 cfs, Q_{100} = 25.2 cfs): Located at the eastern portion of the site, Basin TSB-C2 consists of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the south where it is intercepted by proposed TSB-C2 at **DP 16**. From there, treated runoff from TSB-C2 will be discharged downstream directly to existing Channel A.

Basin TSB-C3 (15.29 AC, Q_5 = 4.1 cfs, Q_{100} = 29.0 cfs): Located at the southeastern portion of the site, Basin TSB-C3 consists of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the southeast where it is intercepted by proposed TSB-C3 at **DP 17**. From there, treated runoff from TSB-C3 will be discharged downstream directly to existing Channel B.

Design Point 17 (Q_5 = 7.3 cfs, Q_{100} = 52.0 cfs): Located at the southeast portion of the site, this design point accounts for the total combined flows from **Basin TSB-C1** & **TSB-C3**. Flows from this design point are discharged directly into the existing Channel B.

Basin TSB-D1 (10.09 AC, Q_5 = 2.8 cfs, Q_{100} = 20.0 cfs): Located at the southwestern portion of the site, Basin TSB-D1 consists of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the east where it is intercepted by proposed TSB-D1 at **DP 18**. From there, treated runoff from TSB-D1 will be discharged downstream directly to existing Channel A.

Basin TSB-E1 (8.21 AC, Q_5 = 2.5 cfs, Q_{100} = 18.0 cfs): Located at the southern portion of the site, Basin TSB-E1 consists of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the east where it is intercepted by proposed TSB-E1 at **DP 19**. From there, treated runoff from TSB-E1 will be discharged downstream directly to **Basin TSB-E2**.

Basin TSB-E2 (13.57 AC, Q_5 = 4.0 cfs, Q_{100} = 28.3 cfs): Located at the southeastern portion of the site, Basin TSB-E2 consists of future residential lots and future roadways. In the interim overland graded phase of development, imperviousness for this sub-basin can be described as nearly bare ground (2%). Runoff from this basin will sheet flow to the east where it is intercepted by proposed TSB-E2 at **DP 20**. From there, treated runoff from TSB-E2 will be discharged downstream directly to existing Channel A.

Design Point 20 (Q_5 = 6.5 cfs, Q_{100} = 46.3 cfs): Located at the south portion of the site, this design point accounts for the total combined flows from **Basin TSB-E1** & **TSB-E2**. Flows from this design point are discharged directly into the existing Channel A.

Basin EA-1 (2.50 AC, Q_5 = 0.7 cfs, Q_{100} = 5.1 cfs): Located along the southeastern property line, Basin EA-1 consists primarily of un-developed disturbed area with a temporary diversion swale put in place to convey existing off-site flows from **DP 5 & 6** through the site to Channel A, as they had in the existing condition. Runoff from this basin will sheet flow into a temporary trapezoidal diversion swale (Swale OS-1) with a 4’ bottom width and 3’ deep. Flows will then be conveyed north and discharge directly into Channel A at **DP 21**.

Design Point 21 (Q_5 = 8.9 cfs, Q_{100} = 55.3 cfs): Located at the southwest portion of the site, this design point accounts for the total combined flows from **DP 5 & 6** from the **E-PDR** and **Basin EA-1**. Flows from this design point are discharged directly into the existing Channel A.

Each of the temporary sediment basins (TSBs) has been sized according to the detail from City of Colorado Springs Stormwater Quality Manual, Figure SB-1 and the pond calculations in the Mile High Flood District (MHFD) spreadsheet. Riser pipes within each TSB will discharge flows downstream, following the interim grading patterns, which will adhere to historic drainage patterns and eventually enter respective drainageways (Channels A & B). Similarly, each TSB will have an overflow spillway which will discharge excess flows downstream in the same drainage pattern as the discharge from the riser pipes within the corresponding TSB. See **Appendix D** for calculation spreadsheets.

VII. Proposed Drainage Conditions

The proposed development lies completely within the Gieck Ranch Drainage Basin and consists of six (6) larger basins (A, B, C, D, &E) which have been broken down into smaller sub-basins. Offsite tributary areas area denoted as EA & OS and are analyzed in the **E-PDR**. Site runoff will be collected via inlets & pipes and diverted to one of the six proposed full spectrum detention ponds or a temporary sediment basin. All necessary calculations can be found within the appendices of this report.

OFF-SITE FLOWS

Analysis was conducted for all of the proposed Eastonville Road in conjunction with the offsite upstream tributary areas to the west of Eastonville Road. This analysis consisted of basins OS1, OS2, OS3, OS4, OS5, OS6, OS7, EA1, EA2, EA3, EA4, EA5. EA6, EA7, EA8, EA9, EA10, EA11, and EA12. See the **E-PDR** in **Appendix F** for reference.

Preliminary sizing calculations for the FSD facilities treating Eastonville Road flows have been completed with the **E**. Sizing for Eastonville Road crossing and Channel B has been included within **Appendix G**, by HR Green. This crossing will require dual 10’ W x 3.5’ H reinforced concrete box culvert (RCBC) with type M riprap for 50’ L x 30’ W at the downstream end.

ON-SITE FLOWS

There are no proposed major channel improvements for Channel A associated with this development - however, Channel B is proposed to be re-routed. The analysis for both channels and design of Channel B were completed by HR Green. A copy of the CLOMR Report is included in **Appendix G** for reference – the CLOMR Report is currently still in review. Final design values will be revised as necessary in subsequent Final Drainage Report submittals.

The site will provide six (6) Full Spectrum Extended Detention Basins (EDBs). Ponds A, B, C, D, E, & Eastonville Pond will discharge treated runoff at historic rates directly into either Channel A Channel B. The project site will also provide one (1) Sediment Basin (SB). SB-2 at the southern corner of the church property (Basin A-1). The SB have been sized to function as PBMPs (and will remain in place until such time development east of the proposed site takes place) and will discharge treated runoff at historic rates directly into Channel B at the northern portion of the project site.

As has been mentioned previously, the site is proposed to have a land use of single family residential. The site will consist primarily of 1/8 Acre lots, with some 1/4 Acre and 1/3 Acre lots, public roadways, along with dedicated Tracts for amenity and/or institutional uses.

The proposed institutional use (**Basin A-1**) area flows have been included in this analysis at a preliminary level only. The Sub-basin is located on the northwest corner of the site, East of Eastonville Rd. & south of the proposed extension of Rex Rd. It is assumed that the area will have a conservative ultimate imperviousness value of 90%. Sub-basin A-1 encompasses an area of 11.67 acres and proposed developed runoff for the site has been calculated to be Q_5 = 46.4 cfs, Q_{100} = 90.7 cfs. However, in the interim conditions (imperviousness of 2.0%), runoff from this basin (Q_5 = 4.4 cfs, Q_{100} = 31.1 cfs) will sheet flow from the northwest to the southeast, to a separate, onsite detention and water quality facility (SB-2) positioned at the southeastern corner of the property, where treated flows will be released to a proposed modified CDOT Type 'C' inlet on the west side of Ivybridge Boulevard **(DP 1)**. Runoff that originates from the east side of Eastonville Road, outside of the dedicated ROW, will be conveyed to SB-2 via a proposed 4' bottom x 2' deep trapezoidal swale (Swale A-1). Flows will then be routed under Ivybridge Boulevard, via 24" RCP, to the re-routed Channel B. It is anticipated that the property will be developed at a later date as a fill in subsequent to the proposed development of the majority of this project site. This property will need to submit a separate drainage report, complete with an updated water quality and detention design, as part of its development. Installation of an internal storm sewer system separate from the outfall for the property will be required. The development is responsible for ensuring the site drainage, once constructed, will not adversely impact any adjacent properties and downstream facilities. Preliminary pond sizing calculations have been provided in **Appendix D** for reference. As stated above, water quality and detention will be addressed with the future development of the institutional site.

Basin A-2a (4.42 AC, Q_5 = 8.5 cfs, Q_{100} = 19.9 cfs): Located on the north portion of the site, this basin consists of residential lots, Tintagel Trail, and a portion of the north half of Dawlish Drive. Runoff from this basin will sheet flow from the lots to the adjacent road. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the northeast side of the intersection of Tintagel Trail and Dawlish Drive **(DP 2a)**.

Basin A-2b (2.75 AC, Q_5 = 8.4 cfs, Q_{100} = 16.7 cfs): Located on the north portion of the site, this basin consists of residential lots, Ivybridge Boulevard, and a portion of the north half of Dawlish Drive. Runoff from this basin will sheet flow from the residential lots to the adjacent Dawlish Drive and directly from within the ROW of Ivybridge Boulevard. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' inlet in sump conditions, located on the northeast side of the intersection of Ivybridge Boulevard and Dawlish Drive **(DP 2b)**.

Basin A-3 (0.36 AC, Q_5 = 1.6 cfs, Q_{100} = 3.2 cfs): Located on the north portion of the site, this basin consists of a portion of the south half of Dawlish Drive. Flows will be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' inlet in sump conditions, located on the southeast side of the intersection of Ivybridge Boulevard and Dawlish Drive **(DP 3)**.

Basin A-4a (6.31 AC, Q_5 = 9.8 cfs, Q_{100} = 22.8 cfs): Located on the northwestern portion of the site, this basin consists of residential lots, Primley Woods Path, and a portion of the west half of Dawlish Drive. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the west side of Dawlish Drive **(DP 4a),** between Primley Woods Path and St Ives Way. Bypass flows will then be routed downstream to a proposed (public) 15' CDOT Type 'R' sump inlet, located on the west side of Dawlish Drive directly across from Sparkwell Street **(DP4)**. Emergency overflows will be routed downstream via proposed curb and gutter to Design Point 7 within Sparkwell Street.

Basin A-4b (3.99 AC, Q_5 = 6.5 cfs, Q_{100} = 15.2 cfs): Located on the northwestern portion of the site, this basin consists of residential lots, St Ives Way, and a portion of the west half of Dawlish Drive. Runoff from

this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the west side of Dawlish Drive **(DP 4b),** between Primley Woods Path and St Ives Way. Bypass flows will then be routed downstream to a proposed (public) 15' CDOT Type 'R' sump inlet, located on the west side of Dawlish Drive directly across from Sparkwell Street **(DP4)**. Emergency overflows will be routed downstream via proposed curb and gutter to Design Point 7 within Sparkwell Street.

Basin A-5 (0.35 AC, Q_5 = 1.6 cfs, Q_{100} = 3.1 cfs): Located on the north portion of the site, this basin consists of a portion of the east half of Dawlish Drive. Flows will be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' inlet in sump conditions, located on the east side of Dawlish Drive **(DP 5),** Just north of the intersection of Sparkwell Street and Dawlish Drive. Emergency overflows will be routed downstream via proposed curb and gutter to Design Point 7 within Sparkwell Street.

Basin A-6 (2.76 AC, Q_5 = 4.6 cfs, Q_{100} = 10.7 cfs): Located centrally on the site, this basin consists of residential lots, Penryn Circle, and a portion of the south half of Sparkwell Street. Runoff from this basin will sheet flow from the lots to the adjacent road. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' inlet in sump conditions, located on the south side of Sparkwell Street **(DP 6),** Just southeast of the intersection of Penryn Circle & Sparkwell Street. Emergency overflows will overtop Sparkwell Street crown to Design Point 7 **(DP 7)**, then overtop curb and gutter and be routed downstream via an overflow swale to proposed Pond A.

Basin A-7 (0.23 AC, Q_5 = 1.1 cfs, Q_{100} = 2.0 cfs): Located centrally on the site, this basin consists of a portion of the north half of Sparkwell Street. Runoff from this basin will sheet flow from edge of ROW to the adjacent road. Flows will then be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' inlet in sump conditions, located on the north side of Sparkwell Street **(DP 7),** Just east of the intersection of Penryn Circle & Sparkwell Street. Emergency overflows will overtop curb and gutter and be routed downstream via an overflow swale to proposed Pond A.

Basin A-8 (5.44 AC, Q_5 = 14.7 cfs, Q_{100} = 30.8 cfs): Located centrally on the site, this basin consists entirely of proposed amenity / park facilities. Runoff from this basin will sheet flow to paved parking lot and drive aisle with curb and gutter. Flows will then be routed, via curb & gutter, to a series of proposed (public) CDOT Type 'R' inlets and area inlets with storm sewer piping conveying generated runoff downstream to Design Point 8 **(DP 8),** located at the southeast corner of the park site. Emergency overflows will overtop curb and gutter and will sheet flow, across green space, to proposed Pond A.

Basin A-9 (4.91 AC, Q_5 = 7.4 cfs, Q_{100} = 17.3 cfs): Located in the central portion of the site, directly west from Pond A. This basin consists of residential lots, one-half of Pixie Place, a section of Salcombe Trail, and a section of the west half of Sparkwell Street. Runoff from this basin will sheet flow to the proposed roadways, where runoff will be directed downstream, via curb & gutter, a proposed (public) 20' CDOT Type 'R' sump inlet **(DP 7a)**. Runoff is then conveyed downstream to **DP 7b** where additional runoff is added from Sub-basin A-10.

Basin A-10 (1.02 AC, Q_5 = 2.1 cfs, Q_{100} = 4.9 cfs): Located in the central portion of the site, directly west from Pond A. This basin consists of residential lots and the easter half of a section of Sparkwell Street. Runoff from this basin will sheet flow to the proposed roadway, where runoff will be directed downstream, via curb & gutter, a proposed (public) 5' CDOT Type 'R' sump inlet **(DP 7b)**. Runoff is then directed downstream to the northwest corner of Pond A. Flows will then be routed to the outlet structure **(DP 8)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into Channel B.

Emergency overflows will overtop via an emergency spillway and be routed downstream directly to Channel B.

Basin A-11 (3.56 AC, Q_5 = 2.0 cfs, Q_{100} = 8.6 cfs): Located on the eastern limits of the site, adjacent to the proposed Main Stem Tributary #2 drainageway. This basin consists of the rear portion of lots along Sparkwell Street and the proposed (private) Full Spectrum Detention Pond A. Runoff from this basin will sheet flow directly to Pond A. Flows will then be routed to the outlet structure **(DP 8)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Channel B. Emergency overflows will overtop via an emergency spillway and be routed downstream directly to Channel B.

Basin B-1 (3.81 AC, Q_5 = 5.3 cfs, Q_{100} = 12.5 cfs): Located on the western limits of the site, adjacent to Eastonville Road. This basin consists of residential lots and the southwest portion of Pixie Place. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' inlet in sump conditions, located at the end of the Cul-De-Sac of Pixie Place **(DP 9)**. Emergency overflows will overtop curb and gutter and be routed downstream via an overflow swale to Dawlish Drive and then downstream via curb & gutter to Design Point **DP 10b**.

Basin B-2 (4.62 AC, Q_5 = 7.1 cfs, Q_{100} = 16.7 cfs): Located on the western limits of the site, partially adjacent to Eastonville Road. This basin consists of residential lots, the northwest portion of Pixie Place and the northwestern portion of Dawlish Drive. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet **(DP 10a)**, located on the northwest side of Dawlish Drive, northeast of Marazion Way. Bypass flows are conveyed downstream via curb & gutter to **DP 10b** where a proposed (public) 15' CDOT Type 'R' sump inlet captures flows.

Basin B-3 (4.15 AC, Q_5 = 8.0 cfs, Q_{100} = 18.6 cfs): Located on the western portion of the site, this basin consists of residential lots, the northwest portion of Dawlish Drive, and Marazion Way. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet **(DP 10b)**, located northeast from the intersection of Dawlish Drive and Zelda Street. on the northwest side of Dawlish Drive, northeast of Marazion Way. Emergency overflows will overtop the crown of the roadway and be conveyed downstream via curb and gutter to Design Point **DP 11, DP12b, and DP13**.

Basin B-4 (1.37 AC, Q_5 = 4.6 cfs, Q_{100} = 9.4 cfs): Located in the west-central portion of the site. This basin consists of the southeast portion of Dawlish Drive. Runoff from this basin will sheet flow directly to the curb & gutter and be directed downstream to a proposed (public) 15' CDOT Type 'R' inlet in sump conditions, located east of the intersection of Dawlish Drive & Zelda Street **(DP 11)**. Emergency overflows will overtop the curb return flowline and be conveyed downstream via curb and gutter to Design Point **DP 12b**.

Basin B-5 (5.12 AC, Q_5 = 7.9 cfs, Q_{100} = 18.5 cfs): Located centrally on the site, this basin consists of residential lots, Marazion Way, the northwest portion of Salcombe Trail, and the southwest portion of Pixie Place. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet **(DP 12a)**, located on the northwest side of Salcombe Trail, northeast of the intersection between Zelda Street and Salcombe Trail. Bypass flows are conveyed downstream via curb & gutter to **DP 12b**.

Basin B-6 (2.28 AC, Q_5 = 3.7 cfs, Q_{100} = 8.7 cfs): Located centrally on the site. This basin consists of residential lots and the northwest portion of Plinky Plonk Path. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet, located on the northwest side of Plinky Plonk Path **(DP 14)**. Bypass flows are conveyed downstream via curb & gutter to **DP 12b**.

Basin B-7 (0.89 AC, Q_5 = 1.6 cfs, Q_{100} = 3.8 cfs): Located centrally on the site. This basin consists of residential lots and the southeast portion of Plinky Plonk Path. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet, located on the southeast side of Plinky Plonk Path **(DP 15)**. Bypass flows are conveyed downstream via curb & gutter to **DP 12b**.

Basin B-8 (3.23 AC, Q_5 = 5.3 cfs, Q_{100} = 12.4 cfs): Located centrally on the site. This basin consists of residential lots, the southeast portion of Plinky Plonk Path, and the northeast portion of Zelda Street. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet, located on the southeast side of the intersection between Plinky Plonk Path and Zelda Street **(DP 12b)**. Emergency overflows will overtop the crown of the roadway and be conveyed downstream via curb and gutter to Design Point **DP 13**.

Basin B-9 (2.42 AC, Q_5 = 3.8 cfs, Q_{100} = 9.0 cfs): Located centrally on the site, adjacent to the Main Stem channel. This basin consists residential lots and the southwest portion of Zelda Street. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' sump inlet, located on the southwest side of the intersection between Plinky Plonk Path and Zelda Street **(DP 13)**. Emergency overflows will overtop the curb & gutter of the roadway and be conveyed downstream via a graded swale into Pond B **(DP 16)**.

Basin B-10 (1.10 AC, Q_5 = 0.5 cfs, Q_{100} = 3.3 cfs): Located centrally on the site, adjacent to the Main Stem channel. This basin consists of the proposed (private) Full Spectrum Detention Pond B. Runoff from this basin will sheet flow directly to Pond B. Flows will then be routed to the outlet structure **(DP 16)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into Channel A.

Basin C-1 (4.12 AC, Q_5 = 6.8 cfs, Q_{100} = 16.0 cfs): Located on the east portion of the site, this basin consists of residential lots and the eastern half of a portion of Salcombe Trail. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the southeast side of the intersection of Stoke Gabriel Way and Totness Terrace **(DP 17b)**. Bypass flows are conveyed downstream via curb & gutter to **DP 17e**.

Basin C-2 (2.71 AC, Q_5 = 4.9 cfs, Q_{100} = 11.4 cfs): Located on the eastern portion of the site, this basin consists of residential lots and the southern portion of Roads Stoke Gabriel Way and Glampton Drive, and the full section of Totness Terrace. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17a)**, located on the southwest side of the intersection of Stoke Gabriel Way and Totness Terrace. Bypass flows are conveyed downstream via curb & gutter to **DP 17c**.

Basin C-3 (1.56 AC, Q_5 = 0.8 cfs, Q_{100} = 4.5 cfs): Located on the southeast portion of the site, this basin consists of the rear portion of residential lots along Stoke Gabriel Way. Runoff from this basin will sheet flow in an eastward direction towards the proposed channel B. All roof drains (for lots 409-426 & 443)

within this sub-basin will be directed toward Stoke Gabriel Way, no impervious surfaces will be allowed within the rear lot setbacks and runoff reduction will be implemented within this sub-basin.

Basin C-4 (2.47 AC, Q_5 = 4.1 cfs, Q_{100} = 9.6 cfs): Located on the southeast portion of the site, this basin consists of residential lots and the eastern half of Frogmore Lane. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17c)**, located on the southwest side of the intersection of Stoke Gabriel Way and Frogmore Lane. Bypass flows are conveyed downstream via curb & gutter to **DP 17d**.

Basin C-5 (3.09 AC, Q_5 = 5.5 cfs, Q_{100} = 12.8 cfs): Located on the southeast portion of the site, this basin consists of residential lots and the western half of Stoke Gabriel Way. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17d)**, located on the northwest side of the intersection of Stoke Gabriel Way and Glampton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 17h**.

Basin C-6 (2.10 AC, Q_5 = 3.2 cfs, Q_{100} = 7.4 cfs): Located on the southeast portion of the site, this basin consists of residential lots and the eastern half of Stoke Gabriel Way. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17e)**, located on the northeast side of the intersection of Stoke Gabriel Way and Glampton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 17h**.

Basin C-7a (0.81 AC, Q_5 = 1.1 cfs, Q_{100} = 3.2 cfs): Located in the central portion of the site, this basin consists of the rear portion of residential lots, existing gas main, and proposed drainage swale (Swale C-7). Runoff from this basin will sheet flow to the proposed swale which will direct runoff to the adjacent roadway **(DP 18a)**.

Basin C-7b (5.91 AC, Q_5 = 9.9 cfs, Q_{100} = 23.2 cfs): Located in the central portion of the site, this basin consists of residential lots, the western half of Glampton Drive, and a portion of Zelda Drive & Sparkwell Street. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 18b)**, located on the southwest side of the intersection of Totness Terrace and Glampton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 18c**.

Basin C-8 (5.11 AC, Q_5 = 8.6 cfs, Q_{100} = 20.0 cfs): Located in the central portion of the site, this basin consists of residential lots, a portion of Totness Terrace, and a portion of Glampton Drive to the west and south of the sub-basin. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17f)**, located on the southeast side of the intersection of Totness Terrace and Glampton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 17g** and **DP 17h**.

Basin C-9a (3.5 AC, Q_5 = 5.6 cfs, Q_{100} = 13.1 cfs): Located on the southeast corner of the site, this basin consists of residential lots, a portion of Frogmore Lane, and the northern half of Glampton Drive. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' sump inlet **(DP 17g)**, located on the northeast corner of Glampton Drive and Frogmore Lane. Bypass flows are conveyed downstream via curb & gutter to **DP 17h.** Emergency overflows will overtop the crown of Glampton Drive and be routed downstream via proposed curb and gutter to Design Point **18b** within Glampton Drive.

Basin C-9b (3.69 AC, Q_5 = 5.9 cfs, Q_{100} = 13.7 cfs): Located on the southeast corner of the site, this basin consists of residential lots and the northern half of Glampton Drive. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet **(DP 17h)**, located on the north side of Glampton Drive just north of Hope Cove Loop. Emergency overflows will overtop the crown of Glampton Drive and be routed downstream via proposed curb and gutter to Design Point **18b** within Glampton Drive.

Basin C-10 (3.47 AC, Q_5 = 5.2 cfs, Q_{100} = 12.1 cfs): Located on the southeast corner of the site, this basin consists of residential lots and the southern half of Glampton Drive. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' sump inlet **(DP 18c)**, located on the south side of Glampton Drive just north of Hope Cove Loop. Emergency overflows will overtop the curb & gutter of Glampton Drive and be routed downstream via a graded grassed swale and curb & gutter within Hope Cove Loop to Design Point **19** within Hope Cove Loop.

Basin C-11 (0.46 AC, Q_5 = 1.0 cfs, Q_{100} = 2.3 cfs): Located on the southeast corner of the site, this basin consists of a grassed amenity area and the north half of Hope Cove Loop. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' sump inlet **(DP 19)**, located on the north side of Hope Cove Loop. Emergency overflows will overtop the crown of Hope Cove Loop and be routed downstream via curb & gutter to Design Point **20** within Hope Cove Loop.

Basin C-12 (1.66 AC, Q_5 = 2.9 cfs, Q_{100} = 6.7 cfs): Located on the southeast corner of the site, this basin consists of residential lots and the south portion of Hope Cove Loop. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' sump inlet **(DP 20a)**, located on the south side of Hope Cove Loop. Emergency overflows will overtop the curb & gutter of Hope Cove Loop and be routed downstream via a graded swale to Design Point **21** within Pond C.

Basin C-13 (2.37 AC, Q_5 = 0.8 cfs, Q_{100} = 5.5 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the proposed (private) Full Spectrum Detention Pond C. Runoff from this basin will sheet flow directly to Pond C. Flows will then be routed to the outlet structure **(DP 20b)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Channel B.

Basin C-14 (1.53 AC, Q_5 = 0.5 cfs, Q_{100} = 3.8 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the undeveloped area outside and downstream of the proposed (private) Full Spectrum Detention Pond C. Runoff from this basin will sheet flow directly to the Channel B.

Basin C-15 (0.16 AC, Q_5 = 0.1 cfs, Q_{100} = 0.5 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the rear portion of Lot 444. Runoff from this basin will sheet flow directly to Channel B. Runoff from this basin will sheet flow in an eastward direction towards the proposed channel B. All roof drains (for lot 444) within this sub-basin will be directed toward Glampton Drive, no impervious surfaces will be allowed within the rear lot setbacks and runoff reduction will be implemented within this sub-basin.

Basin D-1 (3.48 AC, Q_5 = 5.4 cfs, Q_{100} = 12.7 cfs): Located on the southwest portion of the site, adjacent to Eastonville Road. This basin consists of residential lots and the west half of Kate Meadow Lane. Runoff

from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet, located on the west side of Kate Meadow Lane **(DP 22)**, just south of the intersection of Kate Meadow Lane & Farm Close Court. Flows will continue downstream to Design Point **24** within Farm Close Court.

Basin D-2 (0.87 AC, Q_5 = 1.7 cfs, Q_{100} = 4.0 cfs): Located on the southwest portion of the site, this basin consists of residential lots and the eastern half of Kate Meadow Lane. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' flow by inlet, located on the east side of Kate Meadow Lane **(DP 23)**, just southeast of the intersection of Kate Meadow Lane & Farm Close Court. Emergency overflows will pool up and be routed around the curb return at the intersection of Kate Meadow Lane and Farm Close Court downstream via curb & gutter to Design Point **24** within Farm Close Court.

Basin D-3 (3.62 AC, Q_5 = 5.9 cfs, Q_{100} = 13.8 cfs): Located on the southwest portion of the site, this basin consists of residential lots and the western half of Farm Close Court. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' inlet in sump conditions, located on the west side of Farm Close Court **(DP 24)**, southeast of the intersection of Kate Meadow Lane & Farm Close Court. Emergency overflows will overtop the crown and be routed downstream via curb & gutter in Farm Close Court to Design Point **25**.

Basin D-4 (1.77 AC, Q_5 = 3.3 cfs, Q_{100} = 7.7 cfs): Located on the southwest portion of the site, this basin consists of residential lots and the eastern half of Farm Close Court. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' inlet in sump conditions, located on the east side of Farm Close Court **(DP 25)**, just southeast of the intersection of Kate Meadow Lane & Farm Close Court. Emergency overflows will overtop curb & gutter and be routed downstream via a graded swale within the maintenance access path to Pond D at Design Point **26**.

Basin D-5 (1.53 AC, Q_5 = 2.0 cfs, Q_{100} = 6.0 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists partially of residential lots and the proposed (private) Full Spectrum Detention Pond D. Runoff from this basin will sheet flow directly to Pond D. Flows will then be routed to the outlet structure **(DP 26)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into Channel A.

Basin D-6 (0.83 AC, Q_5 = 0.3 cfs, Q_{100} = 2.1 cfs): Located on the southwest corner of the site, adjacent to the Main Stem channel. This basin consists of the undeveloped area outside and downstream of the proposed (private) Full Spectrum Detention Pond D. Runoff from this basin will sheet flow directly to Channel A.

Basin D-7a (0.25 AC, Q_5 = 0.2 cfs, Q_{100} = 0.8 cfs): Located on the southwest corner of the site, adjacent to the Main Stem channel. This basin consists of the back portions of residential lots. Runoff from this basin will sheet flow directly to the Main Stem Channel. All roof drains (for lots 18-20) within this sub-basin will be directed toward Farm Close Court, no impervious surfaces will be allowed within the rear lot setbacks and runoff reduction will be implemented within this sub-basin.

Basin D-7b (0.88 AC, Q_5 = 1.7 cfs, Q_{100} = 4.0 cfs): Located on the southwest corner of the site, adjacent to the Main Stem channel. This basin consists of the back portions of residential lots and a drainage swale (Swale D-7). Runoff from this basin will sheet flow from the residential lots, into the adjacent swale and will be routed directly to Pond D.

Basin E-1 (5.33 AC, Q_5 = 9.8 cfs, Q_{100} = 22.9 cfs): Located on the southern portion of the site, this basin consists of residential lots, the southern half of Brixham Drive, Starcross Court, and the southern half of Kate Meadow Lane. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the southwest corner of the intersection between Kate Meadow Lane and Mill Yard Circle **(DP 27)**, just north of the cul-de-sac. Bypass flows are conveyed downstream via curb & gutter to **DP 29**.

Basin E-2 (5.42 AC, Q_5 = 10.1 cfs, Q_{100} = 23.6 cfs): Located on the southern portion of the site, this basin consists of residential lots, a small portion of Mill Yard Circle, and the north half of Kate Meadow Lane. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the northwest corner of the intersection between Kate Meadow Lane and Mill Yard Circle **(DP 28)**, just north of the cul-de-sac. Bypass flows are conveyed downstream via curb & gutter to **DP 29**.

Basin E-3 (3.20 AC, Q_5 = 6.0 cfs, Q_{100} = 14.0 cfs): Located on the southern portion of the site, this basin consists of residential lots and the western half of Mill Yard Circle. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet, located just northeast from the cul-de-sac of Mill Yard Circle **(DP 29)**. Emergency overflows will overtop the crown of Mill Yard Circle and be routed downstream via curb & gutter to Design Point **30**.

Basin E-4 (6.28 AC, Q_5 = 9.0 cfs, Q_{100} = 21.0 cfs): Located on the southern portion of the site, this basin consists of residential lots and the eastern half of Mill Yard Circle. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet, located just northeast from the cul-de-sac of Mill Yard Circle **(DP 30)**. Emergency overflows will overtop the curb & gutter and be routed downstream via a graded swale within the maintenance access to Pond E at Design Point **31**.

Basin E-5 (1.13 AC, Q_5 = 0.4 cfs, Q_{100} = 3.0 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the proposed (private) Full Spectrum Detention Pond E. Runoff from this basin will sheet flow directly to Pond E. Flows will then be routed to the outlet structure **(DP 31)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Channel A.

Basin E-6 (0.74 AC, Q_5 = 0.3 cfs, Q_{100} = 1.8 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the undeveloped area outside and downstream of the proposed (private) Full Spectrum Detention Pond E. Runoff from this basin will sheet flow directly to A and offsite to the south.

VIII. Storm Sewer System

All development is anticipated to be urban and will include storm sewer & street inlets. Storm sewers collect storm water runoff and convey the water to the water quality facilities prior to discharging. Storm sewer systems will be designed to the 100-year storm and checked with the 5-year storm. Inlets will be placed at sump areas and intersections where street flow is larger than street capacity. UDFCD Inlet spreadsheet has been used to determine the size of all sump inlets.

There will be a minimum of 5 proposed storm systems within the site. Each of the five storm sewer systems will discharge storm water into its correlated WQCV pond. Additionally, there will be two bypass storm sewer systems that collect off-site basin flows at **DP11, DP12 & DP 21.**

The bypass system at **DP 21** will cross through sub-basins **EA-10, EA-11, EA-12, D-1, & D-3,** and tie-into the outfall pipe from the Eastonville Road Pond, discharging directly into Channel A. This bypass system will only convey flows from **DP 21** and will not be connected to any storm systems within any of the on-site sub-basins it crosses.

The bypass system at **DP 11 & 12** will cross through sub-basins **EA-8, EA-9, A-2a, & A-2b** and discharge directly into Channel B. This bypass system will only convey flows from **DP 11 & 12** and will not be connected to any storm systems within any of the on-site sub-basins it crosses.

Each system will consist of reinforced concrete pipe (RCP), CDOT Type 'R' inlets, and storm sewer manholes.

Furthermore, there are three (3) proposed drainage swales that runs along the back of the residential lots in Basins A-1, C-7a, and D-7. The swales were analyzed using the Bentley software FlowMaster to properly size a trapezoidal channel (4' W x 2.0' D), (1' W x 1.50' D), & (1' W x 1.54' D), respectively, to convey the 100-year flows from the basin to corresponding outfall locations (SB-2, Glampton Drive, & Pond D), while providing 1.0-ft of freeboard. The sizing calculations can be found in **Appendix C.**

The Final drainage report will include details concerning at-grade inlet locations, street capacity, storm sewer sizing, outlet protection and location. Preliminary sump inlets have been sized and the calculations can be found in **Appendix C**. As mentioned, these sump inlets sizes are preliminary and are currently oversized. It is anticipated that the inlets will reduce in size with the addition of at-grade inlets at the time of the Final Drainage Report.

IX. Proposed Water Quality Detention Ponds

Seven (7) Water Quality Capture Volume Detention Ponds will be provided for the proposed site, six (6) of which are full spectrum ponds and one (1) of which is a sediment basins\. Of These, all six (6) of the ponds and the (1) Sediment Basin on-site are private and will be maintained by the DISTRICT, once established. These detention ponds are proposed to be full spectrum and will provide water quality and detention. The WQCV and EURV release will be controlled with an orifice plate. The release rates for the WQCV and EURV will be 40-hours and 72-hours, respectively. The 100-year volume will be controlled by orifice and/or restrictor plate and will be designed to release at or below the pre-development flow rate. Outlet structures, forebays, trickle channels, etc. will be designed with the final drainage report during final plat. The required FSD pond volumes are as described below:

Pond A: Located to the north of the site, just west of the newly routed Channel B. This pond will discharge into Channel B, ultimately merging with Main Stem to the south, off-site. The required volume WQCV and EURV are 0.756 Ac-Ft & 2.115 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.761 Ac-Ft & 2.882 Ac-Ft, respectively. The total required detention basin volume is 4.290 Ac-Ft. The total provided detention basin storage is 4.626 Ac-Ft.

Pond B: Located centrally on the site, just east of the Channel A drainage way. This pond will discharge into Channel A. The required volume WQCV and EURV are 0.586 Ac-Ft & 1.610 Ac-Ft, respectively. The

provided storage for the WQCV and EURV are 0.587 Ac-Ft & 2.197 Ac-Ft, respectively. The total required detention basin volume is 3.310 Ac-Ft. The total provided detention basin storage is 3.449 Ac-Ft.

Pond C: Located on the southeast portion of the site, between Channels A & B. This pond will discharge into Channel B. The required volume WQCV and EURV are 0.828 Ac-Ft & 2.256 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.831 Ac-Ft & 3.088 Ac-Ft, respectively. The total required detention basin volume is 4.633 Ac-Ft. The total provided detention basin storage is 5.040 Ac-Ft.

Pond D: Located centrally on the site, just west of the Main Stem channel. This pond will discharge into Channel A. The required volume WQCV and EURV are 0.244 Ac-Ft & 0.666 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.246 Ac-Ft & 0.913 Ac-Ft, respectively. The total required detention basin volume is 1.373 Ac-Ft. The total provided detention basin storage is 1.373 Ac-Ft.

Pond E: Located on the south side of the site, just west of the Main Stem channel. This pond will discharge into Channel A. The required volume WQCV and EURV are 0.431 Ac-Ft & 1.163 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.437 Ac-Ft & 1.601 Ac-Ft, respectively. The total required detention basin volume is 2.421 Ac-Ft. The total provided detention basin storage is 2.583 Ac-Ft.

SB-2: Located on the north side of the site, at the southeast corner of the church property. This TSB will discharge into Channel B. This TSB captures an upstream tributary area of approximately 11.23 acres and per the MHFD standard, this TSB has been upsized to 12-acre tributary area.

X. Proposed Channel Improvements

According to the **MDDP**, there are two major drainage ways that run through the site. As was discussed within the Existing Conditions portion of the report, both the Gieck Ranch Tributary #1 (Channel A) and Gieck Ranch Tributary #2 (Channel B) run through the site. There are no proposed major channel improvements for Channel A as part of this project (to be determined with CDR-22-008). An analysis has been done for Channel A with both existing and future condition flows as described within the *Grandview Reserve CLOMR Report*, HR Green; March 22, 2023 (**CLOMR**). All HEC-RAS modelling, velocities, shear, depths, etc. are included within the CLOMR, which can be found in **Appendix E**. Both scenarios, throughout the channel fall within the channel stability criteria.

Channel B is proposed to be rerouted. As part of this rerouting of Channel B, offsite upstream tributary flows will be captured upstream from the proposed Rex Road extension and be conveyed via culvert to the rerouted Channel B. An analysis has been done for Channel B with both existing and future condition flows as described within the *Grandview Reserve CLOMR Report*, HR Green; March 22, 2023 (**CLOMR**). Both scenarios, throughout the channel fall within the channel stability criteria.

A majority of the developed runoff will be captured and conveyed to one of the corresponding water quality and detention facilities and release at or below historic levels. Some basins will release directly into the respective adjacent channels. These basins are contained within the backs of lots and will provide water quality through runoff reduction; impervious areas will not be permitted in the back of these lots and roof drains are to drain to the front. Therefore, there will be no adverse impact to downstream facilities. The analysis for both drainage ways (Channel A & B), offsite upstream tributary capture, and design of Channel B were done by HR Green within the *Grandview Reserve CLOMR Report*, HR Green; March 22, 2023 (**CLOMR**) which will be submitted separately for review. A copy of this report is included in **Appendix E**.

Additional channel stabilization may be required for erosion control prevention measures, pending the channel design review with the County.

XI. Maintenance

After completion of construction and upon the Board of County Commissioners acceptance, it is anticipated all drainage facilities within the public Right-of-Way are to be owned and maintained by El Paso County.

All private detention ponds are to be owned and maintained by the Grandview Reserve Metropolitan District No. 2 (DISTRICT), once established, unless an agreement is reached stating otherwise. The existing Channel A and rerouted Channel B will be maintained by the DISTRICT. Maintenance access for all full spectrum detention facilities will be provided from public Right-of-Way. Maintenance access for Channel A and Channel B will be provided along the respective eastern top of channel bank within the proposed tracts.

XII. Wetlands Mitigation

There are two existing wetlands on site associated with the two major channels, Channel A and Channel B. The wetlands are both contained within the existing channels with the wetland in Channel A being classified as jurisdictional and the wetland in Channel B classified as non-jurisdictional. The wetlands USACE determination will be provided with the *Grandview Reserve CLOMR Report*, HR Green; March 22, 2023, which can be found in **Appendix E**. Wetlands maintenance will be the responsibility of the Grandview Reserve Metropolitan District No. 2 (DISTRICT).

XIII. Floodplain Statement

A portion of the project sit lies with Zone A Special Flood Hazard Area as defined by the FIRM Map number 08041C0552G and 08041C0556G effective December 7, 2018. A copy of the FIRM Panel is included in **Appendix A.** FEMA-approved floodplain elevations are required to be shown on final plats.

XIV. Drainage Fees & Maintenance

Gieck Ranch Basin is not listed as part of the El Paso County drainage basin fee program. Unless otherwise instructed, no drainage fees will be assessed. If it is found drainage basin fees are required, these will be included in the Final Drainage Report.

XV. Conclusion

The Grandview Reserve residential subdivision lies within the Gieck Ranch Drainage Basin. Water quality for the site is provided in six on-site Full Spectrum Detention Ponds; Ponds A, B, C, D, E, & Eastonville Pond as well as two Sediment Basins; SB-1 and SB-2. Both of these SBs have been sized to function as PBMPs (and will remain in place until such time development east of the proposed site takes place) and will discharge treated runoff at historic rates directly into Channel B at the northern portion of the project site. All drainage facilities within this report were sized according to the El Paso County Drainage Criteria Manuals. The proposed facilities are adequate to protect the site from generated runoff. The site runoff will not adversely affect the downstream facilities and surrounding developments. There are two major channels passing through the site, Channel A & B, which will be addressed by HR Green within the *Grandview Reserve CLOMR Report*, HR Green; March 22, 2023. The six (6) WQCV ponds will

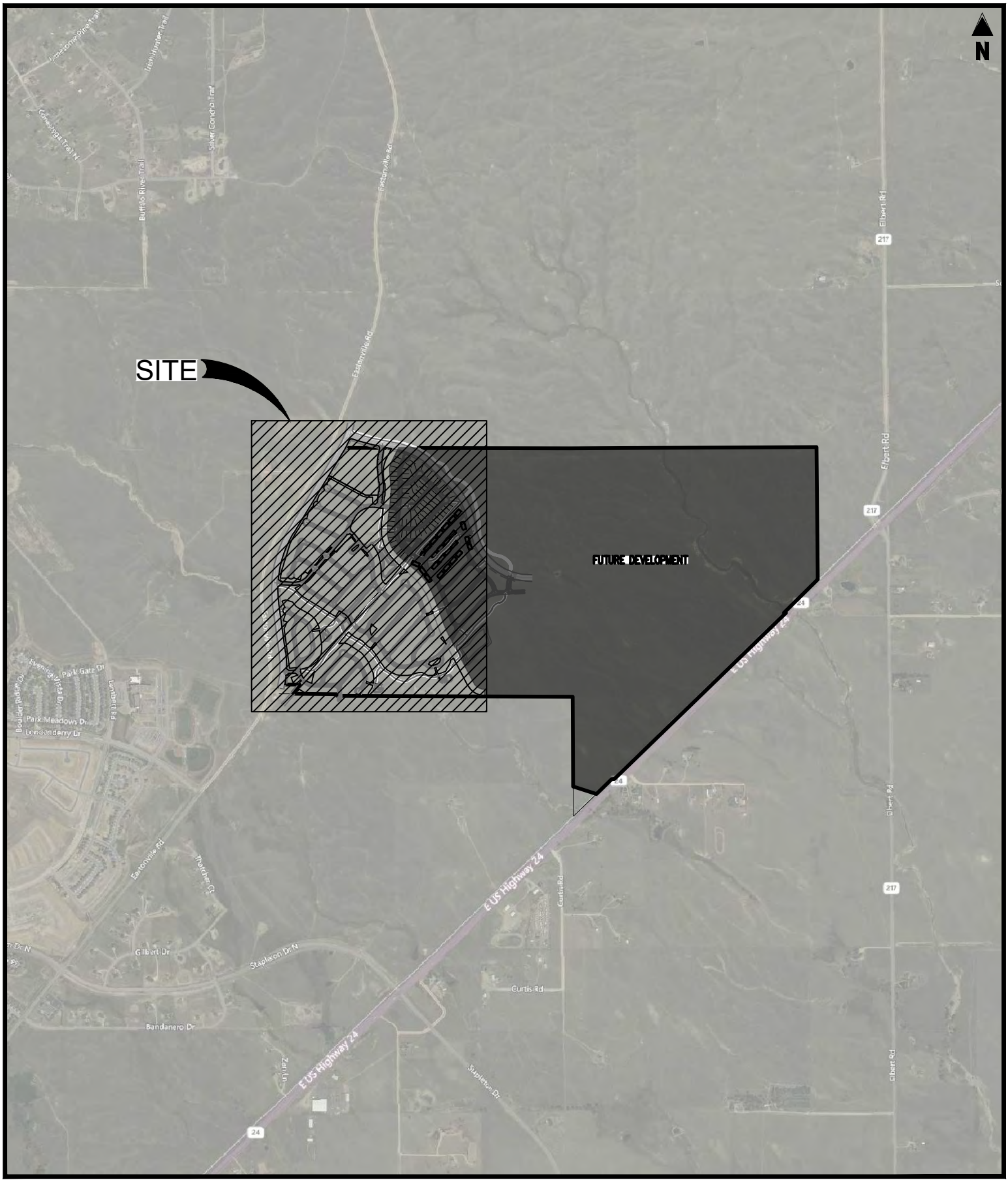
be maintained by a newly established Grandview Reserve Metropolitan District No. 2 (DISTRICT). A Final Drainage Report will be submitted along with the final plat and construction drawings.

XVI. References

1. *El Paso County Drainage Criteria Manual*, 1990.
2. *Drainage Criteria Manual, Volume 2*, City of Colorado Springs, 2002.
3. *El Paso County Drainage Criteria Manual Update*, 2015.
4. *El Paso County Engineering Criteria Manual*, 2020.
5. *Urban Storm Drainage Criteria Manual*, Urban Drainage and Flood Control District, January 2016 (with current revisions).
6. *Gieck Ranch Drainage Basin Study (DBPS),* Drexel Barrell, October 2010 (Not adopted by County).
7. *Grandview Reserve Master Development Drainage Plan (MDDP),* HR Green, November 2020.
8. *Grandview Reserve CLOMR Report*, HR Green; March 22, 2023.
9. *Meridian Ranch MDDP,* January 2018, updated 2021.
10. *Eastonville Road Preliminary Drainage Report*", HR Green, September 2023.
11. *The Sanctuary Filing 1 FDR (Meridian Ranch),* Tech Contractors, August 2022.

APPENDIX A

Exhibits and Figures



GRANDVIEW RESERVE

-

EASTONVILLE RD

SCALE: 1"=2,000'

VICINITY MAP

Project No:	HRG1.20
Drawn By:	JDP
Checked By:	RGD
Date:	07/26/2021

Galloway

1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920
719.900.7220 • GallowayUS.com

NOTES TO USERS

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

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

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

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

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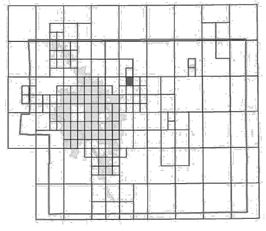
El Paso County Vertical Datum Offset Table

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

Panel Location Map



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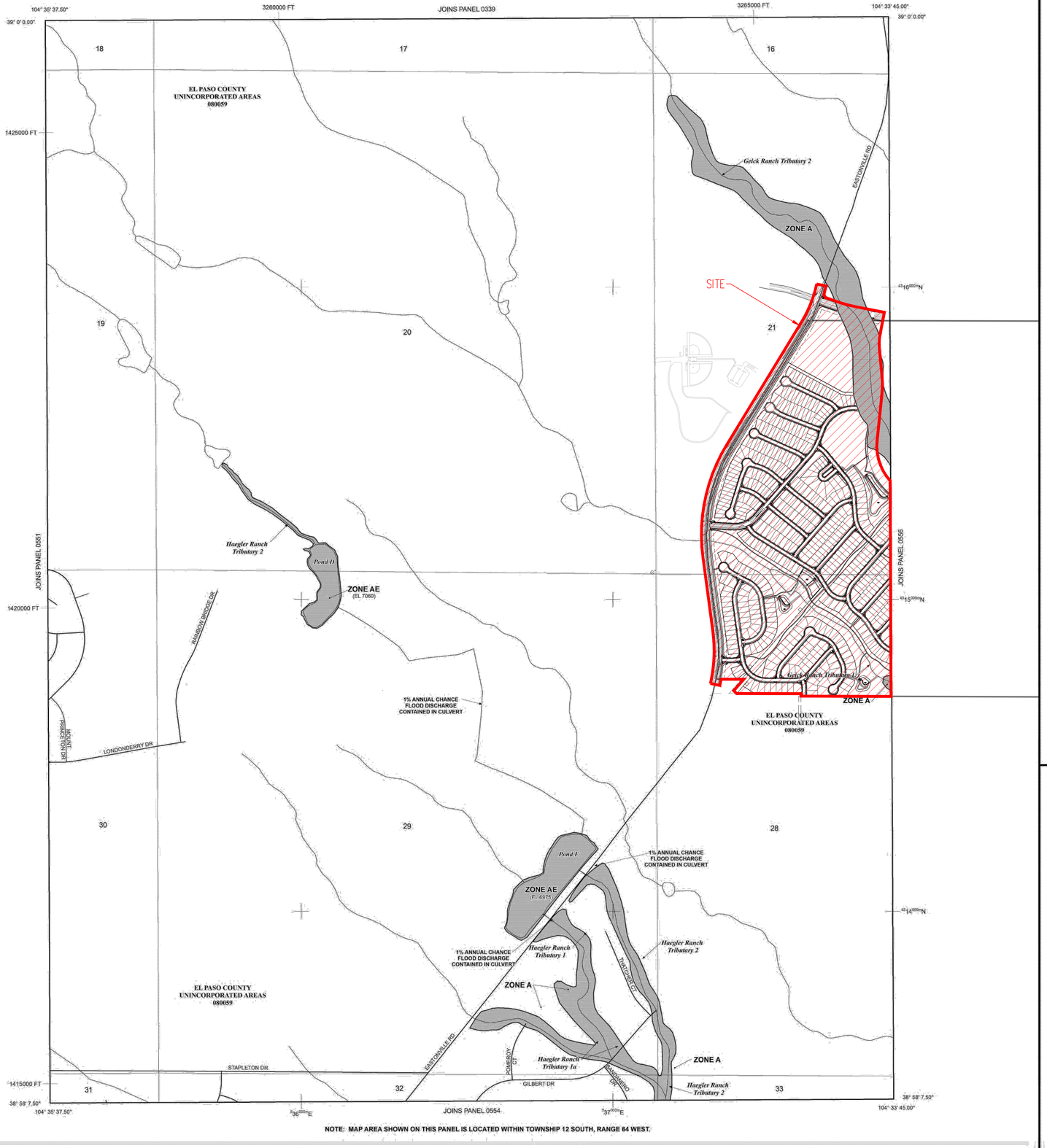

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

- A — A — Cross section line
- 23 — 23 — Transect line
- 97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4376000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0552G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	G

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

MAP NUMBER
08041C0552G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

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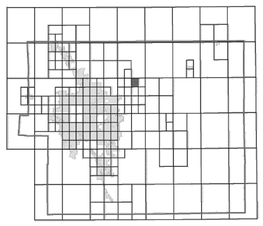

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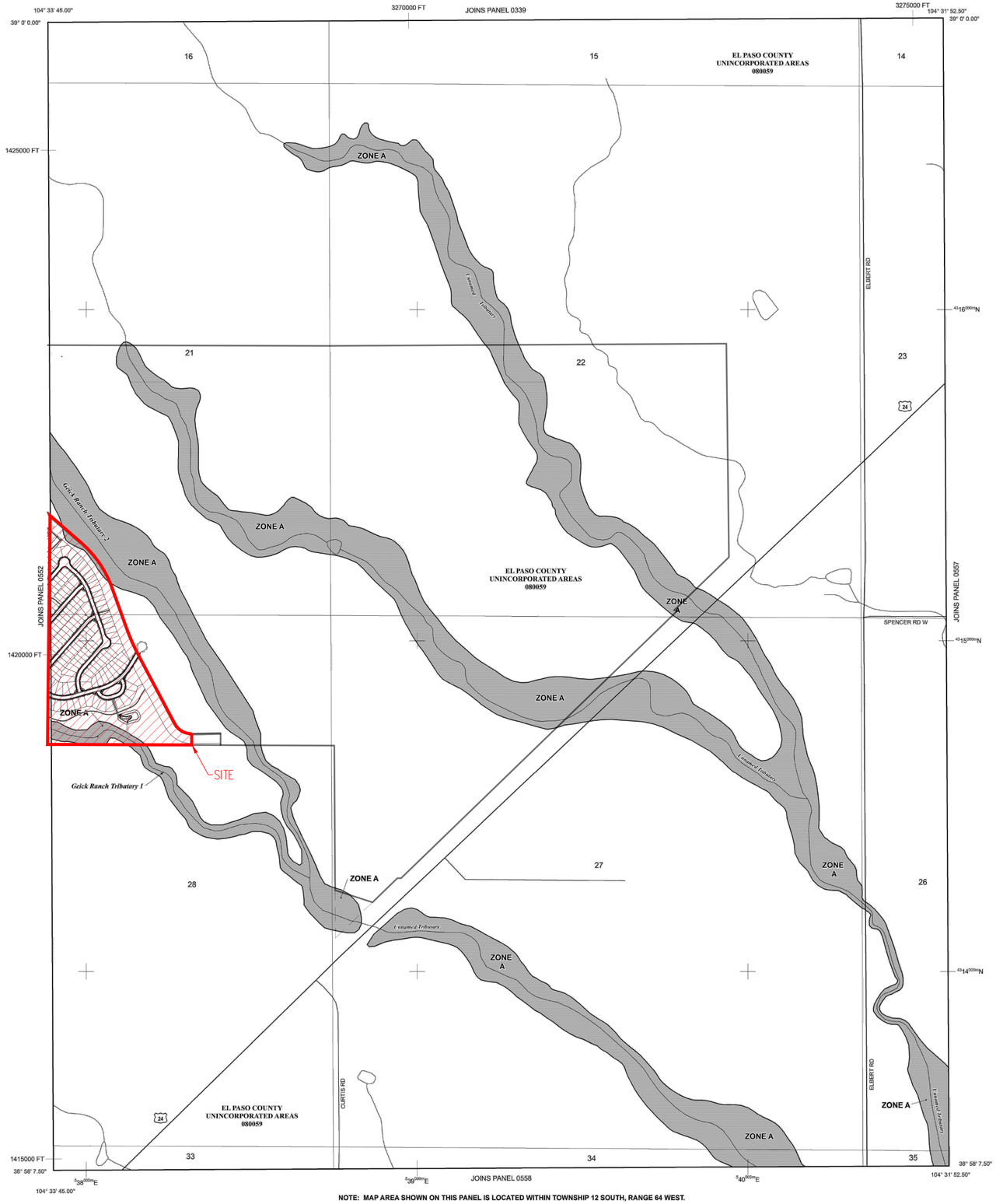

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST.

LEGEND

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0556G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 556 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0556	G

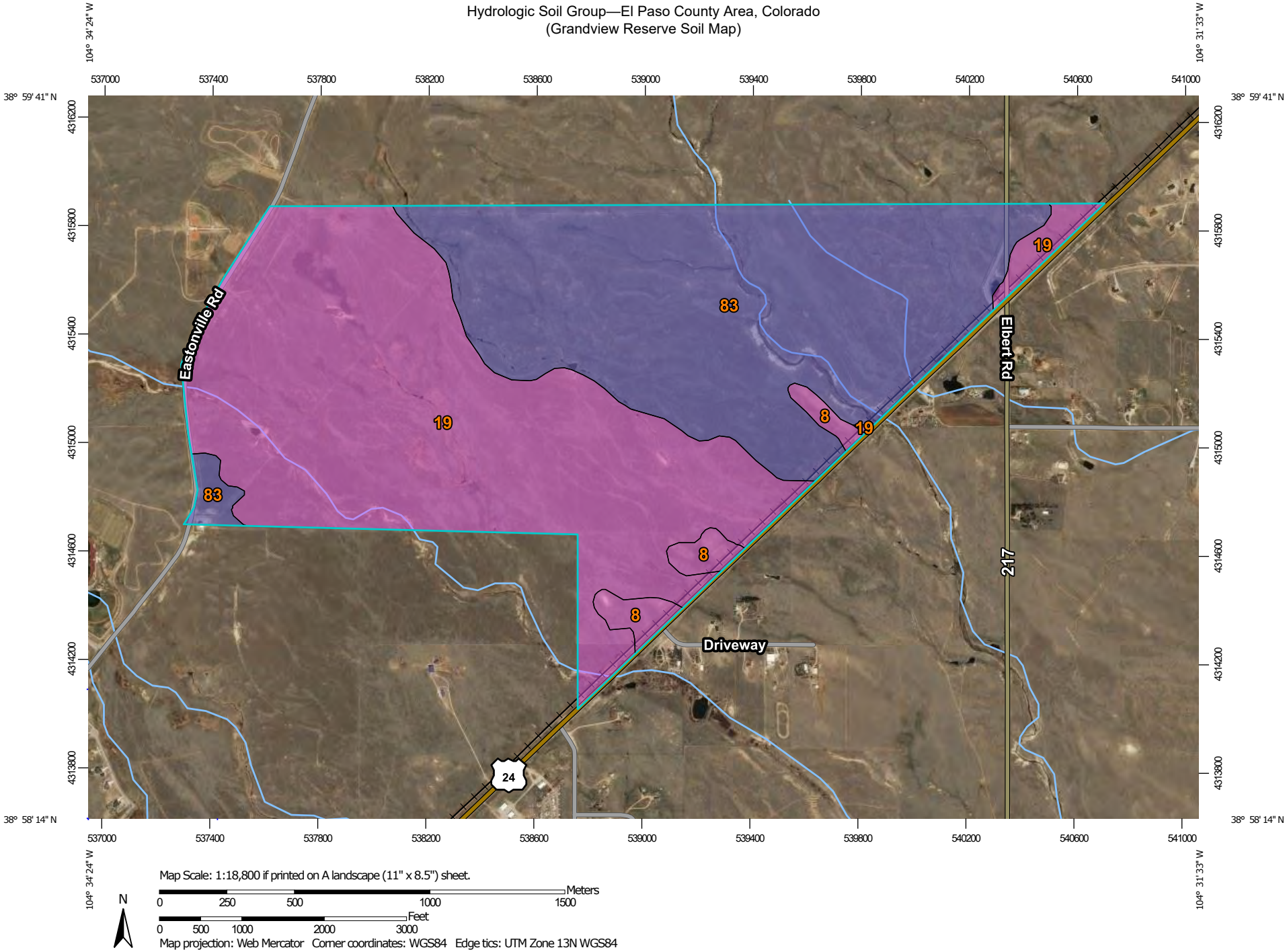
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0556G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Hydrologic Soil Group—El Paso County Area, Colorado
(Grandview Reserve Soil Map)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	22.4	2.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	450.7	52.5%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	385.4	44.9%
Totals for Area of Interest			**858.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOAA Atlas 14, Volume 8, Version 2
Location name: Peyton, Colorado, USA*
Latitude: 38.985°, Longitude: -104.565°
Elevation: 6975.71 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.239 (0.189-0.303)	0.291 (0.231-0.370)	0.381 (0.301-0.486)	0.461 (0.361-0.589)	0.576 (0.440-0.768)	0.671 (0.499-0.904)	0.770 (0.554-1.06)	0.875 (0.604-1.24)	1.02 (0.678-1.48)	1.14 (0.733-1.67)
10-min	0.350 (0.277-0.444)	0.426 (0.338-0.542)	0.558 (0.441-0.711)	0.674 (0.529-0.863)	0.844 (0.644-1.13)	0.982 (0.731-1.32)	1.13 (0.811-1.56)	1.28 (0.884-1.81)	1.49 (0.992-2.17)	1.66 (1.07-2.44)
15-min	0.426 (0.338-0.541)	0.520 (0.412-0.660)	0.681 (0.537-0.867)	0.823 (0.645-1.05)	1.03 (0.785-1.37)	1.20 (0.891-1.62)	1.37 (0.988-1.90)	1.56 (1.08-2.21)	1.82 (1.21-2.65)	2.03 (1.31-2.98)
30-min	0.608 (0.482-0.771)	0.740 (0.586-0.940)	0.968 (0.764-1.23)	1.17 (0.916-1.49)	1.46 (1.11-1.94)	1.70 (1.26-2.29)	1.94 (1.40-2.68)	2.21 (1.52-3.12)	2.57 (1.71-3.73)	2.86 (1.85-4.19)
60-min	0.775 (0.615-0.984)	0.933 (0.739-1.19)	1.21 (0.956-1.54)	1.46 (1.15-1.87)	1.84 (1.41-2.47)	2.16 (1.61-2.92)	2.49 (1.80-3.45)	2.85 (1.97-4.05)	3.37 (2.24-4.90)	3.78 (2.44-5.55)
2-hr	0.943 (0.754-1.19)	1.13 (0.898-1.42)	1.46 (1.16-1.84)	1.76 (1.39-2.23)	2.22 (1.72-2.97)	2.62 (1.97-3.52)	3.04 (2.21-4.19)	3.50 (2.45-4.95)	4.16 (2.80-6.03)	4.70 (3.06-6.85)
3-hr	1.03 (0.829-1.29)	1.22 (0.978-1.53)	1.57 (1.25-1.97)	1.90 (1.51-2.40)	2.41 (1.88-3.22)	2.86 (2.17-3.84)	3.35 (2.45-4.60)	3.88 (2.73-5.48)	4.66 (3.15-6.74)	5.29 (3.46-7.69)
6-hr	1.20 (0.968-1.49)	1.40 (1.13-1.74)	1.78 (1.44-2.22)	2.16 (1.73-2.70)	2.76 (2.18-3.66)	3.28 (2.52-4.39)	3.86 (2.86-5.29)	4.51 (3.21-6.34)	5.46 (3.73-7.86)	6.24 (4.12-9.01)
12-hr	1.38 (1.13-1.70)	1.61 (1.31-1.98)	2.05 (1.67-2.53)	2.48 (2.00-3.07)	3.15 (2.51-4.15)	3.74 (2.89-4.96)	4.39 (3.28-5.96)	5.12 (3.67-7.13)	6.17 (4.25-8.82)	7.04 (4.69-10.1)
24-hr	1.60 (1.31-1.95)	1.87 (1.54-2.28)	2.38 (1.94-2.91)	2.85 (2.32-3.51)	3.60 (2.88-4.67)	4.24 (3.29-5.56)	4.94 (3.71-6.63)	5.71 (4.12-7.87)	6.82 (4.73-9.66)	7.73 (5.20-11.0)
2-day	1.85 (1.54-2.24)	2.18 (1.80-2.63)	2.76 (2.28-3.35)	3.29 (2.70-4.01)	4.11 (3.30-5.27)	4.80 (3.76-6.22)	5.54 (4.19-7.36)	6.35 (4.62-8.68)	7.50 (5.25-10.5)	8.44 (5.73-11.9)
3-day	2.03 (1.69-2.44)	2.39 (1.98-2.87)	3.02 (2.50-3.64)	3.60 (2.97-4.36)	4.47 (3.60-5.69)	5.20 (4.09-6.70)	5.98 (4.55-7.90)	6.83 (4.99-9.28)	8.03 (5.65-11.2)	9.00 (6.15-12.7)
4-day	2.18 (1.82-2.61)	2.56 (2.13-3.06)	3.22 (2.68-3.87)	3.82 (3.16-4.62)	4.73 (3.83-6.00)	5.49 (4.33-7.04)	6.30 (4.81-8.30)	7.18 (5.26-9.72)	8.43 (5.95-11.7)	9.43 (6.46-13.3)
7-day	2.58 (2.17-3.07)	2.98 (2.50-3.54)	3.68 (3.08-4.39)	4.32 (3.60-5.18)	5.29 (4.31-6.65)	6.09 (4.84-7.76)	6.96 (5.34-9.09)	7.89 (5.82-10.6)	9.21 (6.55-12.8)	10.3 (7.10-14.4)
10-day	2.93 (2.48-3.47)	3.37 (2.84-3.98)	4.13 (3.47-4.90)	4.81 (4.02-5.74)	5.83 (4.76-7.29)	6.68 (5.32-8.45)	7.58 (5.85-9.86)	8.55 (6.34-11.4)	9.92 (7.09-13.7)	11.0 (7.65-15.4)
20-day	3.91 (3.33-4.58)	4.51 (3.84-5.29)	5.52 (4.68-6.50)	6.39 (5.39-7.55)	7.63 (6.25-9.37)	8.62 (6.90-10.8)	9.64 (7.47-12.4)	10.7 (7.98-14.1)	12.2 (8.74-16.6)	13.3 (9.31-18.4)
30-day	4.70 (4.02-5.47)	5.44 (4.65-6.34)	6.65 (5.66-7.78)	7.66 (6.49-9.00)	9.06 (7.44-11.0)	10.1 (8.15-12.5)	11.2 (8.74-14.3)	12.3 (9.24-16.2)	13.8 (9.98-18.7)	15.0 (10.5-20.6)
45-day	5.67 (4.88-6.57)	6.55 (5.63-7.60)	7.97 (6.82-9.27)	9.12 (7.77-10.7)	10.7 (8.79-12.9)	11.9 (9.56-14.5)	13.0 (10.2-16.4)	14.2 (10.6-18.4)	15.6 (11.3-21.0)	16.7 (11.9-23.0)
60-day	6.49 (5.60-7.48)	7.46 (6.43-8.62)	9.01 (7.74-10.4)	10.3 (8.77-11.9)	11.9 (9.82-14.3)	13.1 (10.6-16.0)	14.3 (11.2-18.0)	15.5 (11.7-20.0)	16.9 (12.3-22.6)	18.0 (12.8-24.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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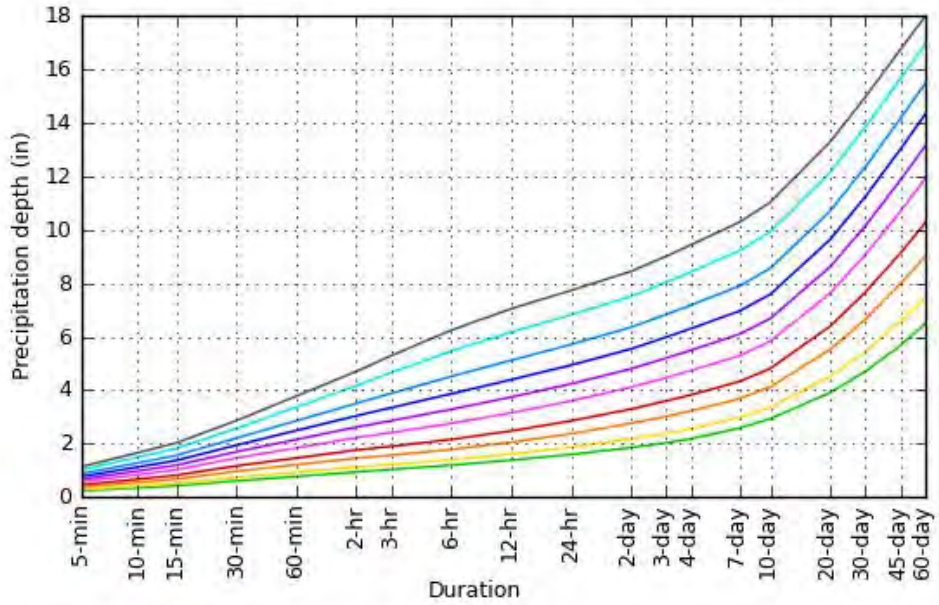
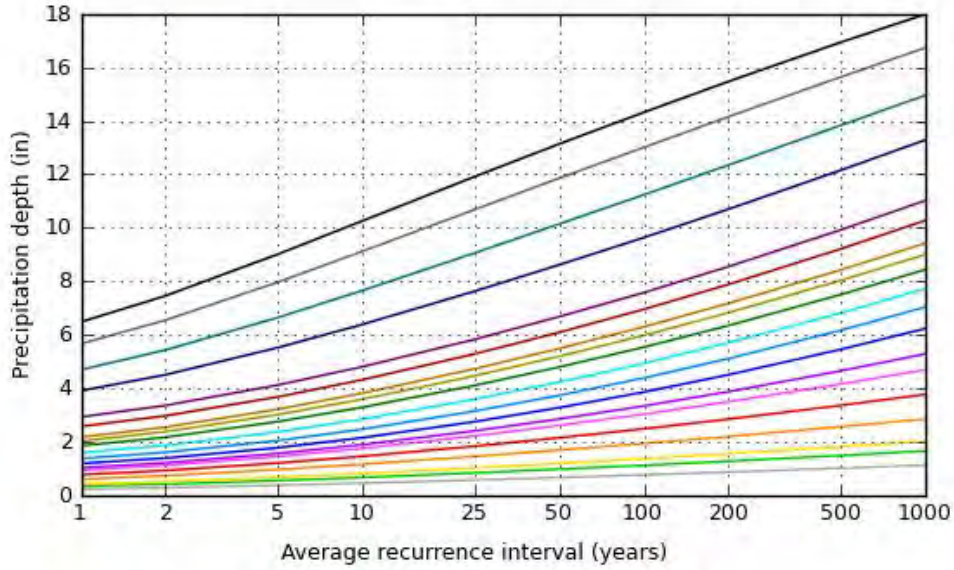
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 38.9850°, Longitude: -104.5650°





NOAA Atlas 14, Volume 8, Version 2 Created (GMT): Thu Dec 2 17:16:51 2021

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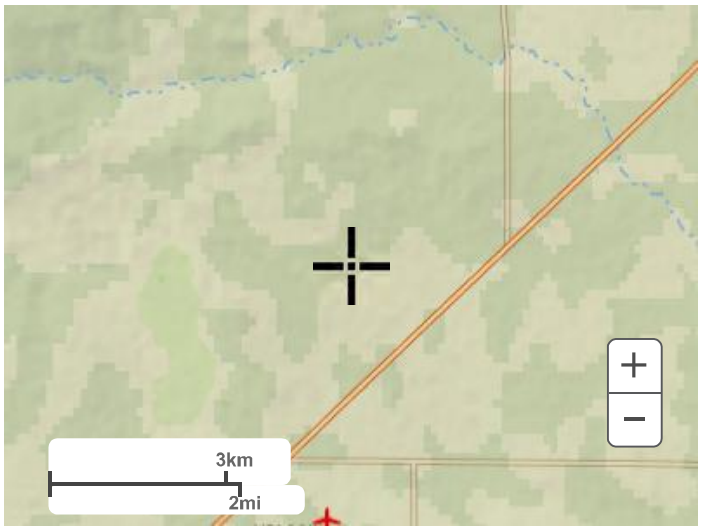
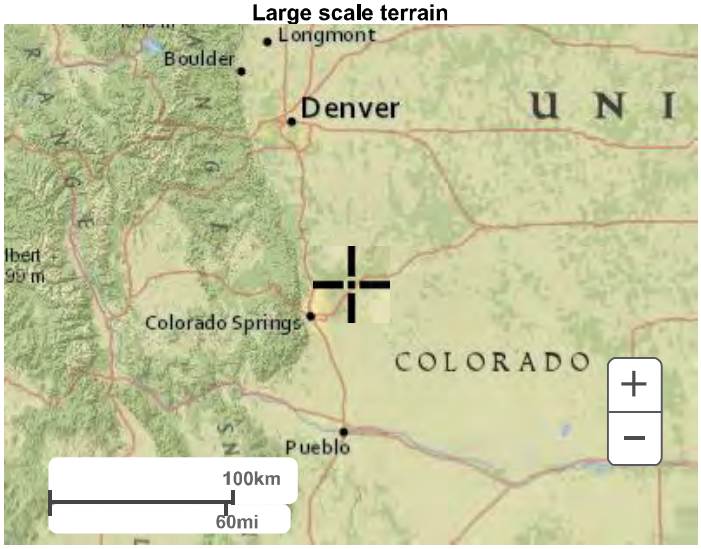
Maps & aerials

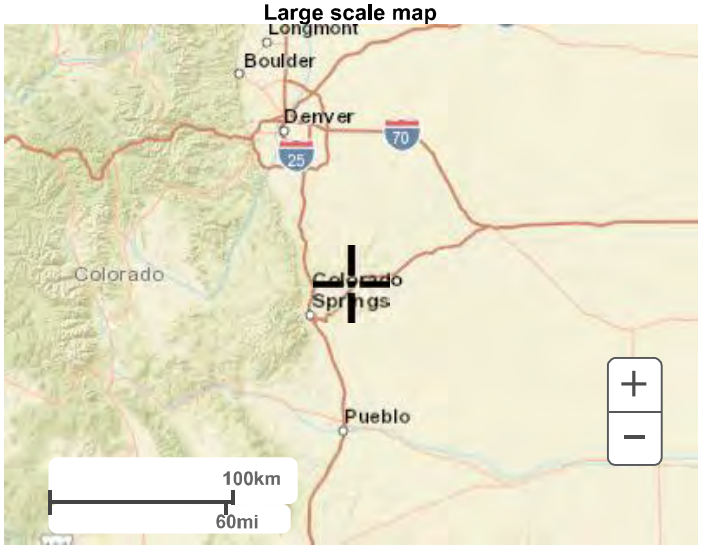
Small scale terrain



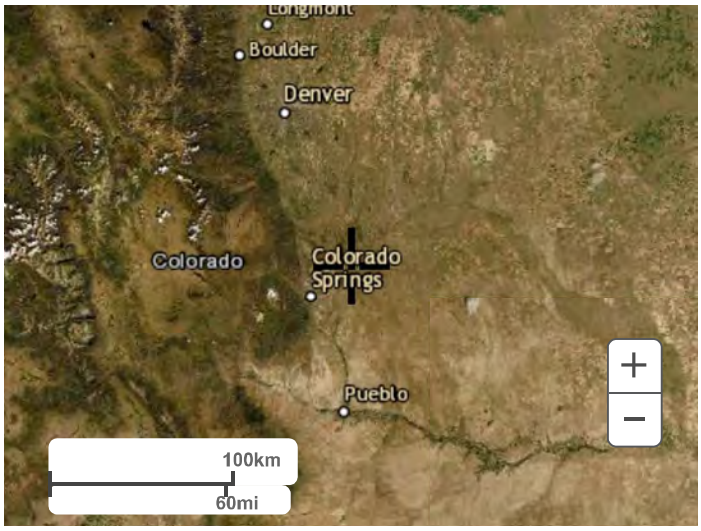
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX B

Hydrologic Computations

COMPOSITE % IMPERVIOUS CALCULATIONS: EXISTING & INTERIM

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR - Interim Conditions
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 12/21/23

1	2	3	4	5	6	7	8	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Basin ID	**Total Area (ac)**	**Paved/Gravel Roads**			**Lawns/Undeveloped**			**Residential - 1/8 Acre**			**Residential - 1/4 Acre**			**Residential - 1/3 Acre**			**Residential - 1/2 Acre**			**Residential - 1 Acre**			**Basins Total Weighted % Imp.**
		% Imp.	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	
EXISTING																							
For Existing Western Offsite Sub-basin analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																							
ES-1	16.37	100	0	0	2	16.37	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
ES-2	46.05	100	0	0	2	46.05	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
ES-3	64.3	100	0	0	2	64.3	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
ES-4	2.68	100	0	0	2	2.68	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
ES-5	26.15	100	0	0	2	26.15	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
ES-6	31.26	100	0	0	2	31.26	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
INTERIM																							
For Existing Western Offsite Sub-basin analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																							
A-1	2.29	100	0.00	0.0	2	2.29	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
A-2	3.96	100	0.00	0.0	2	3.96	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
EA-1	2.50	100	0.00	0.0	2	2.50	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-A1	10.67	100	0.00	0.0	2	10.67	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-A2	4.56	100	0.00	0.0	2	4.56	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-A3	13.72	100	0.00	0.0	2	13.72	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-B1	14.03	100	0.00	0.0	2	14.03	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-B2	14.48	100	0.00	0.0	2	14.48	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-C1	11.26	100	0.00	0.0	2	11.26	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-C2	11.92	100	0.00	0.0	2	11.92	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-C3	15.29	100	0.00	0.0	2	15.29	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-D1	10.09	100	0.00	0.0	2	10.09	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-E1	8.21	100	0.00	0.0	2	8.21	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
TSB-E2	13.57	100	0.00	0.0	2	13.57	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0

Lot Type Identification:	
Lot Size (SF)	*Lot Size (Acre)*
0 - 8,167	1/8 Acre
8,168 - 12,704	1/4 Acre
12,705 - 18,149	1/3 Acre
18,150 - 32,670	1/2 Acre
32,671 - 43,560	1 Acre

NOTES:
% Impervious values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS: EXISTING & INTERIM

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR - Interim Conditions
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 12/21/23

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Basin ID	**Total Area (ac)**	**Paved/Gravel Roads**			**Lawns/Undeveloped**			**Roofs**			**Residential - 1/8 Acre**			**Residential - 1/4 Acre**			**Residential - 1/3 Acre**			**Residential - 1/2 Acre**			**Residential - 1 Acre**			**Composite C_5**	**Composite C_{100}**
		C_5	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**		
EXISTING																											
For Existing Western Offsite Sub-basin analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																											
ES-1	16.37	0.90	0.96	0.00	0.09	0.36	16.37	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
ES-2	46.05	0.90	0.96	0.00	0.09	0.36	46.05	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
ES-3	64.30	0.90	0.96	0.00	0.09	0.36	64.30	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
ES-4	2.68	0.90	0.96	0.00	0.09	0.36	2.68	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
ES-5	26.15	0.90	0.96	0.00	0.09	0.36	26.15	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
ES-6	31.26	0.90	0.96	0.00	0.09	0.36	31.26	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
INTERIM																											
For Existing Western Offsite Sub-basin analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																											
A-1	2.29	0.90	0.96	0.00	0.09	0.36	2.29	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
A-2	3.96	0.90	0.96	0.00	0.09	0.36	3.96	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
EA-1	2.50	0.90	0.96	0.00	0.09	0.36	2.50	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-A1	10.67	0.90	0.96	0.00	0.09	0.36	10.67	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-A2	4.56	0.90	0.96	0.00	0.09	0.36	4.56	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-A3	13.72	0.90	0.96	0.00	0.09	0.36	13.72	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-B1	14.03	0.90	0.96	0.00	0.09	0.36	14.03	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-B2	14.48	0.90	0.96	0.00	0.09	0.36	14.48	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-C1	11.26	0.90	0.96	0.00	0.09	0.36	11.26	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-C2	11.92	0.90	0.96	0.00	0.09	0.36	11.92	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-C3	15.29	0.90	0.96	0.00	0.09	0.36	15.29	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-D1	10.09	0.90	0.96	0.00	0.09	0.36	10.09	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-E1	8.21	0.90	0.96	0.00	0.09	0.36	8.21	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
TSB-E2	13.57	0.90	0.96	0.00	0.09	0.36	13.57	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36

Lot Type Identification:	
Lot Size (SF)	*Lot Size (Acre)*
0 - 8,167	</= 1/8 Acre
8,168 - 12,704	1/4 Acre
12,705 - 18,149	1/3 Acre
18,150 - 32,670	1/2 Acre
32,671 - 43,560	1 Acre

NOTES:
C values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)
Coeffficients use HSG A&B soils - Refer to "Appendix A: Exhibits and Figures" for soil map

STANDARD FORM SF-2: EXISTING & INTERIM
TIME OF CONCENTRATION

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR - Interim Conditions
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 12/21/23

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SUB-BASIN DATA						**INITIAL/OVERLAND (T_i)**			**TRAVEL TIME (T_t)**					**Tc CHECK (T_c)**			**FINAL**
BASIN ID	**D.A. (AC)**	**Hydrologic Soils Group**	**Impervious (%)**	**C_5**	**C_{100}**	**L (FT)**	**S (%)**	**T_i (MIN)**	**L (FT)**	**S (%)**	**Cv**	**VEL. (FPS)**	**T_t (MIN)**	**COMP. T_c (MIN)**	**TOTAL LENGTH(FT)**	**Calculated T_c (MIN)**	**T_c (MIN)**
EXISTING																	
For Existing Western Offsite Sub-basin analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																	
ES-1	16.37	A	2.0	0.09	0.36	300	3.3	21.6	1433	2.5	15	2.4	10.0	31.6	1732.7	19.6	31.6
ES-2	46.05	A	2.0	0.09	0.36	300	2.5	23.6	3127	2.0	15	2.1	24.7	48.3	3427.0	29.0	48.3
ES-3	64.30	A	2.0	0.09	0.36	300	3.2	21.7	3964	2.1	15	2.2	30.4	52.1	4263.6	33.7	52.1
ES-4	2.68	A	2.0	0.09	0.36	300	2.5	23.8	462	2.4	15	2.3	3.3	27.1	762.3	14.2	27.1
ES-5	26.15	A	2.0	0.09	0.36	300	3.1	22.1	2121	2.3	15	2.3	15.6	37.7	2420.8	23.4	37.7
ES-6	31.26	A	2.0	0.09	0.36	300	3.6	20.9	1488	2.1	15	2.2	11.4	32.3	1788.5	19.9	32.3
INTERIM																	
For Existing Western Offsite Sub-basin analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																	
A-1	2.29	A	2.0	0.09	0.36	40	2.0	9.3	927	2.9	10	1.7	9.1	18.4	967.0	15.4	15.4
A-2	3.96	A	2.0	0.09	0.36	56	2.0	11.0	828	2.5	10	1.6	8.7	19.7	884.0	14.9	14.9
EA-1	2.50	A	2.0	0.09	0.36	160	5.0	13.7	1254	0.5	10	0.7	29.6	43.2	1414.0	17.9	17.9
TSB-A1	10.67	A	2.0	0.09	0.36	136	2.0	17.1	865	3.0	10	1.7	8.4	25.5	1001.0	15.6	15.6
TSB-A2	4.56	A	2.0	0.09	0.36	163	2.0	18.7	749	3.8	10	1.9	6.4	25.1	912.0	15.1	15.1
TSB-A3	13.72	A	2.0	0.09	0.36	159	2.0	18.5	1220	2.3	10	1.5	13.4	31.9	1379.0	17.7	17.7
TSB-B1	14.03	A	2.0	0.09	0.36	212	2.0	21.4	1035	3.2	10	1.8	9.6	31.0	1247.0	16.9	16.9
TSB-B2	14.48	A	2.0	0.09	0.36	60	2.0	11.4	1245	2.8	10	1.7	12.4	23.7	1305.0	17.3	17.3
TSB-C1	11.26	A	2.0	0.09	0.36	300	2.0	25.4	1105	2.0	10	1.4	12.9	38.3	1405.0	17.8	17.8
TSB-C2	11.92	A	2.0	0.09	0.36	50	2.0	10.4	1151	3.1	10	1.8	10.9	21.3	1201.0	16.7	16.7
TSB-C3	15.29	A	2.0	0.09	0.36	181	2.0	19.7	1745	2.6	10	1.6	18.2	38.0	1926.0	20.7	20.7
TSB-D1	10.09	A	2.0	0.09	0.36	155	2.0	18.3	1450	2.0	10	1.4	17.1	35.4	1605.0	18.9	18.9
TSB-E1	8.21	A	2.0	0.09	0.36	150	2.0	18.0	842	4.1	10	2.0	6.9	24.9	992.0	15.5	15.5
TSB-E2	13.57	A	2.0	0.09	0.36	300	2.0	25.4	989	2.0	10	1.4	11.7	37.1	1289.0	17.2	17.2

NOTES:

$T_i = (0.395*(1.1 - C_5)*(L)^{0.5})/((S)^{0.33})$, S in ft/ft

T_t=L/60V (Velocity From Fig. 501)

Velocity V=Cv*S^0.5, S in ft/ft

T_c Check = 10+L/180

For Urbanized basins a minimum T_c of 5.0 minutes is required.

For non-urbanized basins a minimum T_c of 10.0 minutes is required

STANDARD FORM SF-3: EXISTING & INTERIM
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 5-Year

Project Name: Grandview Subdivision PDR - Interim Conditions
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 12/21/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
EXISTING																					
	1	**EX1**	**321.53**					**28.3**				**28.3**									****SEE NOTE**
	2	**EX2**	**18.88**					**1.7**				**1.7**									****SEE NOTE**
	3	**EX3**	**131.26**					**6.1**				**6.1**									****SEE NOTE**
	4	**EX4**	**832.70**					**22.4**				**22.4**									****SEE NOTE**
	5	**EX5**	**22.35**					**7.0**				**7.0**									****SEE NOTE**
	6	**EX6**	**3.05**					**1.2**				**1.2**									****SEE NOTE**
	7	**EX7**	**1.47**					**0.9**				**0.9**									****SEE NOTE**
	X1	ES-1	16.37	0.09	31.6	1.47	2.35	3.5				4.7									Sheet flow to Channel A Total Flow from DP 6 & Basin ES-1
	X2	ES-2	46.05	0.09	48.3	4.14	1.82	7.5				36.9									Sheet flow to Channel A Total Flow from DP 4, DP 5 & Basin ES-2
	X3	ES-3	64.30	0.09	52.1	5.79	1.73	10.0				10.0									Sheet flow offiste - outfalls to Channel B
	X4	ES-4	2.68	0.09	27.1	0.24	2.57	0.6				0.6									Sheet flow offiste - outfalls to Channel B
	X5	ES-5	26.15	0.09	37.7	2.35	2.12	5.0				5.0									Sheet flow offiste - outfalls to Channel B
	X6	ES-6	31.26	0.09	32.3	2.81	2.32	6.5				40.9									Sheet flow offiste - outfalls to Channel B Total Flow from DP 1, DP 3 & ES-6
	X7											56.5									Total Existing Flow offsite - outfalls to Channel B
****For Existing Western Offsite Sub-basin analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023**																					
INTERIM																					
	8	A-1	2.29	0.09	15.4	0.21	3.42	0.7				0.7									Flows offsite through Pr. Swale A-1
	9	TSB-A1	10.67	0.09	15.6	0.96	3.40	3.3				3.3									Residential Undeveloped-Overland Graded
	10	A-2	3.96	0.09	14.9	0.36	3.47	1.2				10.6									Flows offsite through Pr. Swale A-2 Combined flow of Basin A-2, DP 3 & DP 9
	11	TSB-A2	4.56	0.09	15.1	0.41	3.46	1.4				1.4									Residential Undeveloped-Overland Graded
	12	TSB-A3	13.72	0.09	17.7	1.23	3.21	3.9				5.4									Residential Undeveloped-Overland Graded Combined flow of Basin TSB-A3 & DP 11
	13	TSB-B1	14.03	0.09	16.9	1.26	3.27	4.1				4.1									Residential Undeveloped-Overland Graded
	14	TSB-B2	14.48	0.09	17.3	1.30	3.24	4.2				8.3									Residential Undeveloped-Overland Graded Combined flow of Basin TSB-B2 & DP13
	15	TSB-C1	11.26	0.09	17.8	1.01	3.19	3.2				3.2									Residential Undeveloped-Overland Graded
	16	TSB-C2	11.92	0.09	16.7	1.07	3.30	3.5				3.5									Residential Undeveloped-Overland Graded
	17	TSB-C3	15.29	0.09	20.7	1.38	2.96	4.1				7.3									Residential Undeveloped-Overland Graded Combined flow of Basin TSB-C3 & DP 15
	18	TSB-D1	10.09	0.09	18.9	0.91	3.10	2.8				2.8									Residential Undeveloped-Overland Graded
	19	TSB-E1	8.21	0.09	15.5	0.74	3.41	2.5				2.5									Residential Undeveloped-Overland Graded
	20	TSB-E2	13.57	0.09	17.2	1.22	3.25	4.0				6.5									Residential Undeveloped-Overland Graded Combined flow of Basin TSB-E2 & DP 19
	21	EA-1	2.50	0.09	17.9	0.23	3.19	0.7				8.9									Existing Eastonville Road Combined flow of Basin EA-1, DP 5 & DP 6

STANDARD FORM SF-3: EXISTING & INTERIM
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 100-Year

Project Name: Grandview Subdivision PDR - Interim Conditions
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 12/21/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
EXISTING																					
	1	**EX1**	**321.53**					**365.2**				**365.2**									****SEE NOTE**
	2	**EX2**	**18.88**					**18.8**				**18.8**									****SEE NOTE**
	3	**EX3**	**131.26**					**112.1**				**112.1**									****SEE NOTE**
	4	**EX4**	**832.70**					**491.0**				**491.0**									****SEE NOTE**
	5	**EX5**	**22.35**					**43.3**				**43.3**									****SEE NOTE**
	6	**EX6**	**3.05**					**6.9**				**6.9**									****SEE NOTE**
	7	**EX7**	**1.47**					**4.2**				**4.2**									****SEE NOTE**
	X1	ES-1	16.37	0.36	31.6	5.89	4.19	24.7				31.6									Sheet flow to Channel A Total Flow from DP 6 & Basin ES-1
	X2	ES-2	46.05	0.36	48.3	16.58	3.24	53.7				588.0									Sheet flow to Channel A Total Flow from DP 4, DP 5 & Basin ES-2
	X3	ES-3	64.30	0.36	52.1	23.15	3.09	71.5				71.5									Sheet flow offiste - outfalls to Channel B
	X4	ES-4	2.68	0.36	27.1	0.96	4.57	4.4				4.4									Sheet flow offiste - outfalls to Channel B
	X5	ES-5	26.15	0.36	37.7	9.41	3.77	35.5				35.5									Sheet flow offiste - outfalls to Channel B
	X6	ES-6	31.26	0.36	32.3	11.25	4.13	46.5				523.8									Sheet flow offiste - outfalls to Channel B Total Flow from DP 1, DP 3 & ES-6
	X7											635.2									Total Existing Flow offsite - outfalls to Channel B
****For Existing Western Offsite Sub-basin analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023**																					
INTERIM																					
	8	A-1	2.29	0.36	15.4	0.82	6.09	5.0				5.0									Flows offsite through Pr. Swale A-1
	9	TSB-A1	10.67	0.36	15.6	3.84	6.06	23.3				23.3									Residential Undeveloped-Overland Graded
	10	A-2	3.96	0.36	14.9	1.43	6.18	8.8				144.2									Flows offsite through Pr. Swale A-2 Combined flow of Basin A-2, DP 3 & DP 9
	11	TSB-A2	4.56	0.36	15.1	1.64	6.15	10.1				10.1									Residential Undeveloped-Overland Graded
	12	TSB-A3	13.72	0.36	17.7	4.94	5.71	28.2				38.3									Residential Undeveloped-Overland Graded Combined flow of Basin TSB-A3 & DP 11
	13	TSB-B1	14.03	0.36	16.9	5.05	5.82	29.4				29.4									Residential Undeveloped-Overland Graded
	14	TSB-B2	14.48	0.36	17.3	5.21	5.77	30.1				59.5									Residential Undeveloped-Overland Graded Combined flow of Basin TSB-B2 & DP13
	15	TSB-C1	11.26	0.36	17.8	4.05	5.68	23.0				23.0									Residential Undeveloped-Overland Graded
	16	TSB-C2	11.92	0.36	16.7	4.29	5.87	25.2				25.2									Residential Undeveloped-Overland Graded
	17	TSB-C3	15.29	0.36	20.7	5.50	5.27	29.0				52.0									Residential Undeveloped-Overland Graded Combined flow of Basin TSB-C3 & DP 15
	18	TSB-D1	10.09	0.36	18.9	3.63	5.52	20.0				20.0									Residential Undeveloped-Overland Graded
	19	TSB-E1	8.21	0.36	15.5	2.96	6.07	18.0				18.0									Residential Undeveloped-Overland Graded
	20	TSB-E2	13.57	0.36	17.2	4.89	5.79	28.3				46.3									Residential Undeveloped-Overland Graded Combined flow of Basin TSB-E2 & DP 19
	21	EA-1	2.50	0.36	17.9	0.90	5.68	5.1				55.3									Existing Eastonville Road Combined flow of Basin EA-1, DP 5 & DP 6

COMPOSITE % IMPERVIOUS CALCULATIONS: EXISTING & PROPOSED

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

1	2	3	4	5	6	7	8	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Basin ID	**Total Area (ac)**	**Paved/Gravel Roads**			**Lawns/Undeveloped**			**Residential - 1/8 Acre**			**Residential - 1/4 Acre**			**Residential - 1/3 Acre**			**Residential - 1/2 Acre**			**Residential - 1 Acre**			**Basins Total Weighted % Imp.**
		% Imp.	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	
PROPOSED																							
For Existing Western Offsite Sub-basin analysis and Proposed Eastonville Road Basin Analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																							
A-1	11.60	100	0.00	0.0	2	11.67	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
A-2a	4.42	100	0.00	0.0	2	0.00	0.0	65.0	4.42	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-2b	2.75	100	1.80	65.5	2	0.00	0.0	65.0	0.95	22.5	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	88.0
A-3	0.36	100	0.36	100.0	2	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	100.0
A-4a	6.31	100	0.00	0.0	2	0.00	0.0	65.0	6.31	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-4b	3.99	100	0.00	0.0	2	0.00	0.0	65.0	3.99	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-5	0.35	100	0.35	100.0	2	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	100.0
A-6	2.76	100	0.00	0.0	2	0.00	0.0	65.0	2.76	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-7	0.23	100	0.23	100.0	2	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	100.0
A-8	5.44	100	4.06	74.5	2	1.39	0.5	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	75.0
A-9	4.91	100	0.00	0.0	2	0.00	0.0	65.0	4.91	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-10	1.02	100	0.00	0.0	2	0.00	0.0	65.0	1.02	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-11	3.56	100	0.00	0.0	2	2.77	1.6	65.0	0.79	14.4	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	16.0
B-1	3.81	100	0.00	0.0	2	0.00	0.0	65.0	3.33	56.8	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	56.8
B-2	4.62	100	0.00	0.0	2	0.00	0.0	65.0	4.51	63.5	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	63.5
B-3	4.15	100	0.00	0.0	2	0.00	0.0	65.0	4.15	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-4	1.37	100	1.07	78.1	2	0.30	0.4	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	78.5
B-5	5.12	100	0.00	0.0	2	0.00	0.0	65.0	5.12	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-6	2.28	100	0.00	0.0	2	0.00	0.0	65.0	2.28	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-7	0.89	100	0.00	0.0	2	0.00	0.0	65.0	0.89	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-8	3.23	100	0.00	0.0	2	0.00	0.0	65.0	3.23	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-9	2.42	100	0.00	0.0	2	0.00	0.0	65.0	2.42	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-10	1.10	100	0.00	0.0	2	1.10	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
C-1	4.12	100	0.00	0.0	2	0.00	0.0	65.0	4.12	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-2	2.71	100	0.00	0.0	2	0.00	0.0	65.0	2.71	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-3	1.56	100	0.08	5.1	2	1.48	1.9	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	7.0
C-4	2.47	100	0.00	0.0	2	0.00	0.0	65.0	2.47	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-5	3.09	100	0.00	0.0	2	0.00	0.0	65.0	3.09	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-6	2.1	100	0.00	0.0	2	0.00	0.0	65.0	2.10	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-7a	0.81	100	0.00	0.0	2	0.26	0.6	65.0	0.55	44.1	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	44.7
C-7b	5.91	100	0.00	0.0	2	0.00	0.0	65.0	5.91	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-8	5.11	100	0.00	0.0	2	0.00	0.0	65.0	5.11	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-9a	3.5	100	0.00	0.0	2	0.00	0.0	65.0	3.50	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-9b	3.69	100	0.00	0.0	2	0.00	0.0	65.0	3.69	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-10	3.47	100	0.00	0.0	2	0.00	0.0	65.0	3.47	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-11	0.46	100	0.00	0.0	2	0.00	0.0	65.0	0.46	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-12	1.66	100	0.00	0.0	2	0.00	0.0	65.0	1.66	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-13	2.37	100	0.00	0.0	2	2.37	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
C-14	1.53	100	0.00	0.0	2	1.53	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
C-15	0.16	100	0.01	6.3	2	0.15	1.9	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	8.2
D-1	3.48	100	0.00	0.0	2	0.00	0.0	65.0	3.48	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
D-2	0.87	100	0.00	0.0	2	0.00	0.0	65.0	0.87	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
D-3	3.69	100	0.00	0.0	2	0.00	0.0	65.0	3.69	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
D-4	1.75	100	0.00	0.0	2	0.00	0.0	65.0	1.75	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
D-5	1.53	100	0.00	0.0	2	0.71	0.9	65.0	0.82	34.8	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	35.7
D-6	0.83	100	0.00	0.0	2	0.83	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
D-7a	0.27	100	0.02	7.4	2	0.23	1.7	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	9.1
D-7b	0.88	100	0.00	0.0	2	0.00	0.0	65.0	0.88	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-1	5.33	100	0.00	0.0	2	0.00	0.0	65.0	5.33	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-2	5.42	100	0.00	0.0	2	0.00	0.0	65.0	5.42	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-3	3.20	100	0.00	0.0	2	0.00	0.0	65.0	3.20	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-4	6.28	100	0.00	0.0	2	0.00	0.0	65.0	6.28	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-5	1.13	100	0.00	0.0	2	1.13	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
E-6	0.74	100	0.00	0.0	2	0.74	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0

Lot Type Identification:	
Lot Size (SF)	*Lot Size (Acre)*
0 - 8,167	1/8 Acre
8,168 - 12,704	1/4 Acre
12,705 - 18,149	1/3 Acre
18,150 - 32,670	1/2 Acre
32,671 - 43,560	1 Acre

NOTES:
% Impervious values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS: EXISTING & PROPOSED

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Basin ID	**Total Area (ac)**	**Paved/Gravel Roads**			**Lawns/Undeveloped**			**Roofs**			**Residential - 1/8 Acre**			**Residential - 1/4 Acre**			**Residential - 1/3 Acre**			**Residential - 1/2 Acre**			**Residential - 1 Acre**			**Composite C_5**	**Composite C_{100}**
		C_5	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**		
PROPOSED																											
For Existing Western Offsite Sub-basin analysis and Proposed Eastonville Road Basin Analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																											
A-1	11.60	0.90	0.96	0.00	0.09	0.36	11.67	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
A-2a	4.42	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.42	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-2b	2.75	0.90	0.96	1.80	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.95	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.74	0.83
A-3	0.36	0.90	0.96	0.36	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.90	0.96
A-4a	6.31	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	6.31	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-4b	3.99	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.99	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-5	0.35	0.90	0.96	0.35	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.90	0.96
A-6	2.76	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.76	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-7	0.23	0.90	0.96	0.23	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.90	0.96
A-8	5.44	0.90	0.96	4.06	0.09	0.36	1.39	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.69	0.81
A-9	4.91	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.91	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-10	1.02	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.02	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-11	3.56	0.90	0.96	0.00	0.09	0.36	2.77	0.73	0.81	0.00	0.45	0.59	0.79	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.17	0.41
B-1	3.81	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.33	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.39	0.52
B-2	4.62	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.51	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.44	0.58
B-3	4.15	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.15	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-4	1.37	0.90	0.96	1.07	0.09	0.36	0.30	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.72	0.83
B-5	5.12	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.12	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-6	2.28	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.28	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-7	0.89	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.89	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-8	3.23	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.23	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-9	2.42	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.42	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-10	1.10	0.90	0.96	0.00	0.09	0.36	1.10	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
C-1	4.12	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.12	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-2	2.71	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.71	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-3	1.56	0.90	0.96	0.08	0.09	0.36	1.48	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.13	0.39
C-4	2.47	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.47	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-5	3.09	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.09	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-6	2.10	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.10	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-7a	0.81	0.90	0.96	0.00	0.09	0.36	0.26	0.73	0.81	0.00	0.45	0.59	0.55	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.33	0.52
C-7b	5.91	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.91	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-8	5.11	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.11	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-9a	3.50	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.50	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-9b	3.69	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.69	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-10	3.47	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.47	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-11	0.46	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.46	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-12	1.66	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.66	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-13	2.37	0.90	0.96	0.00	0.09	0.36	2.37	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
C-14	1.53	0.90	0.96	0.00	0.09	0.36	1.53	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
C-15	0.16	0.90	0.96	0.01	0.09	0.36	0.15	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.14	0.40
D-1	3.48	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.48	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
D-2	0.87	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.87	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
D-3	3.69	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.69	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
D-4	1.75	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.75	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
D-5	1.53	0.90	0.96	0.00	0.09	0.36	0.71	0.73	0.81	0.00	0.45	0.59	0.82	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.28	0.48
D-6	0.83	0.90	0.96	0.00	0.09	0.36	0.83	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
D-7a	0.27	0.90	0.96	0.02	0.09	0.36	0.23	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.14	0.38
D-7b	0.88	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.88	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-1	5.33	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.33	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-2	5.42	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.42	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-3	3.20	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.20	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-4	6.28	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	6.28	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-5	1.13	0.90	0.96	0.00	0.09	0.36	1.13	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
E-6	0.74	0.90	0.96	0.00	0.09	0.36	0.74	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36

Lot Type Identification:	
Lot Size (SF)	*Lot Size (Acre)*
0 - 8,167	</= 1/8 Acre
8,168 - 12,704	1/4 Acre
12,705 - 18,149	1/3 Acre
18,150 - 32,670	1/2 Acre
32,671 - 43,560	1 Acre

NOTES:
C values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)
Coeffficients use HSG A&B soils - Refer to "Appendix A: Exhibits and Figures" for soil map

STANDARD FORM SF-2: EXISTING & PROPOSED TIME OF CONCENTRATION

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					Tc CHECK (T_c)			FINAL
BASIN ID	D.A. (AC)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (FT)	S (%)	T_i (MIN)	L (FT)	S (%)	Cv	VEL. (FPS)	T_t (MIN)	COMP. T_c (MIN)	TOTAL LENGTH(FT)	Calculated T_c (MIN)	T_c (MIN)
PROPOSED																	
For Existing Western Offsite Sub-basin analysis and Proposed Eastonville Road Basin Analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																	
A-1	11.60	A	2.0	0.09	0.36	50	10.0	6.1	957	5.0	20	4.5	3.6	9.6	1007.0	15.6	9.6
A-2a	4.42	A	65.0	0.45	0.59	50	5.0	4.9	742	2.5	20	3.2	3.9	8.8	792.0	14.4	8.8
A-2b	2.75	A	88.0	0.74	0.83	250	2.0	8.3	300	2.5	20	3.2	1.6	9.9	550.0	13.1	9.9
A-3	0.36	A	100.0	0.90	0.96	18	2.0	1.2	560	1.9	20	2.8	3.4	4.6	578.0	13.2	5.0
A-4a	6.31	A	65.0	0.45	0.59	230	2.0	14.3	700	2.5	20	3.2	3.7	18.0	930.0	15.2	15.2
A-4b	3.99	A	65.0	0.45	0.59	100	2.0	9.4	770	2.5	20	3.2	4.1	13.5	870.0	14.8	13.5
A-5	0.35	A	100.0	0.90	0.96	18	2.0	1.2	332	1.4	20	2.4	2.3	3.6	350.0	11.9	5.0
A-6	2.76	A	65.0	0.45	0.59	217	4.5	10.6	310	1.0	20	2.0	2.6	13.2	527.0	12.9	12.9
A-7	0.23	A	100.0	0.90	0.96	36	3.0	1.5	340	2.3	20	3.0	1.9	3.4	376.0	12.1	5.0
A-8	5.44	A	75.0	0.69	0.81	250	2.0	9.4	300	2.0	20	2.8	1.8	11.2	550.0	13.1	11.2
A-9	4.91	A	65.0	0.45	0.59	160	2.0	11.9	950	1.5	20	2.4	6.5	18.4	1110.0	16.2	16.2
A-10	1.02	A	65.0	0.45	0.59	18	3.0	3.5	450	1.0	20	2.0	3.8	7.3	468.0	12.6	7.3
A-11	3.56	A	16.0	0.17	0.41	450	5.0	21.1	718	1.0	20	2.0	6.0	27.1	1168.0	16.5	16.5
B-1	3.81	A	56.8	0.39	0.52	210	3.5	12.4	560	1.7	20	2.6	3.6	16.0	770.0	14.3	14.3
B-2	4.62	A	63.5	0.44	0.58	230	3.0	12.7	611	2.5	20	3.2	3.2	15.9	841.0	14.7	14.7
B-3	4.15	A	65.0	0.45	0.59	34	2.0	5.5	680	2.7	20	3.3	3.4	9.0	714.0	14.0	9.0
B-4	1.37	A	78.5	0.72	0.83	10	6.0	1.2	700	1.0	20	2.0	5.8	7.0	710.0	13.9	7.0
B-5	5.12	A	65.0	0.45	0.59	60	1.0	9.2	946	1.7	20	2.6	6.0	15.3	1006.0	15.6	15.3
B-6	2.28	A	65.0	0.45	0.59	186	3.0	11.3	480	1.0	20	2.0	4.0	15.3	666.0	13.7	13.7
B-7	0.89	A	65.0	0.45	0.59	62	3.0	6.5	509	1.0	20	2.0	4.2	10.7	571.0	13.2	10.7
B-8	3.23	A	65.0	0.45	0.59	177	5.0	9.3	700	2.0	20	2.8	4.1	13.4	877.0	14.9	13.4
B-9	2.42	A	65.0	0.45	0.59	152	3.0	10.2	800	2.4	20	3.1	4.3	14.5	952.0	15.3	14.5
B-10	1.10	A	2.0	0.09	0.36	66	25.0	5.1	187	1.0	20	2.0	1.6	6.7	253.0	11.4	6.7
C-1	4.12	A	65.0	0.45	0.59	65	3.0	6.7	1077	2.0	20	2.8	6.3	13.0	1142.0	16.3	13.0
C-2	2.71	A	65.0	0.45	0.59	55	2.0	7.0	620	1.9	20	2.8	3.7	10.8	675.0	13.8	10.8
C-3	1.56	A	7.0	0.13	0.39	77	4.0	9.8	0	0.0	20	0.0	0.0	9.8	77.0	10.4	9.8
C-4	2.47	A	65.0	0.45	0.59	194	2.0	13.2	345	1.3	20	2.3	2.5	15.7	539.0	13.0	13.0
C-5	3.09	A	65.0	0.45	0.59	38	4.0	4.6	761	1.0	20	2.0	6.3	11.0	799.0	14.4	11.0
C-6	2.10	A	65.0	0.45	0.59	61	3.0	6.4	1176	1.0	20	2.0	9.8	16.2	1236.5	16.9	16.2
C-7a	0.81	A	44.7	0.33	0.52	142	8.3	8.3	136	2.5	15	2.4	1.0	9.3	278.0	11.5	9.3
C-7b	5.91	A	65.0	0.45	0.59	35	4.0	4.4	1278	1.7	20	2.6	8.2	12.6	1313.0	17.3	12.6
C-8	5.11	A	65.0	0.45	0.59	58	2.0	7.2	834	1.6	20	2.5	5.5	12.7	892.0	15.0	12.7
C-9a	3.50	A	65.0	0.45	0.59	193	2.0	13.1	570	0.7	20	1.7	5.7	18.8	763.0	14.2	14.2
C-9b	3.69	A	65.0	0.45	0.59	160	3.0	10.4	665	2.0	20	2.8	3.9	14.4	825.0	14.6	14.4
C-10	3.47	A	65.0	0.45	0.59	122	3.0	9.1	1084	1.5	20	2.4	7.4	16.5	1206.0	16.7	16.5
C-11	0.46	A	65.0	0.45	0.59	26	2.0	4.8	152	0.5	20	1.4	1.8	6.6	178.0	11.0	6.6
C-12	1.66	A	65.0	0.45	0.59	160	4.0	9.5	200	0.5	20	1.4	2.4	11.8	360.0	12.0	11.8
C-13	2.37	A	2.0	0.09	0.36	225	15.0	11.3	352	1.0	20	2.0	2.9	14.2	577.0	13.2	13.2
C-14	1.53	A	2.0	0.09	0.36	300	5.0	18.7	0	0.0	10	0.0	0.0	18.7	300.0	11.7	11.7
C-15	0.16	A	8.2	0.14	0.40	72	5.0	8.7	0	0.0	20	0.0	0.0	8.7	72.0	10.4	8.7
D-1	3.48	A	65.0	0.45	0.59	170	3.0	10.8	715	1.0	20	2.0	6.0	16.7	885.0	14.9	14.9
D-2	0.87	A	65.0	0.45	0.59	10	2.0	3.0	700	1.3	20	2.3	5.1	8.1	710.0	13.9	8.1
D-3	3.69	A	65.0	0.45	0.59	140	3.0	9.8	660	2.2	20	3.0	3.7	13.5	800.0	14.4	13.5
D-4	1.75	A	65.0	0.45	0.59	50	3.0	5.8	663	2.0	20	2.8	3.9	9.7	713.0	14.0	9.7
D-5	1.53	A	35.7	0.28	0.48	110	25.0	5.4	201	1.0	20	2.0	1.7	7.1	311.0	11.7	7.1
D-6	0.83	A	2.0	0.09	0.36	300	5.0	18.7	0	0.0	10	0.0	0.0	18.7	300.0	11.7	11.7
D-7a	0.27	A	9.1	0.14	0.38	75	5.0	8.9	0	0.0	20	0.0	0.0	8.9	75.0	10.4	8.9
D-7b	0.88	A	65.0	0.45	0.59	75	8.0	5.2	478	2.0	15	2.1	3.8	8.9	553.0	13.1	8.9
E-1	5.33	A	65.0	0.45	0.59	25	4.0	3.7	1360	3.3	20	3.6	6.2	10.0	1385.0	17.7	10.0
E-2	5.42	A	65.0	0.45	0.59	20	2.0	4.2	1250	3.5	20	3.7	5.6	9.8	1270.0	17.1	9.8
E-3	3.20	A	65.0	0.45	0.59	10	2.0	3.0	965	1.5	20	2.4	6.6	9.6	975.0	15.4	9.6
E-4	6.28	A	65.0	0.45	0.59	305	7.0	10.9	1125	1.6	20	2.5	7.4	18.3	1430.0	17.9	17.9
E-5	1.13	A	2.0	0.09	0.36	127	25.0	7.1	315	1.0	20	2.0	2.6	9.8	442.0	12.5	9.8
E-6	0.74	A	2.0	0.09	0.36	350	2.0	27.5	113	2.0	10	1.4	1.3	28.8	463.0	12.6	12.6

NOTES:
$T_i = (0.395*(1.1 - C_5)*(L)^{0.5})/((S)^{0.33})$, S in ft/ft
T_t=L/60V (Velocity From Fig. 501)
Velocity V=Cv*S^0.5, S in ft/ft
Tc Check = 10+L/180
For Urbanized basins a minimum T_c of 5.0 minutes is required.
For non-urbanized basins a minimum T_c of 10.0 minutes is required

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 5-Year

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
PROPOSED																					
For Existing Western Offsite Sub-basin analysis and Proposed Eastonville Road Basin Analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																					
	1	A-1	11.60	0.09	9.6	1.04	4.16	4.3				4.3									Institutional Tract Basin will have own water quality & detention pond
	2a	A-2a	4.42	0.45	8.8	1.99	4.29	8.5				8.5									On-Grade 15' CDOT Type R Inlet (0.6 cfs bypass to DP 2b)
	2b	A-2b	2.75	0.74	9.9	2.04	4.13	8.4				9.0									Sump 20' CDOT Type R Inlet (Receives 0.6 cfs upstream bypass)
	3	A-3	0.36	0.90	5.0	0.32	5.10	1.6				1.6									Sump 5' CDOT Type R Inlet
	4a	A-4a	6.31	0.45	15.2	2.84	3.44	9.8				9.8									On-Grade 15' CDOT Type R Inlet (1.2 cfs bypass to DP 4)
	4b 4	A-4b	3.99	0.45	13.5	1.80	3.63	6.5				6.5 2.5									On-Grade 15' CDOT Type R Inlet (1.3 cfs bypass to DP 4) Sump 15' CDOT Type R Inlet (Receives 2.5 cfs upstream bypass)
	5	A-5	0.35	0.90	5.0	0.32	5.10	1.6				1.6									Sump 5' CDOT Type R Inlet
	6	A-6	2.76	0.45	12.9	1.24	3.70	4.6				4.6									On-Grade 10' CDOT Type R Inlet (0.4 cfs bypass to DP 7a)
	7	A-7	0.23	0.90	5.0	0.21	5.10	1.1				1.1									On-Grade 5' CDOT Type R Inlet (0.1 cfs bypass to DP 7b)
	8	A-8	5.44	0.69	11.2	3.75	3.93	14.7				14.7									Proposed Amenitity Center - Assumed 75% Imperviousness
	7a	A-9	4.91	0.45	16.2	2.21	3.34	7.4				7.8									Sump 20' CDOT Type R Inlet (Receives 0.4 cfs upstream bypass)
	7b	A-10	1.02	0.45	7.3	0.46	4.59	2.1				2.2									Sump 5' CDOT Type R Inlet (Receives 0.1 cfs upstream bypass)
	8a	A-11	3.56	0.17	16.5	0.61	3.31	2.0	16.5	17.79	3.31	58.9									Total of Flows to Pond A
	9	B-1	3.81	0.39	14.3	1.49	3.54	5.3				5.3									Sump 15' CDOT Type R Inlet
	10a	B-2	4.62	0.44	14.7	2.03	3.50	7.1				7.1									On-Grade 10' CDOT Type R Inlet (1.6 cfs bypass to DP 10b)
	10b	B-3	4.15	0.45	9.0	1.87	4.27	8.0				9.6									Sump 20' CDOT Type R Inlet (Receives 1.6 cfs of upstream bypass)
	11	B-4	1.37	0.72	7.0	0.99	4.63	4.6				4.6									Sump 15' CDOT Type R Inlet
	12a	B-5	5.12	0.45	15.3	2.30	3.43	7.9				7.9									On-Grade 10' CDOT Type R Inlet (2.0 cfs bypass to DP 12b)
	14	B-6	2.28	0.45	13.7	1.03	3.61	3.7				3.7									On-Grade 10' CDOT Type R Inlet (0.1 cfs bypass to DP 12b)
	15	B-7	0.89	0.45	10.7	0.40	3.99	1.6				1.6									On-Grade 10' CDOT Type R Inlet (0.0 cfs bypass to DP 12b)
	12b	B-8	3.23	0.45	13.4	1.45	3.64	5.3				7.4									Sump 20' CDOT Type R Inlet (Receives 2.1 cfs of upstream bypass)
	13	B-9	2.42	0.45	14.5	1.09	3.52	3.8				3.8									Sump 10' CDOT Type R Inlet
	16	B-10	1.10	0.09	6.7	0.10	4.70	0.5	15.3	12.75	3.43	43.7									Total of flows to Pond B
	17b	C-1	4.12	0.45	13.0	1.85	3.69	6.8				6.8									On-Grade 15' CDOT Type R (0.1 cfs bypass to DP 17e)
	17a	C-2	2.71	0.45	10.8	1.22	3.99	4.9				4.9									On-Grade 15' CDOT Type R (1.7 cfs bypass to DP 17c)
	17c	C-4	2.47	0.45	13.0	1.11	3.69	4.1				5.8									Receives 1.7 cfs of Bypass from DP 17a On-Grade 15' CDOT Type R (0.0 cfs bypass to DP 17d)
	17d	C-5	3.09	0.45	11.0	1.39	3.96	5.5				5.5									Receives 0.0 cfs of Bypass from DP 17c On-Grade 15' CDOT Type R (0.0 cfs bypass to DP 17h)
	17e	C-6	2.10	0.45	16.2	0.95	3.34	3.2				3.3									Receives 0.1 cfs of Bypass from DP 17b On-Grade 15' CDOT Type R (0.0 cfs bypass to DP 17h)
	17f	C-8	5.11	0.45	12.7	2.30	3.73	8.6				8.6									On-Grade 15' CDOT Type R (0.6 cfs bypass to DP 17g)

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 5-Year

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
	17g	C-9a	3.50	0.45	14.2	1.58	3.54	5.6				6.2									Receives 0.6 cfs of Bypass from DP 17f On-Grade 15' CDOT Type R (0.0 cfs bypass to DP 17h)
	17h	C-9b	3.69	0.45	14.4	1.66	3.53	5.9				5.9									Sump 20' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	18a	C-7a	0.81	0.33	9.3	0.27	4.22	1.1				1.1									Drainage Swale/SW Chase - Flows to DP 18b
	18b	C-7b	5.91	0.45	12.6	2.66	3.74	9.9	12.6	2.93	3.74	11.0									On-Grade 15' CDOT Type R (1.6 cfs bypass to DP 18c)
	18c	C-10	3.47	0.45	16.5	1.56	3.31	5.2				6.9									Sump 15' CDOT Type R (Receives 1.6 cfs of upstream bypass)
	19	C-11	0.46	0.45	6.6	0.21	4.72	1.0				1.0									Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	20a	C-12	1.66	0.45	11.8	0.75	3.84	2.9				2.9									Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	20b	C-13	2.37	0.09	13.2	0.21	3.66	0.8	16.5	17.72	3.31	58.7									Total combined flows to Pond C
		C-3	1.56	0.13	9.8	0.20	4.13	0.8													Back of Lots 409-426 - Sheet Flows to MS 2
		C-14	1.53	0.09	11.7	0.14	3.86	0.5													Un-developed area - Sheet flows to MS 2
		C-15	0.16	0.14	8.7	0.02	4.31	0.1													Portion of Lot 444 - Sheet flows to MS 2
	22	D-1	3.48	0.45	14.9	1.57	3.47	5.4				5.4									On-Grade 10' CDOT Type R Inlet (0.7 cfs bypass to DP 24)
	23	D-2	0.87	0.45	8.1	0.39	4.42	1.7				1.7									On-Grade 10' CDOT Type R Inlet (0.0 cfs bypass to DP 24)
	24	D-3	3.69	0.45	13.5	1.66	3.63	6.0				6.7									Receives 0.7 cfs of upstream bypass Sump 15' CDOT Type R Inlet
	25	D-4	1.75	0.45	9.7	0.79	4.14	3.3				3.3									Sump 10' CDOT Type R Inlet
	25a	D-7b	0.88	0.45	8.9	0.40	4.28	1.7				1.7									Sheet flows to Channel and Conveyed to Pond D
	26	D-5	1.53	0.28	7.1	0.43	4.63	2.0	14.9	5.24	3.47	18.2									Total of flows to Pond D
		D-6	0.83	0.09	11.7	0.07	3.86	0.3													Un-developed area - Sheet flows to MS
		D-7a	0.27	0.14	8.9	0.04	4.28	0.2													Back of Lots 18-20 - Sheet Flows to MST

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 5-Year

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
	27	E-1	5.33	0.45	10.0	2.40	4.10	9.8				9.8									On-Grade 15' CDOT Type R Inlet (0.9 cfs bypass to DP 29)
	28	E-2	5.42	0.45	9.8	2.44	4.13	10.1				10.1									On-Grade 15' CDOT Type R Inlet (1.2 cfs bypass to DP 29)
	29	E-3	3.20	0.45	9.6	1.44	4.17	6.0				8.1									Receives 2.1 cfs of upstream bypass Sump 15' CDOT Type R Inlet
	30	E-4	6.28	0.45	17.9	2.83	3.18	9.0				9.0									Sump 20' CDOT Type R Inlet
	31	E-5	1.13	0.09	9.8	0.10	4.14	0.4	17.9	9.21	3.18	29.3									Total of flows to Pond E
		E-6	0.74	0.09	12.6	0.07	3.74	0.3													Un-developed area - Sheet flows to MS

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 100-Year

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
PROPOSED																					
For Existing Western Offsite Sub-basin analysis and Proposed Eastonville Road Basin Analysis, see Rational Calcs Included, from titled "Eastonville Road Preliminary Drainage Report", by HR Green, September 2023																					
	1	A-1	11.60	0.36	9.6	4.18	7.40	30.9				30.9									Institutional Tract Basin will have own water quality & detention pond
	2a	A-2a	4.42	0.59	8.8	2.61	7.64	19.9				19.9									On-Grade 15' CDOT Type R Inlet (7.0 cfs bypass to DP 2b)
	2b	A-2b	2.75	0.83	9.9	2.28	7.34	16.7				23.7									Sump 20' CDOT Type R Inlet (Receives 7.0 cfs upstream bypass)
	3	A-3	0.36	0.96	5.0	0.35	9.09	3.2				3.2									Sump 5' CDOT Type R Inlet
	4a	A-4a	6.31	0.59	15.2	3.72	6.13	22.8				22.8									On-Grade 15' CDOT Type R Inlet (9.0 cfs bypass to DP 4)
	4b 4	A-4b	3.99	0.59	13.5	2.35	6.46	15.2				15.2 16.1									On-Grade 15' CDOT Type R Inlet (7.1 cfs bypass to DP 4) Sump 15' CDOT Type R Inlet (Receives 16.1 cfs upstream bypass)
	5	A-5	0.35	0.96	5.0	0.34	9.09	3.1				3.1									Sump 5' CDOT Type R Inlet
	6	A-6	2.76	0.59	12.9	1.63	6.58	10.7				10.7									On-Grade 10' CDOT Type R Inlet (3.8 cfs bypass to DP 7a)
	7	A-7	0.23	0.96	5.0	0.22	9.09	2.0				2.0									On-Grade 5' CDOT Type R Inlet (0.4 cfs bypass to DP 7b)
	8	A-8	5.44	0.81	11.2	4.41	6.99	30.8				30.8									Proposed Amenitity Center - Assumed 75% Imperviousness
	7a	A-9	4.91	0.59	16.2	2.90	5.95	17.3				21.1									Sump 20' CDOT Type R Inlet (Receives 3.8 cfs upstream bypass)
	7b	A-10	1.02	0.59	7.3	0.60	8.17	4.9				5.3									Sump 5' CDOT Type R Inlet (Receives 0.4 cfs upstream bypass)
	8a	A-11	3.56	0.41	16.5	1.46	5.90	8.6	16.5	22.87	5.90	134.9									Total of Flows to Pond A
	9	B-1	3.81	0.52	14.3	1.98	6.30	12.5				12.5									Sump 15' CDOT Type R Inlet
	10a	B-2	4.62	0.58	14.7	2.68	6.22	16.7				16.7									On-Grade 10' CDOT Type R Inlet (8.3 cfs bypass to DP 10b)
	10b	B-3	4.15	0.59	9.0	2.45	7.61	18.6				26.9									Sump 20' CDOT Type R Inlet (Receives 8.3 cfs of upstream bypass)
	11	B-4	1.37	0.83	7.0	1.14	8.25	9.4				9.4									Sump 15' CDOT Type R Inlet
	12a	B-5	5.12	0.59	15.3	3.02	6.11	18.5				18.5									On-Grade 10' CDOT Type R Inlet (9.5 cfs bypass to DP 12b)
	14	B-6	2.28	0.59	13.7	1.35	6.42	8.7				8.7									On-Grade 10' CDOT Type R Inlet (2.5 cfs bypass to DP 12b)
	15	B-7	0.89	0.59	10.7	0.53	7.10	3.8				3.8									On-Grade 10' CDOT Type R Inlet (0.1 cfs bypass to DP 12b)
	12b	B-8	3.23	0.59	13.4	1.91	6.48	12.4				24.5									Sump 20' CDOT Type R Inlet (Receives 12.1 cfs of upstream bypass)
	13	B-9	2.42	0.59	14.5	1.43	6.26	9.0				9.0									Sump 10' CDOT Type R Inlet
	16	B-10	1.10	0.36	6.7	0.40	8.37	3.3	15.3	16.89	6.11	103.2									Total of flows to Pond B
	17b	C-1	4.12	0.59	13.0	2.43	6.57	16.0				16.0									On-Grade 15' CDOT Type R (4.3 cfs bypass to DP 17e)
	17a	C-2	2.71	0.59	10.8	1.60	7.10	11.4				11.4									On-Grade 15' CDOT Type R (11.2 cfs bypass to DP 17c)
	17c	C-4	2.47	0.59	13.0	1.46	6.57	9.6				20.8									Receives 11.2 cfs of Bypass from DP 17a On-Grade 15' CDOT Type R (7.4 cfs bypass to DP 17d)
	17d	C-5	3.09	0.59	11.0	1.82	7.04	12.8				20.2									Receives 7.4 cfs of Bypass from DP 17c On-Grade 15' CDOT Type R (7.0 cfs bypass to DP 17h)
	17e	C-6	2.10	0.59	16.2	1.24	5.94	7.4				11.7									Receives 4.3 cfs of Bypass from DP 17b On-Grade 15' CDOT Type R (2.0 cfs bypass to DP 17h)
	17f	C-8	5.11	0.59	12.7	3.01	6.63	20.0				20.0									On-Grade 15' CDOT Type R (6.9 cfs bypass to DP 17g)

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 100-Year

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C* A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C* A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
	17g	C-9a	3.50	0.59	14.2	2.07	6.31	13.1				20.0									Receives 6.9 cfs of Bypass from DP 17f On-Grade 15' CDOT Type R (6.8 cfs bypass to DP 17h)
	17h	C-9b	3.69	0.59	14.4	2.18	6.29	13.7				29.5									Sump 20' CDOT Type R (Receives 15.8 cfs of upstream bypass)
	18a	C-7a	0.81	0.52	9.3	0.42	7.51	3.2				3.2									Drainage Swale/SW Chase - Flows to DP 18b
	18b	C-7b	5.91	0.59	12.6	3.49	6.65	23.2	12.6	3.91	6.65	26.0									On-Grade 15' CDOT Type R (11.3 cfs bypass to DP 18c)
	18c	C-10	3.47	0.59	16.5	2.05	5.90	12.1				23.3									Sump 15' CDOT Type R (Receives 11.3 cfs of upstream bypass)
	19	C-11	0.46	0.59	6.6	0.27	8.41	2.3				2.3									Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	20a	C-12	1.66	0.59	11.8	0.98	6.83	6.7				6.7									Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	20b	C-13	2.37	0.36	13.2	0.85	6.52	5.5	16.5	23.87	5.90	140.8									Total combined flows to Pond C
		C-3	1.56	0.39	9.8	0.61	7.35	4.5													Back of Lots 409-426 - Sheet Flows to MS 2
		C-14	1.53	0.36	11.7	0.55	6.87	3.8													Un-developed area - Sheet flows to MS 2
		C-15	0.16	0.40	8.7	0.06	7.68	0.5													Portion of Lot 444 - Sheet flows to MS 2
	22	D-1	3.48	0.59	14.9	2.05	6.18	12.7				12.7									On-Grade 10' CDOT Type R Inlet (5.2 cfs bypass to DP 24)
	23	D-2	0.87	0.59	8.1	0.51	7.88	4.0				4.0									On-Grade 10' CDOT Type R Inlet (0.2 cfs bypass to DP 24)
	24	D-3	3.69	0.59	13.5	2.18	6.46	14.1				19.5									Receives 5.4 cfs of upstream bypass Sump 15' CDOT Type R Inlet
	25	D-4	1.75	0.59	9.7	1.03	7.37	7.6				7.6									Sump 10' CDOT Type R Inlet
	25a	D-7b	0.88	0.59	8.9	0.52	7.62	4.0				4.0									Sheet flows to Channel and Conveyed to Pond D
	26	D-5	1.53	0.48	7.1	0.73	8.24	6.0	14.9	7.02	6.18	43.4									Total of flows to Pond D
		D-6	0.83	0.36	11.7	0.30	6.87	2.1													Un-developed area - Sheet flows to MS
		D-7a	0.27	0.38	8.9	0.10	7.62	0.8													Back of Lots 18-20 - Sheet Flows to MST

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 100-Year

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 9/20/23

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C* A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C* A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
	27	E-1	5.33	0.59	10.0	3.14	7.30	22.9				22.9									On-Grade 15' CDOT Type R Inlet (8.8 cfs bypass to DP 29)
	28	E-2	5.42	0.59	9.8	3.20	7.36	23.6				23.6									On-Grade 15' CDOT Type R Inlet (9.3 cfs bypass to DP 29)
	29	E-3	3.20	0.59	9.6	1.89	7.43	14.0				32.1									Receives 18.1 cfs of upstream bypass Sump 15' CDOT Type R Inlet
	30	E-4	6.28	0.59	17.9	3.71	5.66	21.0				21.0									Sump 20' CDOT Type R Inlet
	31	E-5	1.13	0.36	9.8	0.41	7.37	3.0	17.9	12.35	5.66	69.9									Total of flows to Pond E
		E-6	0.74	0.36	12.6	0.27	6.66	1.8													Un-developed area - Sheet flows to MS

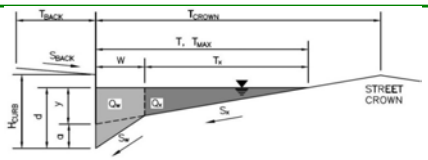
APPENDIX C

Hydraulic Computations

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-2a (DP2a)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

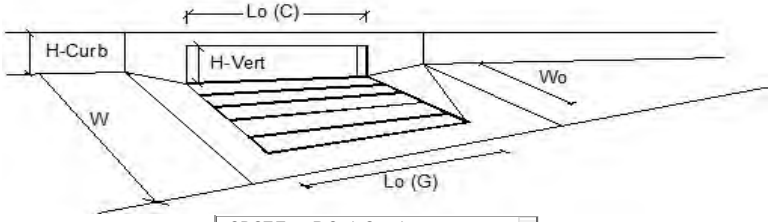
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**12.5**	**42.1**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	8.5	19.9	cfs
Water Spread Width	T =	13.2	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.8	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.5	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.183	0.130	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	6.6	16.4	cfs
Discharge within the Gutter Section W	Q_w =	1.5	2.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.23	0.32	sq ft
Velocity within the Gutter Section W	V_W =	6.3	7.8	fps
Water Depth for Design Condition	d_{LOCAL} =	6.8	8.0	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

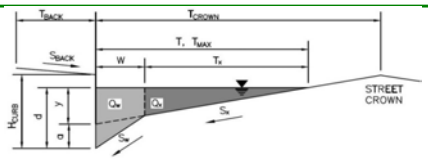
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.087	0.068	ft/ft
Required Length L_T to Have 100% Interception	L_T =	18.41	31.80	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	7.7	12.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**7.7**	**12.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.8**	**7.1**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**7.7**	**12.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.8**	**7.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**90**	**64**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-2b (DP2b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

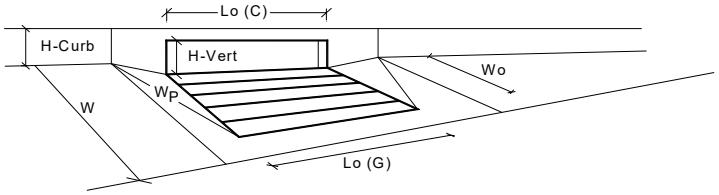
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	4	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	20.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	**Warning 1**	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.33	1.33	
Clogging Factor for Multiple Units		Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	10.0	35.4	cfs
Interception with Clogging		Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	33.6	43.9	cfs
Interception with Clogging		Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	17.0	36.7	cfs
Interception with Clogging		Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	9.2	23.8	cfs

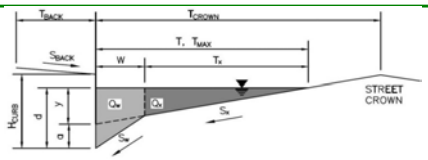
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-3 (DP3)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

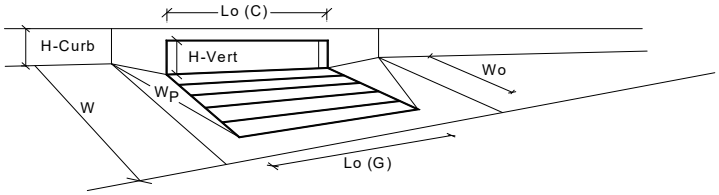
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



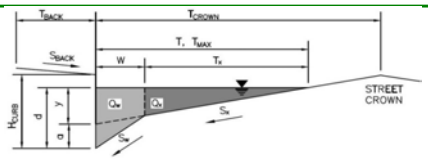
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	☑ Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.7	10.1	cfs
Interception with Clogging	Q_{wa} =	2.4	9.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.4	11.0	cfs
Interception with Clogging	Q_{oa} =	7.6	9.9	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	4.4	9.8	cfs
Interception with Clogging	Q_{ma} =	4.0	8.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**2.4**	**8.8**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.9	25.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.3	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.20	0.47	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.56	0.98	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.4**	**8.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.6	3.0	cfs

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-4a (DP4a)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

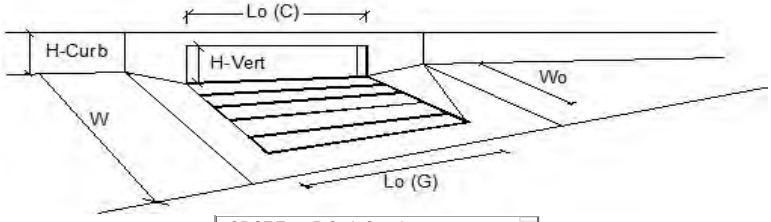
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.5**	**42.1**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



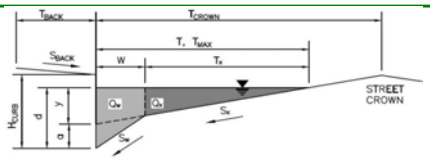
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	9.8	22.8	cfs
Water Spread Width	T =	14.2	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.0	5.3	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.9	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.169	0.122	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	8.1	20.0	cfs
Discharge within the Gutter Section W	Q_w =	1.7	2.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.25	0.34	sq ft
Velocity within the Gutter Section W	V_W =	6.6	8.2	fps
Water Depth for Design Condition	d_{LOCAL} =	7.0	8.3	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.082	0.064	ft/ft
Required Length L_T to Have 100% Interception	L_T =	20.84	35.80	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	8.8	14.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	13.03	13.03	ft
Actual Interception Capacity	**Q_a =**	**8.6**	**13.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.2**	**9.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.6**	**13.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.2**	**9.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**88**	**61**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-4b (DP4b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

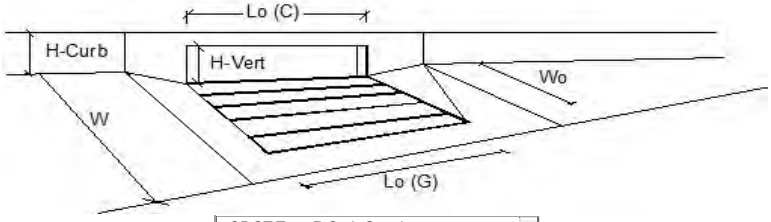
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**12.5**	**42.1**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	6.5	15.2	cfs
Water Spread Width	T =	12.1	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	4.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.2	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.200	0.142	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	5.2	13.1	cfs
Discharge within the Gutter Section W	Q_w =	1.3	2.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.29	sq ft
Velocity within the Gutter Section W	V_W =	6.0	7.4	fps
Water Depth for Design Condition	d_{LOCAL} =	6.5	7.7	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.093	0.072	ft/ft
Required Length L_T to Have 100% Interception	L_T =	15.94	27.68	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	5.4	8.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**5.2**	**8.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.3**	**7.1**	**cfs**

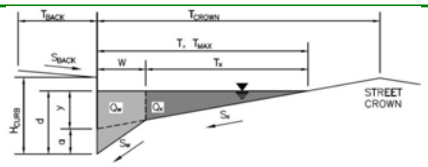
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.2**	**8.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.3**	**7.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**80**	**53**	**%**

MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **Grandview Reserve**
Inlet ID: **DP 4**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

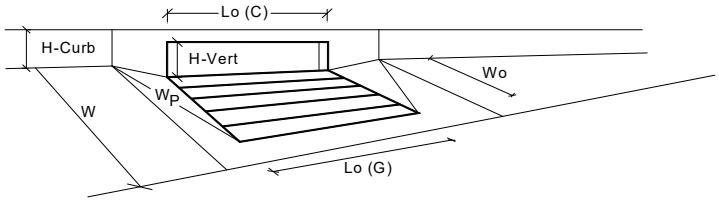
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

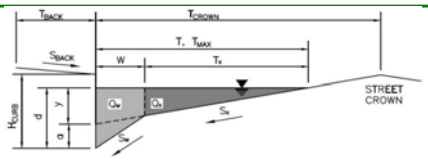


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.9	19.2	cfs
Interception with Clogging	Q_{wa} =	3.8	18.4	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	25.2	32.9	cfs
Interception with Clogging	Q_{oa} =	24.1	31.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	9.2	23.4	cfs
Interception with Clogging	Q_{ma} =	8.8	22.4	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.8**	**18.4**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.9	25.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.3	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.20	0.47	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.8**	**18.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.5	16.1	cfs

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-5 (DP5)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

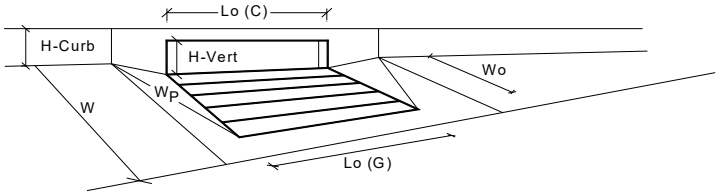
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



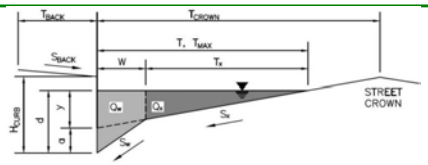
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	☑ Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.3	5.6	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.6	5.1	cfs
Interception with Clogging	Q_{wa} =	2.3	4.6	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.3	9.4	cfs
Interception with Clogging	Q_{oa} =	7.5	8.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	4.3	6.4	cfs
Interception with Clogging	Q_{ma} =	3.9	5.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**2.3**	**4.6**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.5	17.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.19	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.55	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.3**	**4.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.6	3.1	cfs

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-6 (DP6)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.3	1.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.5**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	0.8	0.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.3	0.3	

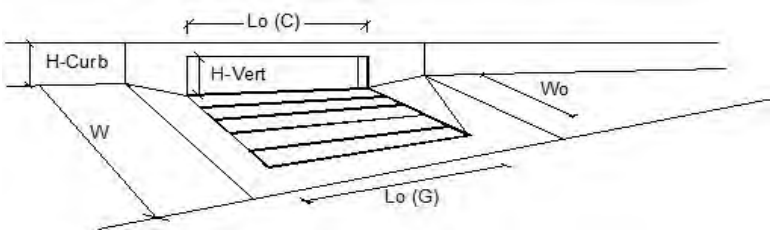
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	16.7	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	15.8	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.142	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	8.2	39.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.2	34.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.4	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.5	38.2	cfs
Average Flow Velocity Within the Gutter Section	V =	0.8	1.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.5**	**38.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.63	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.17	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.5**	**38.2**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

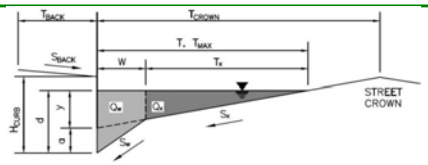


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	4.6	10.7	cfs
Water Spread Width	T =	12.6	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.7	4.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.4	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.191	0.136	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	3.7	9.2	cfs
Discharge within the Gutter Section W	Q_w =	0.9	1.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.30	sq ft
Velocity within the Gutter Section W	V_W =	3.9	4.8	fps
Water Depth for Design Condition	d_{LOCAL} =	6.7	7.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.090	0.070	ft/ft
Required Length L_T to Have 100% Interception	L_T =	12.88	22.25	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	4.3	7.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**4.2**	**6.9**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.4**	**3.8**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.2**	**6.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.4**	**3.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**92**	**64**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-7 (DP7)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	1.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	58.7	58.7	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	34.8	34.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**93.5**	**93.5**	**cfs**
Flow Velocity within the Gutter Section	V =	48.0	48.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	21.4	21.4	

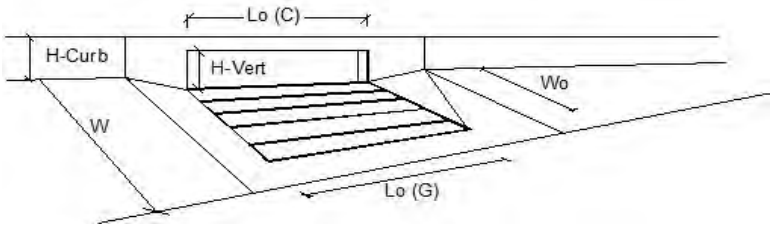
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	23.1	239.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	23.1	217.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	22.8	70.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	7.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	45.9	295.0	cfs
Average Flow Velocity Within the Gutter Section	V =	40.6	63.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	14.8	40.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	0.13	0.04	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.2**	**10.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	2.43	2.89	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.2**	**10.8**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



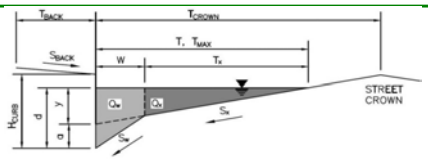
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.1	2.0	cfs
Water Spread Width	T =	1.3	1.6	ft
Water Depth at Flowline (outside of local depression)	d =	1.3	1.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.012	1.000	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.0	cfs
Discharge within the Gutter Section W	Q_w =	1.1	2.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.05	0.10	sq ft
Velocity within the Gutter Section W	V_W =	22.0	19.2	fps
Water Depth for Design Condition	d_{LOCAL} =	4.3	4.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.208	0.208	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.50	7.47	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.1	1.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	**1.0**	**1.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**0.4**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.0**	**1.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**95**	**81**	**%**

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

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

Project: **Grandview Reserve**

Inlet ID: **Basin A-9(DP7a)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

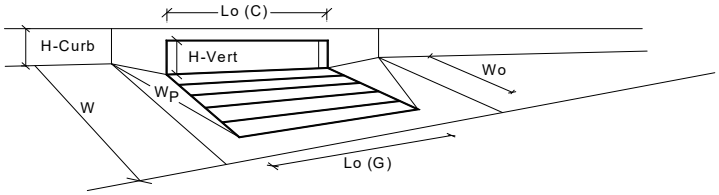
MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	4	4	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	Warning 1	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.33	1.33	
Clogging Factor for Multiple Units		Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	10.0	35.4	cfs
Interception with Clogging		Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	33.6	43.9	cfs
Interception with Clogging		Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	17.0	36.7	cfs
Interception with Clogging		Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	7.8	21.1	cfs

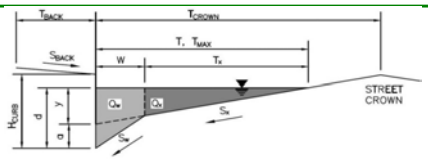
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-10(DP7b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

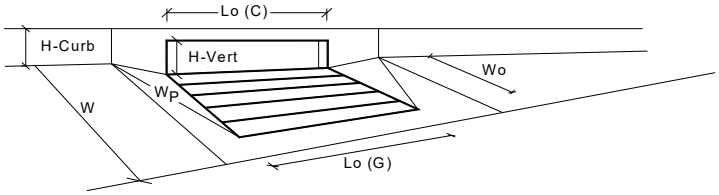
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.3	8.0	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	**Warning 1**	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.00	1.00	
Clogging Factor for Multiple Units		Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	3.6	10.8	cfs
Interception with Clogging		Q_{wa} =	3.2	9.7	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	8.3	11.2	cfs
Interception with Clogging		Q_{oa} =	7.5	10.1	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	5.1	10.2	cfs
Interception with Clogging		Q_{ma} =	4.6	9.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**3.2**	**9.2**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.2	30.7	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.5	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.60	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.55	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.2**	**9.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.2	5.3	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:

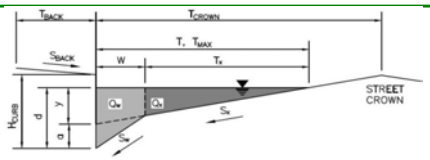
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**

Inlet ID: **Basin B-1 (DP 9)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

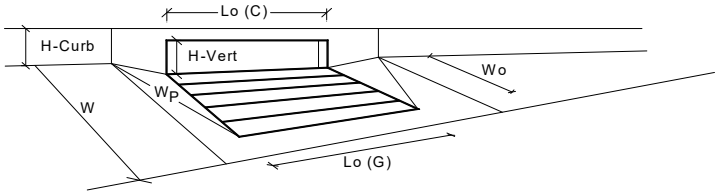
MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	**Warning 1**	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.31	1.31	
Clogging Factor for Multiple Units		Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	6.3	22.5	cfs
Interception with Clogging		Q_{wa} =	6.1	21.5	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	25.2	32.9	cfs
Interception with Clogging		Q_{oa} =	24.1	31.5	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	11.8	25.3	cfs
Interception with Clogging		Q_{ma} =	11.2	24.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**6.1**	**21.5**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**6.1**	**21.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	5.3	12.5	cfs

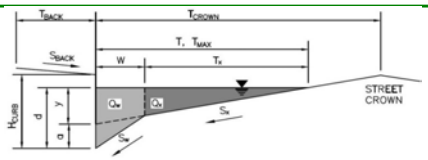
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin B-2 (DP 10a)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

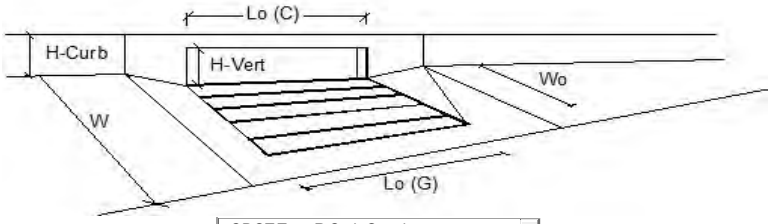
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**11.2**	**45.0**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

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

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	7.1	16.7	cfs
Water Spread Width	T =	13.1	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.8	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.5	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.184	0.131	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	5.8	14.5	cfs
Discharge within the Gutter Section W	Q_w =	1.3	2.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.23	0.32	sq ft
Velocity within the Gutter Section W	V_W =	5.7	6.9	fps
Water Depth for Design Condition	d_{LOCAL} =	6.8	8.0	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

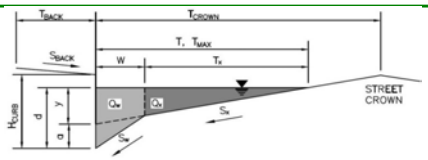
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.087	0.068	ft/ft
Required Length L_T to Have 100% Interception	L_T =	16.94	29.43	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	5.7	8.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**5.5**	**8.4**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.6**	**8.3**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.5**	**8.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.6**	**8.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**77**	**50**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin B-3 (DP 10b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

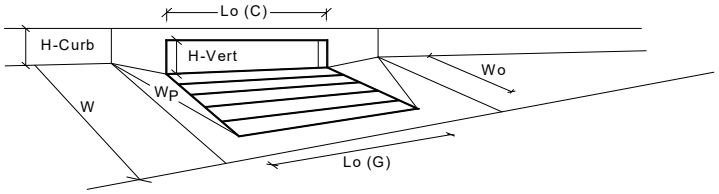
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

	Design Information (Input)		MINOR	MAJOR	
	Type of Inlet	Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	☑ Override Depths
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
	Grate Information		MINOR	MAJOR	
	Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
	Width of a Unit Grate	W_o =	N/A	N/A	feet
	Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
	Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
	Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
	Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
	Curb Opening Information		MINOR	MAJOR	
	Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
	Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
	Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
	Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1	Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
	Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
	Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
	Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
	Grate Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
	Clogging Factor for Multiple Units	Clog =	N/A	N/A	
	Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
	Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
	Grate Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
	Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
	Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
	Clogging Factor for Multiple Units	Clog =	0.03	0.03	
	Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
	Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
	Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
	Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
	Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
	Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
	Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
	Resultant Street Conditions		MINOR	MAJOR	
	Total Inlet Length	L =	20.00	20.00	feet
	Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
	Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
	Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
	Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
	Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
	Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
	Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
	Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**34.3**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.6	26.9	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

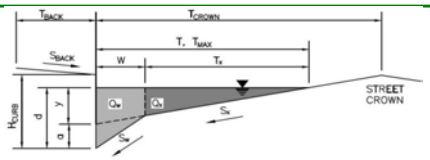
Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**

Inlet ID: **Basin B-4 (DP 11)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	11.5	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.76	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.27	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	9.5	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.511	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	27.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.7	25.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.216	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

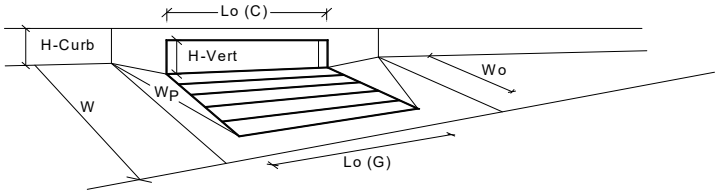
MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



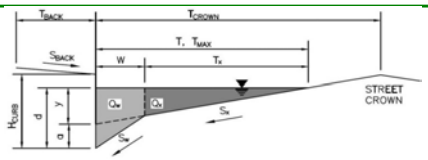
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	☐ Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.3	5.6	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	5.1	11.6	cfs
Interception with Clogging	Q_{wa} =	4.9	11.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	24.9	28.3	cfs
Interception with Clogging	Q_{oa} =	23.8	27.1	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	10.5	16.9	cfs
Interception with Clogging	Q_{ma} =	10.0	16.1	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**4.9**	**11.1**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.5	17.0	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.19	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.40	0.53	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.66	0.76	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**4.9**	**11.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.6	9.4	cfs

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin B-5 (DP 12a)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

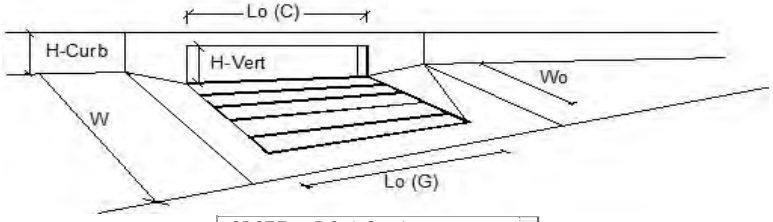
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



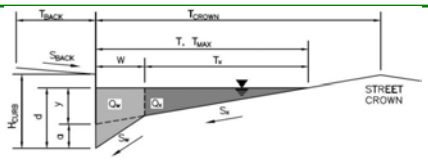
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	7.9	18.5	cfs
Water Spread Width	T =	13.6	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.7	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.177	0.126	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	6.5	16.2	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.33	sq ft
Velocity within the Gutter Section W	V_W =	5.8	7.1	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.084	0.066	ft/ft
Required Length L_T to Have 100% Interception	L_T =	18.17	31.40	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	6.0	9.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**5.9**	**9.0**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**2.0**	**9.5**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.9**	**9.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**2.0**	**9.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**75**	**49**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin B-6 (DP 14)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

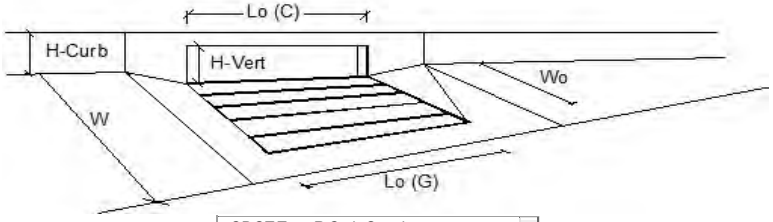
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	3.7	8.7	cfs
Water Spread Width	T =	10.2	14.1	ft
Water Depth at Flowline (outside of local depression)	d =	3.1	4.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.240	0.170	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	2.8	7.2	cfs
Discharge within the Gutter Section W	Q_w =	0.9	1.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.18	0.25	sq ft
Velocity within the Gutter Section W	V_W =	4.8	5.9	fps
Water Depth for Design Condition	d_{LOCAL} =	6.1	7.0	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

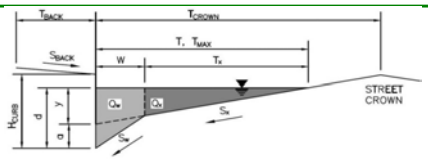
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.107	0.082	ft/ft
Required Length L_T to Have 100% Interception	L_T =	11.03	19.34	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	3.6	6.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**3.6**	**6.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**2.5**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.6**	**6.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**2.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**71**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin B-7 (DP 15)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

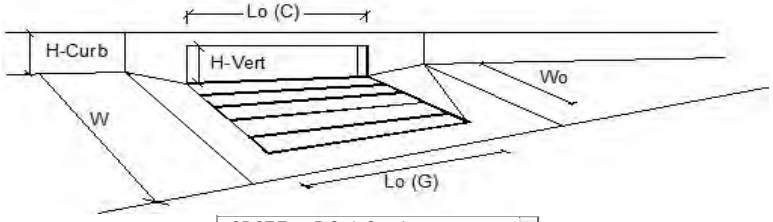
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**11.2**	**45.0**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



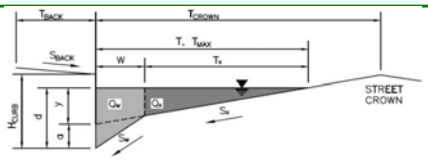
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.6	3.8	cfs
Water Spread Width	T =	7.3	10.3	ft
Water Depth at Flowline (outside of local depression)	d =	2.4	3.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.339	0.238	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.1	2.9	cfs
Discharge within the Gutter Section W	Q_w =	0.5	0.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.14	0.19	sq ft
Velocity within the Gutter Section W	V_W =	4.0	4.9	fps
Water Depth for Design Condition	d_{LOCAL} =	5.4	6.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.143	0.106	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.31	11.23	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.31	10.00	ft
Interception Capacity	Q_i =	1.6	3.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**1.6**	**3.7**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.6**	**3.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**97**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin B-8 (DP 12b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

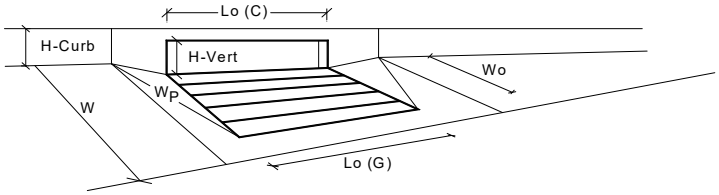
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

	Design Information (Input)		MINOR	MAJOR	
	Type of Inlet	Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	☑ Override Depths
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
	Grate Information		MINOR	MAJOR	
	Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
	Width of a Unit Grate	W_o =	N/A	N/A	feet
	Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
	Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
	Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
	Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
	Curb Opening Information		MINOR	MAJOR	
	Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
	Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
	Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
	Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1	Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
	Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
	Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
	Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
	Grate Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
	Clogging Factor for Multiple Units	Clog =	N/A	N/A	
	Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
	Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
	Grate Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
	Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
	Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
	Clogging Factor for Multiple Units	Clog =	0.03	0.03	
	Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
	Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
	Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
	Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
	Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
	Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
	Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
	Resultant Street Conditions		MINOR	MAJOR	
	Total Inlet Length	L =	20.00	20.00	feet
	Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
	Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
	Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
	Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
	Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
	Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
	Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
	Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**34.3**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	7.4	24.5	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

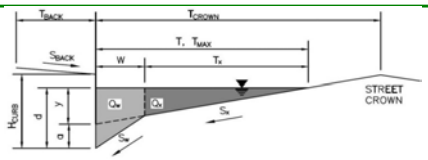
Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**

Inlet ID: **Basin B-9 (DP 13)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

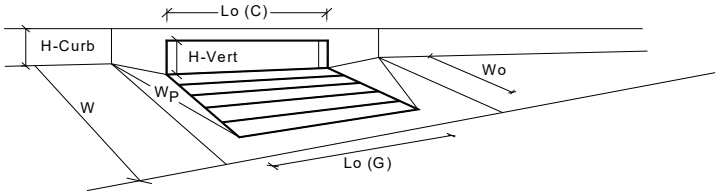
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

	Design Information (Input)		MINOR	MAJOR	
	Type of Inlet	Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	☑ Override Depths
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
	Grate Information		MINOR	MAJOR	
	Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
	Width of a Unit Grate	W_o =	N/A	N/A	feet
	Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
	Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
	Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
	Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
	Curb Opening Information		MINOR	MAJOR	
	Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
	Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
	Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
	Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1	Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
	Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
	Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
	Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
	Grate Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
	Clogging Factor for Multiple Units	Clog =	N/A	N/A	
	Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
	Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
	Grate Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
	Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
	Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
	Clogging Factor for Multiple Units	Clog =	0.06	0.06	
	Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	6.1	20.2	cfs
	Interception with Clogging	Q_{wa} =	5.7	18.9	cfs
	Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	16.8	21.9	cfs
	Interception with Clogging	Q_{oa} =	15.7	20.6	cfs
	Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	9.4	19.6	cfs
	Interception with Clogging	Q_{ma} =	8.8	18.3	cfs
	Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**5.7**	**18.3**	**cfs**
	Resultant Street Conditions		MINOR	MAJOR	
	Total Inlet Length	L =	10.00	10.00	feet
	Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
	Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
	Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
	Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
	Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
	Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
	Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.82	1.00	
	Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.7**	**18.3**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.8	9.0	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

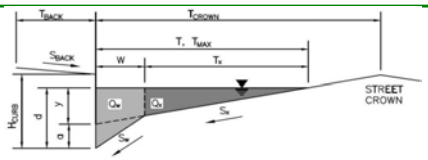
Warning 1 Note:

This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-1 (DP 17b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

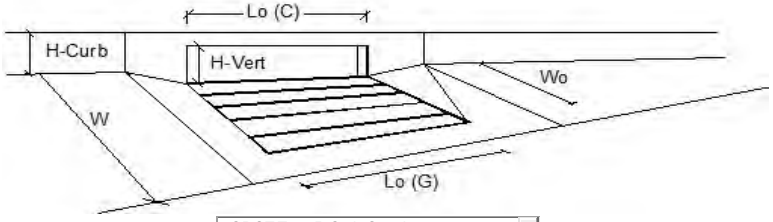
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**12.5**	**42.1**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	6.8	16.0	cfs
Water Spread Width	T =	12.3	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	4.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.3	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.196	0.139	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	5.5	13.8	cfs
Discharge within the Gutter Section W	Q_w =	1.3	2.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.30	sq ft
Velocity within the Gutter Section W	V_W =	6.1	7.5	fps
Water Depth for Design Condition	d_{LOCAL} =	6.6	7.7	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

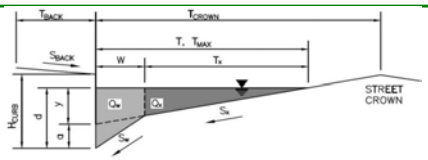
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.091	0.071	ft/ft
Required Length L_T to Have 100% Interception	L_T =	16.42	28.60	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	6.7	11.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**6.7**	**11.7**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**4.3**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.7**	**11.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**4.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**73**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-2 (DP 17a)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X TH}$	$Q_{X TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

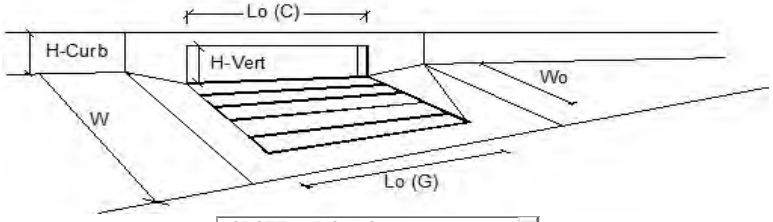
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**12.5**	**42.1**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



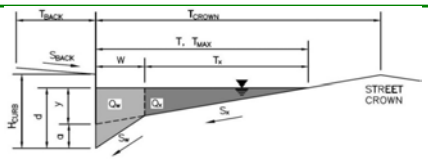
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	11.3	26.3	cfs
Water Spread Width	T =	15.0	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.2	5.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	1.1	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.160	0.116	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	9.5	23.3	cfs
Discharge within the Gutter Section W	Q_w =	1.8	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.26	0.36	sq ft
Velocity within the Gutter Section W	V_W =	6.9	8.5	fps
Water Depth for Design Condition	d_{LOCAL} =	7.2	8.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.078	0.062	ft/ft
Required Length L_T to Have 100% Interception	L_T =	22.86	39.13	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	9.6	15.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**9.6**	**15.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.7**	**11.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.6**	**15.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.7**	**11.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**85**	**57**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-4 (DP 17c)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

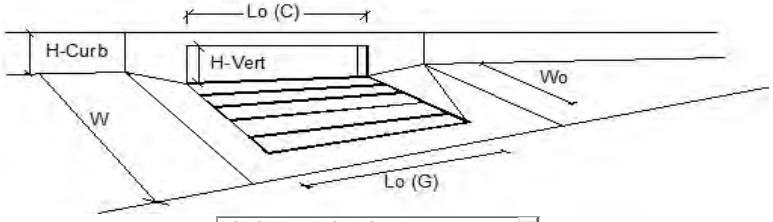
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	5.8	20.8	cfs
Water Spread Width	T =	12.1	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	5.4	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.9	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.200	0.121	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	4.7	18.3	cfs
Discharge within the Gutter Section W	Q_w =	1.2	2.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.34	sq ft
Velocity within the Gutter Section W	V_W =	5.4	7.3	fps
Water Depth for Design Condition	d_{LOCAL} =	6.5	8.4	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

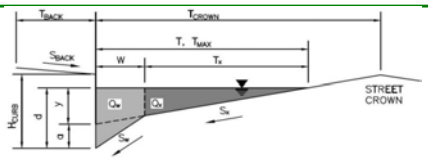
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.093	0.064	ft/ft
Required Length L_T to Have 100% Interception	L_T =	14.91	33.79	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	14.91	15.00	ft
Interception Capacity	Q_i =	5.8	13.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**5.8**	**13.4**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**7.4**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.8**	**13.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**7.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**64**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-5 (DP 17d)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.9	8.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.6	1.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.5**	**10.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.0	1.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

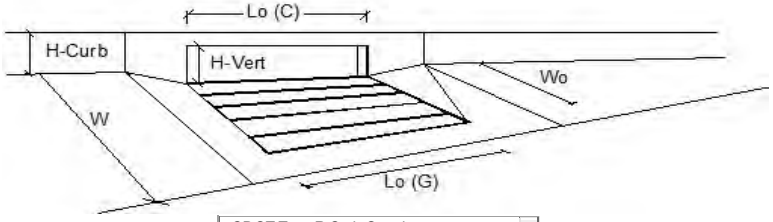
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	8.2	48.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.2	41.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.5	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.7	46.8	cfs
Average Flow Velocity Within the Gutter Section	V =	0.9	1.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.7**	**46.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**9.7**	**46.8**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



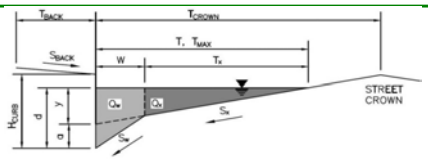
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	5.5	20.2	cfs
Water Spread Width	T =	12.5	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	5.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	1.1	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.193	0.116	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	4.4	17.9	cfs
Discharge within the Gutter Section W	Q_w =	1.1	2.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.36	sq ft
Velocity within the Gutter Section W	V_W =	4.8	6.5	fps
Water Depth for Design Condition	d_{LOCAL} =	6.6	8.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.090	0.062	ft/ft
Required Length L_T to Have 100% Interception	L_T =	14.40	33.15	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	14.40	15.00	ft
Interception Capacity	Q_i =	5.5	13.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**5.5**	**13.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**7.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.5**	**13.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**7.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**65**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-6 (DP 17e)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.9	8.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.6	1.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.5**	**10.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.0	1.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	8.2	48.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.2	41.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.5	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.7	46.8	cfs
Average Flow Velocity Within the Gutter Section	V =	0.9	1.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.7**	**46.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.22	inches

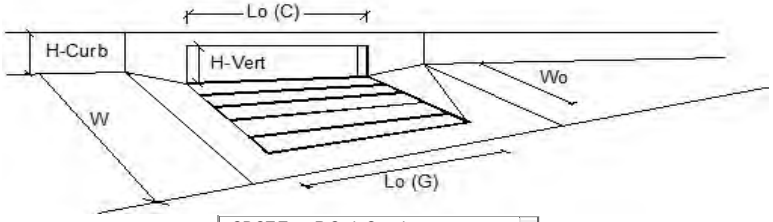
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**9.7**	**46.8**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	3.3	11.7	cfs
Water Spread Width	T =	10.3	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.1	4.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.2	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.237	0.142	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	2.5	10.1	cfs
Discharge within the Gutter Section W	Q_w =	0.8	1.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.19	0.29	sq ft
Velocity within the Gutter Section W	V_W =	4.2	5.7	fps
Water Depth for Design Condition	d_{LOCAL} =	6.1	7.6	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

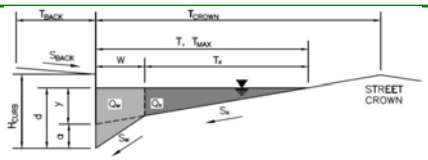
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.106	0.072	ft/ft
Required Length L_T to Have 100% Interception	L_T =	10.30	23.52	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.30	15.00	ft
Interception Capacity	Q_i =	3.3	9.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**3.3**	**9.7**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**2.0**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.3**	**9.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**83**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-8 (DP 17f)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.8	10.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.9	1.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.7**	**12.7**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

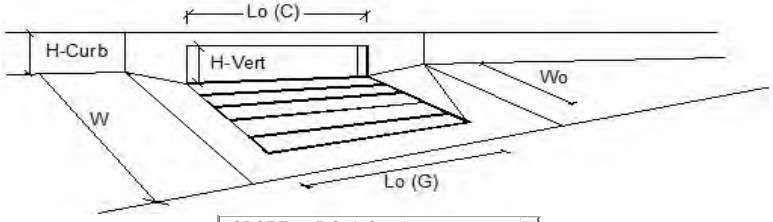
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.0	58.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.0	50.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.8	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.8	56.6	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.8**	**43.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.49	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.8**	**43.8**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	8.6	20.0	cfs
Water Spread Width	T =	13.8	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.7	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.174	0.125	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	7.1	17.5	cfs
Discharge within the Gutter Section W	Q_w =	1.5	2.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.33	sq ft
Velocity within the Gutter Section W	V_W =	6.1	7.5	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.2	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

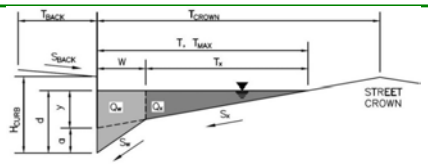
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.083	0.065	ft/ft
Required Length L_T to Have 100% Interception	L_T =	19.17	32.97	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	8.0	13.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**8.0**	**13.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.6**	**6.9**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.0**	**13.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.6**	**6.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**66**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-9a (DP17g)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

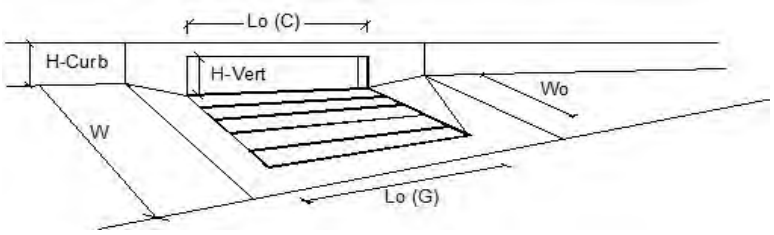
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

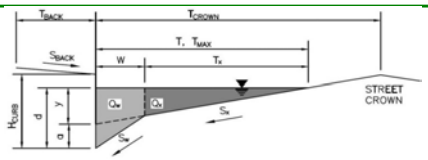


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	6.2	20.0	cfs
Water Spread Width	T =	12.4	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	5.3	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.8	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.195	0.123	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	5.0	17.5	cfs
Discharge within the Gutter Section W	Q_w =	1.2	2.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.34	sq ft
Velocity within the Gutter Section W	V_W =	5.5	7.3	fps
Water Depth for Design Condition	d_{LOCAL} =	6.6	8.3	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.091	0.065	ft/ft
Required Length L_T to Have 100% Interception	L_T =	15.52	32.93	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	6.2	13.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**6.2**	**13.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**6.8**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.2**	**13.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**6.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**66**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-9b (DP17h)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.018	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.46	3.46	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.65	0.65	inches
Water Depth at Gutter Flowline	d =	4.10	4.10	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.151	0.151	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

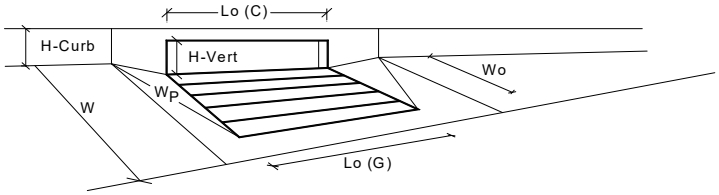
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.2	32.6	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	16.4	31.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.140	0.071	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	4	4	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	**Warning 1**	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.33	1.33	
Clogging Factor for Multiple Units		Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	10.0	35.4	cfs
Interception with Clogging		Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	33.6	43.9	cfs
Interception with Clogging		Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	17.0	36.7	cfs
Interception with Clogging		Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	17.2	32.6	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.3	3.6	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	5.9	29.5	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

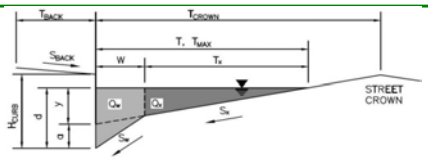
Warning 1 Note:

This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-7b (DP 18b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.8	10.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.9	1.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.7**	**12.7**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

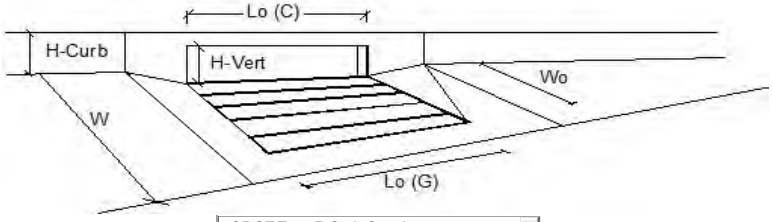
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.0	58.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.0	50.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.8	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.8	56.6	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.8**	**43.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.49	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.8**	**43.8**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	11.0	26.4	cfs
Water Spread Width	T =	15.2	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.3	5.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	1.3	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.158	0.113	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	9.3	23.4	cfs
Discharge within the Gutter Section W	Q_w =	1.7	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.27	0.37	sq ft
Velocity within the Gutter Section W	V_W =	6.5	8.1	fps
Water Depth for Design Condition	d_{LOCAL} =	7.3	8.8	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

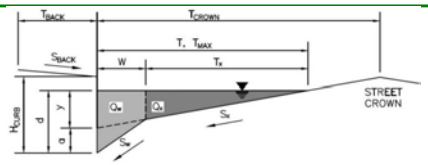
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.077	0.061	ft/ft
Required Length L_T to Have 100% Interception	L_T =	22.49	39.20	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	9.5	15.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**9.4**	**15.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.6**	**11.3**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.4**	**15.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.6**	**11.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**85**	**57**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-7b (DP 18b)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.8	10.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.9	1.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.7**	**12.7**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

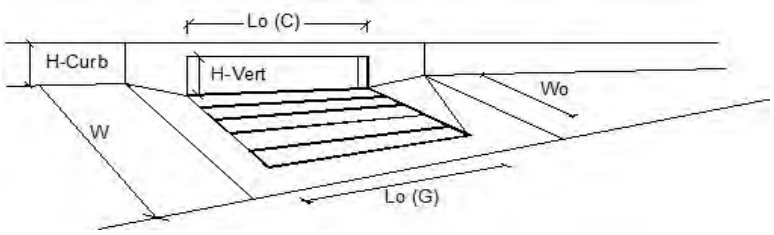
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.0	58.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.0	50.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.8	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.8	56.6	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.8**	**43.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.49	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.8**	**43.8**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

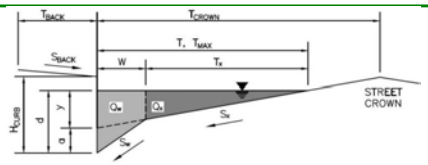


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	11.0	26.4	cfs
Water Spread Width	T =	15.2	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.3	5.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	1.3	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.158	0.113	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	9.3	23.4	cfs
Discharge within the Gutter Section W	Q_w =	1.7	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.27	0.37	sq ft
Velocity within the Gutter Section W	V_W =	6.5	8.1	fps
Water Depth for Design Condition	d_{LOCAL} =	7.3	8.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.077	0.061	ft/ft
Required Length L_T to Have 100% Interception	L_T =	22.49	39.20	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	9.5	15.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**9.4**	**15.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.6**	**11.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.4**	**15.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.6**	**11.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**85**	**57**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-10 (DP 18c)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

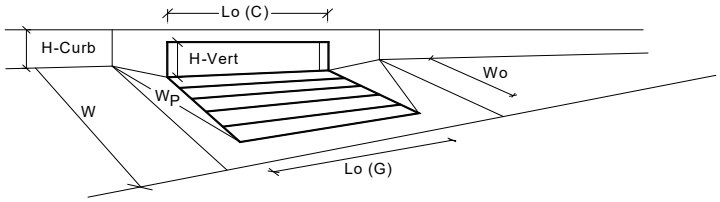
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



			MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening				
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	3	3	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.31	1.31	
Clogging Factor for Multiple Units		Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	7.5	26.6	cfs
Interception with Clogging		Q_{wa} =	7.2	25.4	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	25.2	32.9	cfs
Interception with Clogging		Q_{oa} =	24.1	31.5	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	12.8	27.5	cfs
Interception with Clogging		Q_{ma} =	12.2	26.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**7.2**	**25.4**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**7.2**	**25.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	6.8	23.4	cfs

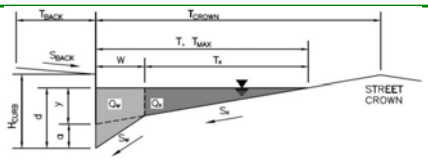
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-11 (DP 19)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

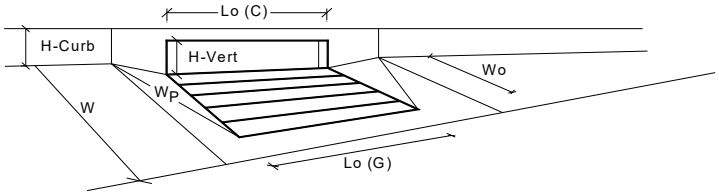
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



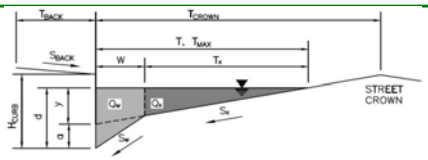
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	☑ Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.7	10.1	cfs
Interception with Clogging	Q_{wa} =	2.4	9.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.4	11.0	cfs
Interception with Clogging	Q_{oa} =	7.6	9.9	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	4.4	9.8	cfs
Interception with Clogging	Q_{ma} =	4.0	8.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**2.4**	**8.8**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.9	25.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.3	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.20	0.47	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.56	0.98	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.4**	**8.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	2.3	cfs

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-12 (DP 20)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

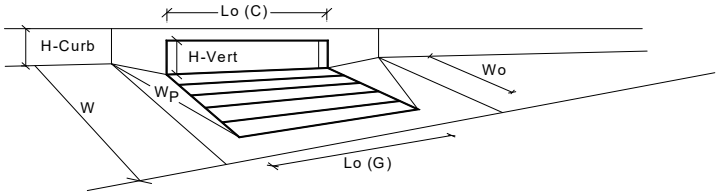
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	**Warning 1**	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.00	1.00	
Clogging Factor for Multiple Units		Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	3.7	10.1	cfs
Interception with Clogging		Q_{wa} =	3.4	9.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	8.4	11.0	cfs
Interception with Clogging		Q_{oa} =	7.6	9.9	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	5.2	9.8	cfs
Interception with Clogging		Q_{ma} =	4.7	8.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**3.4**	**8.8**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.56	0.98	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.4**	**8.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.9	6.7	cfs

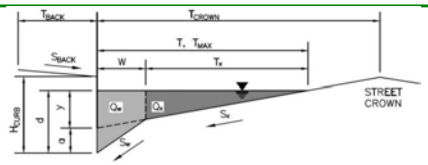
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin D-1 (DP 22)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.3	1.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.5**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	0.8	0.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.3	0.3	

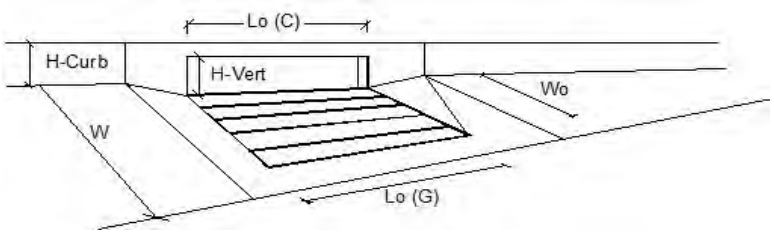
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	6.7	39.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	6.7	34.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.9	38.2	cfs
Average Flow Velocity Within the Gutter Section	V =	0.8	1.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.9**	**38.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**7.9**	**38.2**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

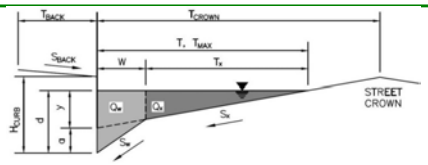


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	5.4	12.7	cfs
Water Spread Width	T =	13.4	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.6	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.179	0.128	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	4.4	11.1	cfs
Discharge within the Gutter Section W	Q_w =	1.0	1.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.32	sq ft
Velocity within the Gutter Section W	V_W =	4.1	5.0	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.085	0.066	ft/ft
Required Length L_T to Have 100% Interception	L_T =	14.30	24.81	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	4.8	7.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**4.7**	**7.5**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.7**	**5.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.7**	**7.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.7**	**5.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**87**	**59**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin D-2 (DP 23)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.3	1.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.5**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	0.8	0.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.3	0.3	

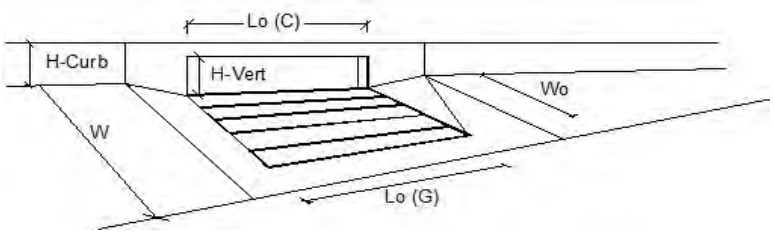
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	6.7	39.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	6.7	34.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.9	38.2	cfs
Average Flow Velocity Within the Gutter Section	V =	0.8	1.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.9**	**38.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**7.9**	**38.2**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

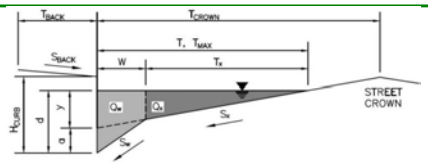


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.7	4.0	cfs
Water Spread Width	T =	8.6	12.0	ft
Water Depth at Flowline (outside of local depression)	d =	2.7	3.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.287	0.202	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.2	3.2	cfs
Discharge within the Gutter Section W	Q_w =	0.5	0.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.16	0.21	sq ft
Velocity within the Gutter Section W	V_W =	3.1	3.8	fps
Water Depth for Design Condition	d_{LOCAL} =	5.7	6.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.124	0.094	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.67	11.75	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.67	10.00	ft
Interception Capacity	Q_i =	1.7	3.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**1.7**	**3.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.7**	**3.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**96**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin D-3 (DP 24)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

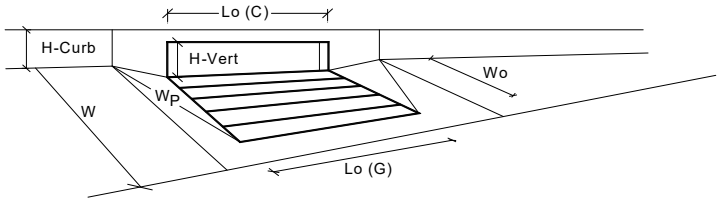
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	3	3	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.31	1.31	
Clogging Factor for Multiple Units		Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	7.5	26.6	cfs
Interception with Clogging		Q_{wa} =	7.2	25.4	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	25.2	32.9	cfs
Interception with Clogging		Q_{oa} =	24.1	31.5	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	12.8	27.5	cfs
Interception with Clogging		Q_{ma} =	12.2	26.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**7.2**	**25.4**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**7.2**	**25.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	6.6	19.2	cfs

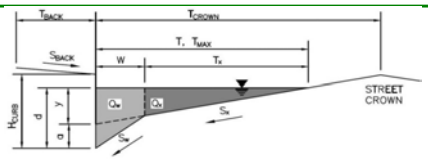
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin D-4 (DP 25)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

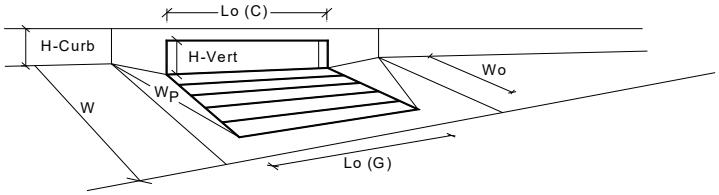
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	**Warning 1**	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.25	1.25	
Clogging Factor for Multiple Units		Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	6.1	20.2	cfs
Interception with Clogging		Q_{wa} =	5.7	18.9	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	16.8	21.9	cfs
Interception with Clogging		Q_{oa} =	15.7	20.6	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	9.4	19.6	cfs
Interception with Clogging		Q_{ma} =	8.8	18.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**5.7**	**18.3**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.82	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.7**	**18.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.3	7.7	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:
This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

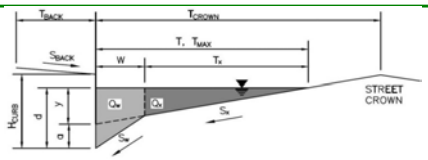
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **Grandview Reserve**

Inlet ID: **Basin E-1 (DP 27)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.033	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	13.2	13.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.3	2.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**15.5**	**15.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.4	1.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	12.2	71.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	12.2	61.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.2	6.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.3	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.4	69.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.4	2.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.5	1.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.56	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.4**	**38.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.15	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	1.68	inches

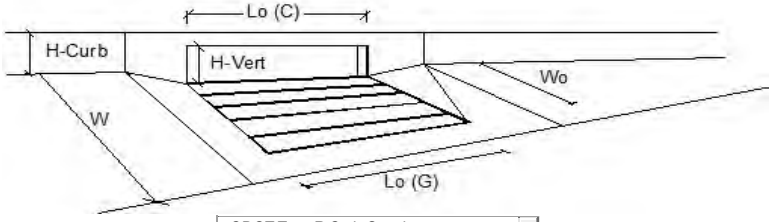
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.4**	**38.8**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	9.8	22.9	cfs
Water Spread Width	T =	13.4	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.6	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.179	0.128	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	8.1	20.0	cfs
Discharge within the Gutter Section W	Q_w =	1.8	2.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.32	sq ft
Velocity within the Gutter Section W	V_W =	7.4	9.1	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.1	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

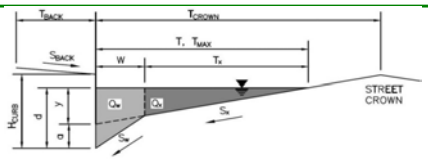
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.085	0.067	ft/ft
Required Length L_T to Have 100% Interception	L_T =	20.77	35.88	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	8.8	14.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**8.8**	**14.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.0**	**8.8**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.8**	**14.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.0**	**8.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**89**	**62**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin E-2 (DP 28)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.035	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	13.6	13.6	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.4	2.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**16.0**	**16.0**	**cfs**
Flow Velocity within the Gutter Section	V =	1.5	1.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	12.6	73.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	12.6	63.8	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.3	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.8	71.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.4	2.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.5	1.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.53	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.8**	**38.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.04	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	1.57	inches

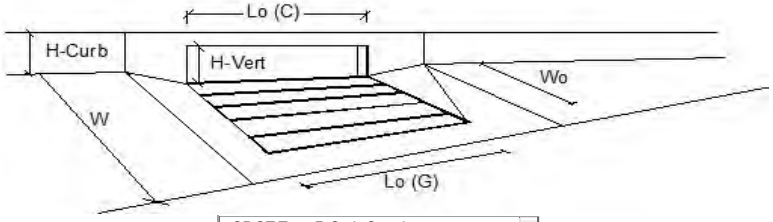
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**14.8**	**38.1**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	10.1	23.6	cfs
Water Spread Width	T =	13.4	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.6	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.179	0.128	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	8.3	20.6	cfs
Discharge within the Gutter Section W	Q_w =	1.8	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.32	sq ft
Velocity within the Gutter Section W	V_W =	7.6	9.3	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.1	inches

Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**

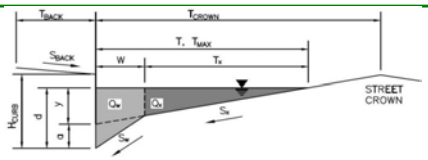
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.085	0.067	ft/ft
Required Length L_T to Have 100% Interception	L_T =	21.17	36.56	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	9.0	14.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**8.9**	**14.3**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.2**	**9.3**	**cfs**

Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.9**	**14.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.2**	**9.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**88**	**61**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin E-3 (DP 29)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

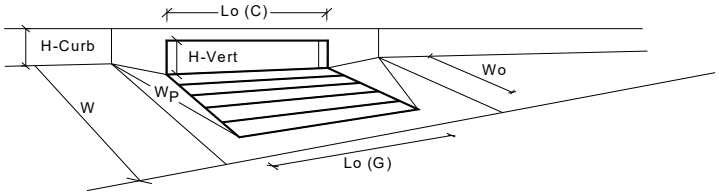
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	4	4	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	**Warning 1**	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.33	1.33	
Clogging Factor for Multiple Units		Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	10.0	35.4	cfs
Interception with Clogging		Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	33.6	43.9	cfs
Interception with Clogging		Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	17.0	36.7	cfs
Interception with Clogging		Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	8.2	32.1	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

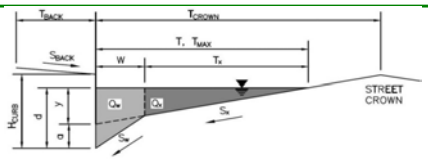
Warning 1 Note:

This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin E-4 (DP 30)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

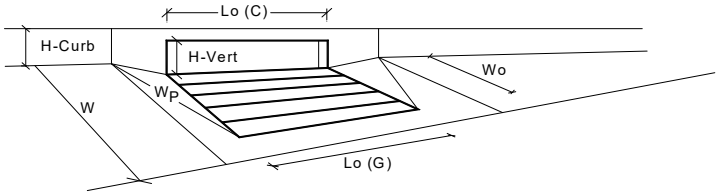
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

			MINOR	MAJOR	
Design Information (Input)					
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	4	4	☑ Override Depths
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	**Warning 1**	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	N/A	N/A	
Clogging Factor for Multiple Units		Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	N/A	N/A	cfs
Interception with Clogging		Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	N/A	N/A	cfs
Interception with Clogging		Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	N/A	N/A	cfs
Interception with Clogging		Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)		**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)			MINOR	MAJOR	
Clogging Coefficient for Multiple Units		Coef =	1.33	1.33	
Clogging Factor for Multiple Units		Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{wi} =	10.0	35.4	cfs
Interception with Clogging		Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)			MINOR	MAJOR	
Interception without Clogging		Q_{oi} =	33.6	43.9	cfs
Interception with Clogging		Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow			MINOR	MAJOR	
Interception without Clogging		Q_{mi} =	17.0	36.7	cfs
Interception with Clogging		Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)		**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
Resultant Street Conditions			MINOR	MAJOR	
Total Inlet Length		L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)		T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown		d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	9.0	21.0	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Warning 1 Note:

This warning is not reflective of the transition from a ramp curb upstream of the inlet to a typical 2' wide gutter pan prior to the inlet. Inputs provided for a 2' gutter pan at the inlet are correct as shown in this calculation & there is no impact to the results provided.

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, May 4 2022

BASIN D-7 SWALE

Trapezoidal

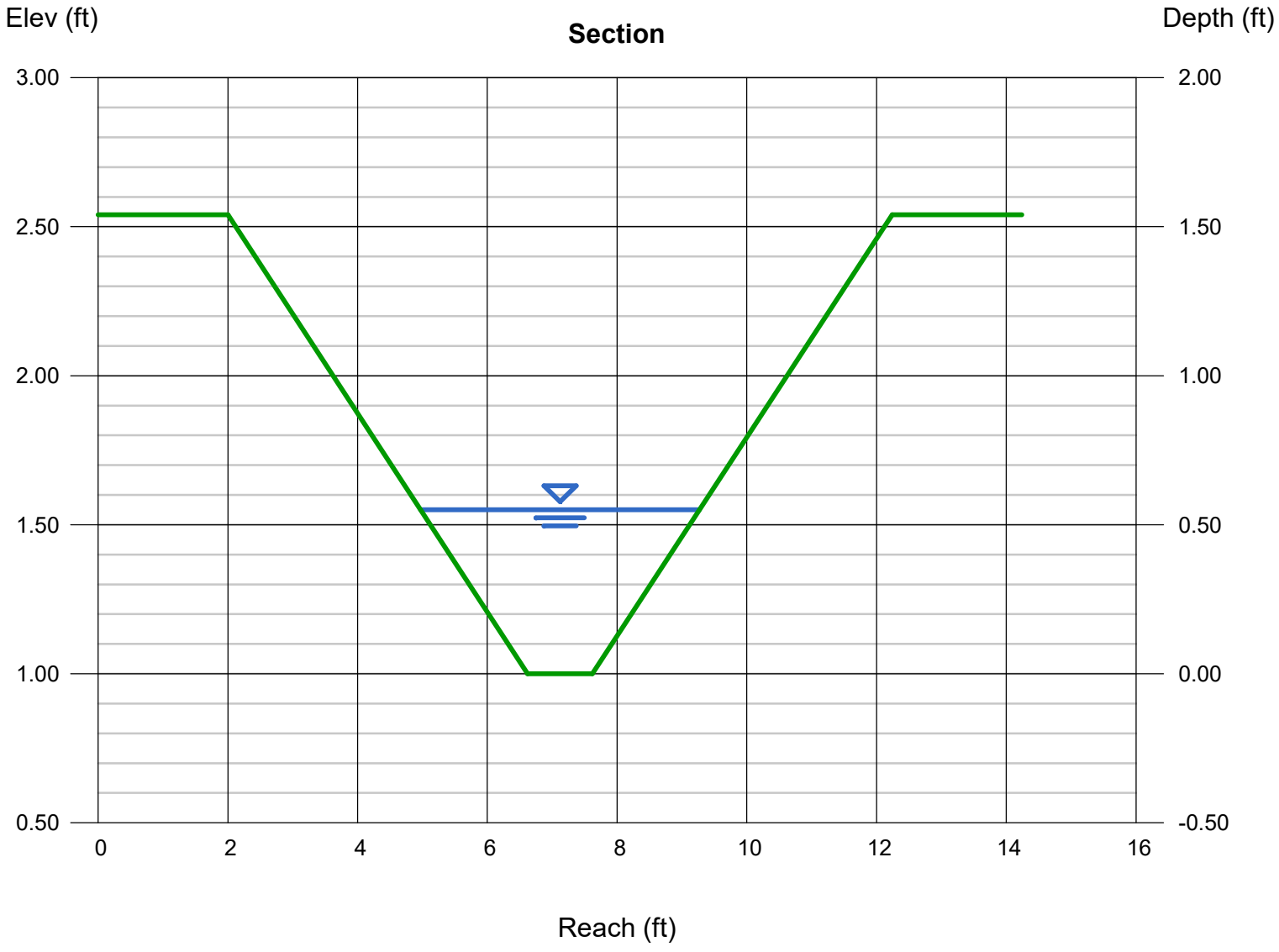
Bottom Width (ft)	= 1.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.54
Invert Elev (ft)	= 1.00
Slope (%)	= 2.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 4.00

Highlighted

Depth (ft)	= 0.55
Q (cfs)	= 4.000
Area (sqft)	= 1.46
Velocity (ft/s)	= 2.74
Wetted Perim (ft)	= 4.48
Crit Depth, Yc (ft)	= 0.51
Top Width (ft)	= 4.30
EGL (ft)	= 0.67



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Jun 6 2022

SWALE A-4a

Trapezoidal

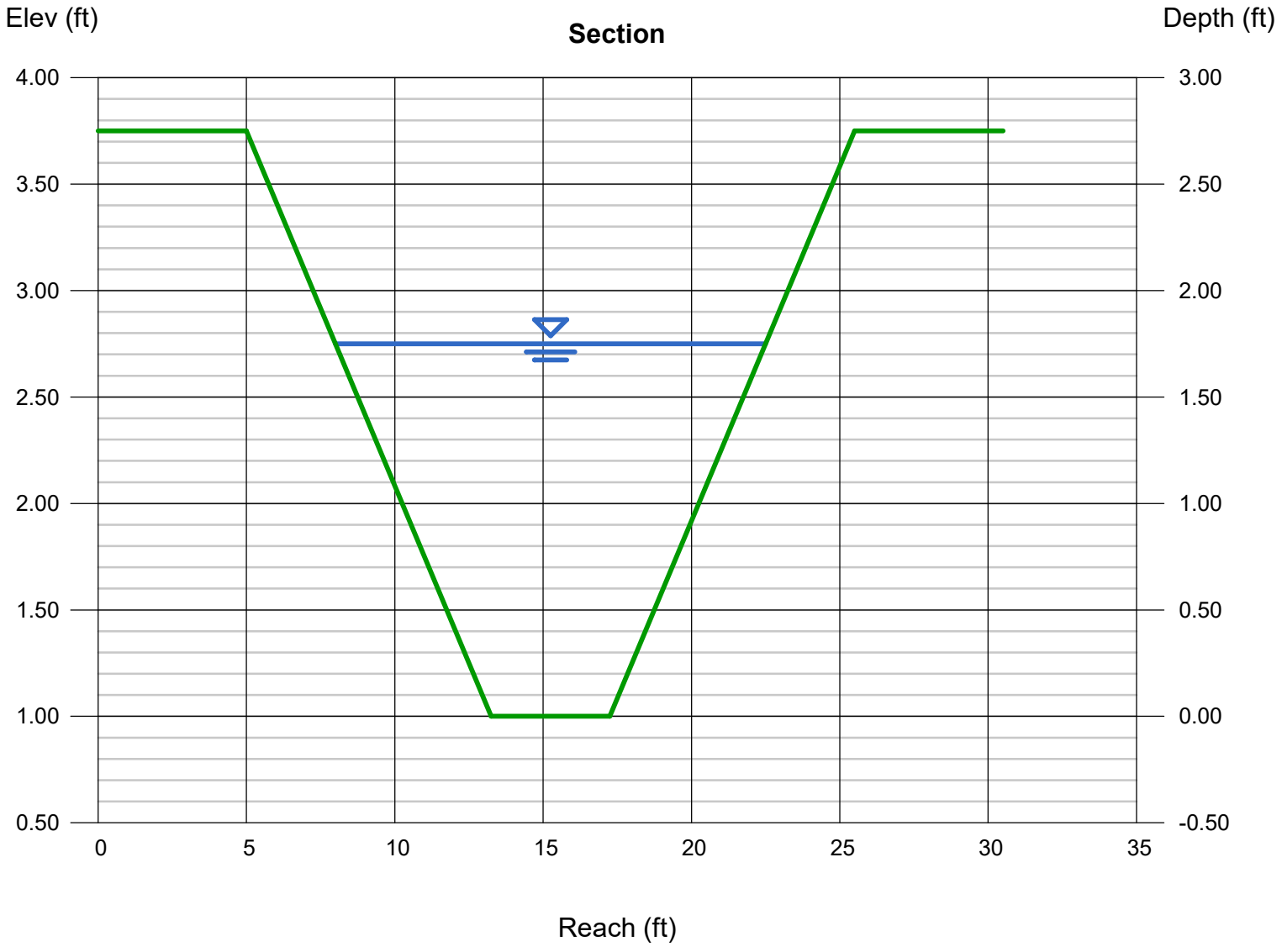
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.75
Invert Elev (ft)	= 1.00
Slope (%)	= 1.00
N-Value	= 0.020

Calculations

Compute by:	Known Q
Known Q (cfs)	= 125.00

Highlighted

Depth (ft)	= 1.75
Q (cfs)	= 125.00
Area (sqft)	= 16.19
Velocity (ft/s)	= 7.72
Wetted Perim (ft)	= 15.07
Crit Depth, Yc (ft)	= 1.99
Top Width (ft)	= 14.50
EGL (ft)	= 2.68



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, May 4 2022

Sidewalk Chase C-7a

Rectangular

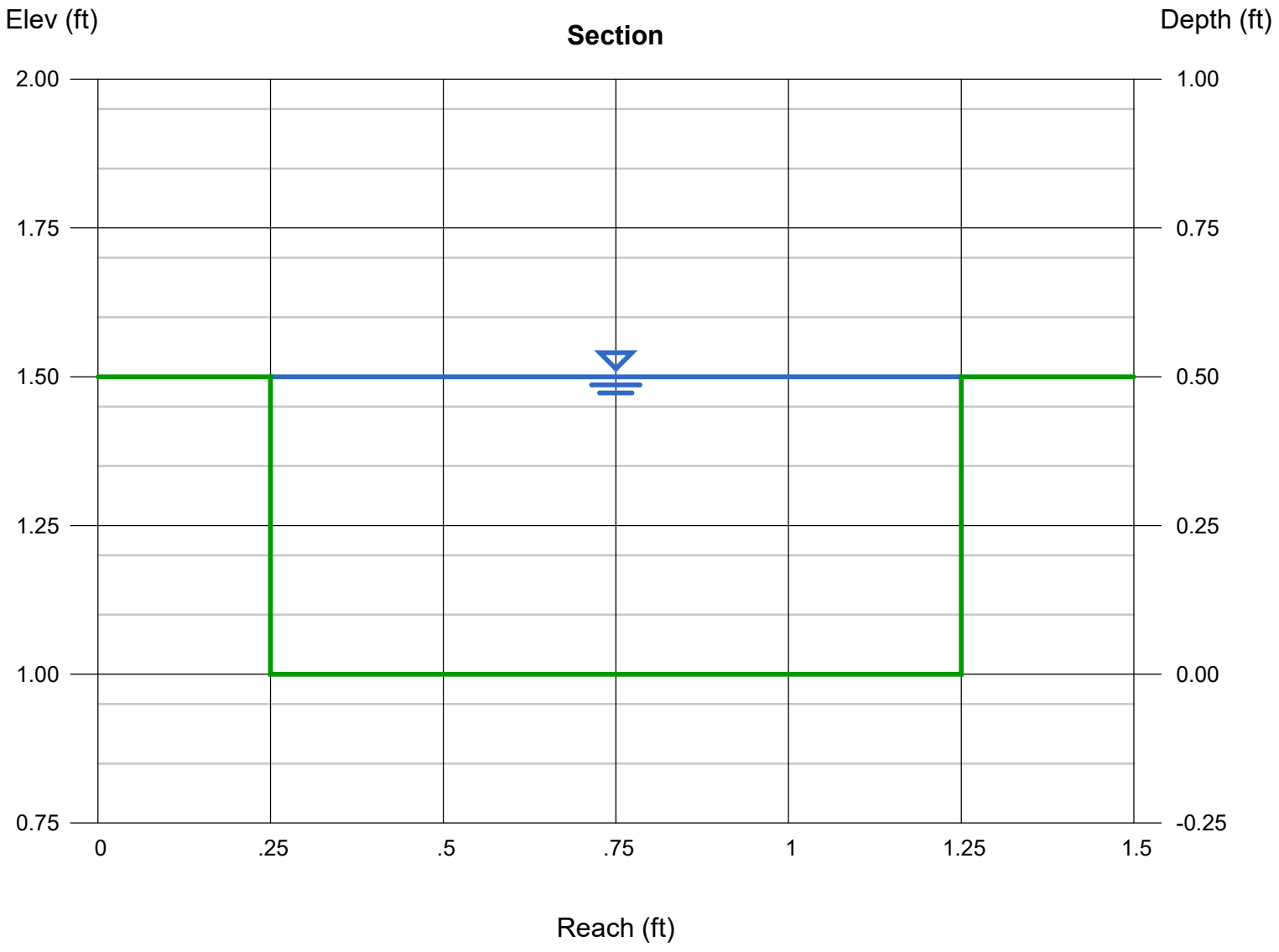
Bottom Width (ft)	= 1.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 1.00
Slope (%)	= 2.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 3.20

Highlighted

Depth (ft)	= 0.50
Q (cfs)	= 3.200
Area (sqft)	= 0.50
Velocity (ft/s)	= 6.40
Wetted Perim (ft)	= 2.00
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 1.00
EGL (ft)	= 1.14



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, May 4 2022

SWALE BASIN C-7a

Trapezoidal

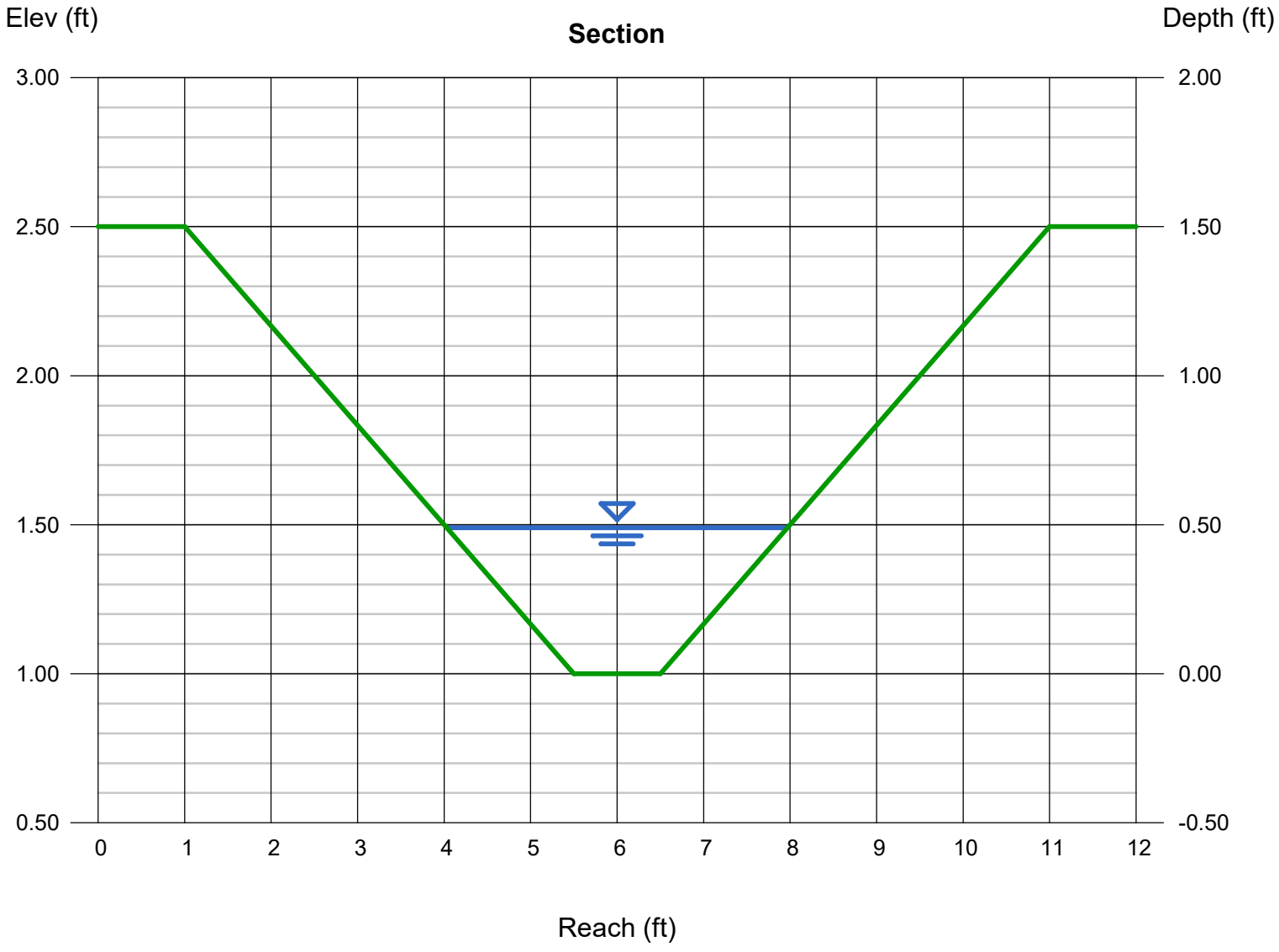
Bottom Width (ft)	= 1.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 1.00
Slope (%)	= 2.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 3.20

Highlighted

Depth (ft)	= 0.49
Q (cfs)	= 3.200
Area (sqft)	= 1.21
Velocity (ft/s)	= 2.64
Wetted Perim (ft)	= 4.10
Crit Depth, Yc (ft)	= 0.45
Top Width (ft)	= 3.94
EGL (ft)	= 0.60



Hydraulic Analysis Report

Project Data

Project Title: **Grandview Reserve – Interim Condition Swale Analysis**

Designer: TJE

Project Date: Friday, December 29, 2023

Notes: This includes the channel and lining analysis for the Interim Condition swales A-1, A-2, & OS-1

Channel Analysis: Swale A-1 - Channel Analysis

Notes:

Input Parameters

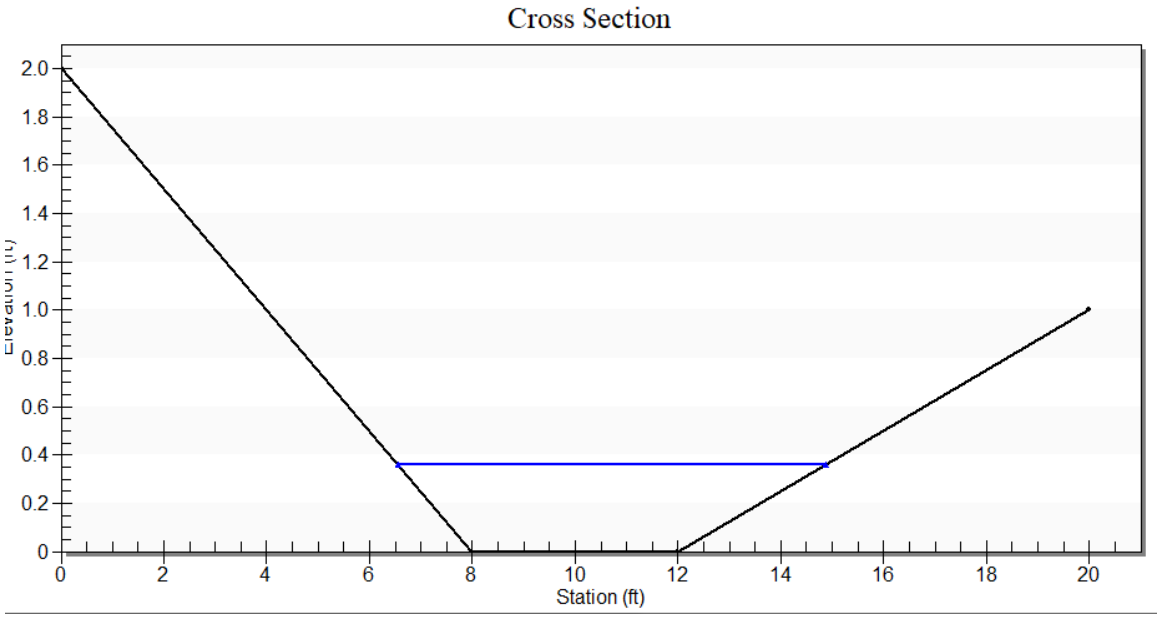
Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	2.00	0.0467
8.00	0.00	0.0467
12.00	0.00	0.0467
20.00	1.00	-----

Longitudinal Slope: 0.0300 ft/ft

Flow 5.0000 cfs



Result Parameters

Depth 0.3586 ft

Area of Flow 2.2059 ft^2

Wetted Perimeter 8.3696 ft

Hydraulic Radius 0.2636 ft

Average Velocity 2.2666 ft/s

Top Width 8.3032 ft

Froude Number: 0.7750

Critical Depth 0.3100 ft

Critical Velocity 2.7526 ft/s

Critical Slope: 0.0520 ft/ft

Critical Top Width 7.72 ft

Calculated Max Shear Stress 0.6713 lb/ft^2

Calculated Avg Shear Stress 0.4934 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0467

Channel Lining Analysis: Swale A-1 - Channel Lining Design Analysis

Notes:

Lining Input Parameters

Channel Lining Type: **Vegetation**

Specific Weight of Water: 62.4 lb/ft^3

Height of Vegetation: 0.333 ft

Vegetation Condition is good

Growth Form of Vegetation is mixed

Cf: 0.75

See HEC-15, Table 4.5 (default: 0.75 for Good cover factor and Mixed growth form)

soil is noncohesive

D75: 2.54 mm

Safety Factor: 1

Lining Results

Cn: 0.165205

Permissible Soil Shear Stress: 0.04 lb/ft^2

Mean Boundary Shear Stress: 0.493392 lb/ft^2

Maximum Shear Stress on the Channel Bottom: 0.671292 lb/ft^2

Manning's n: 0.0466795

Soil Grain Roughness: 0.0177136

Effective Shear Stress: 0.019717 lb/ft^2

Permissible Shear Stress on Vegetation: 1.11111 lb/ft^2

This value is compared with the maximum shear stress times the safety factor to determine lining stability

This value is compared with the maximum shear stress times the safety factor to determine lining stability

Channel bottom is stable

Channel Lining Stability Results 2

The channel is stable

Channel Analysis: Swale A-2 - Channel Analysis

Notes:

Input Parameters

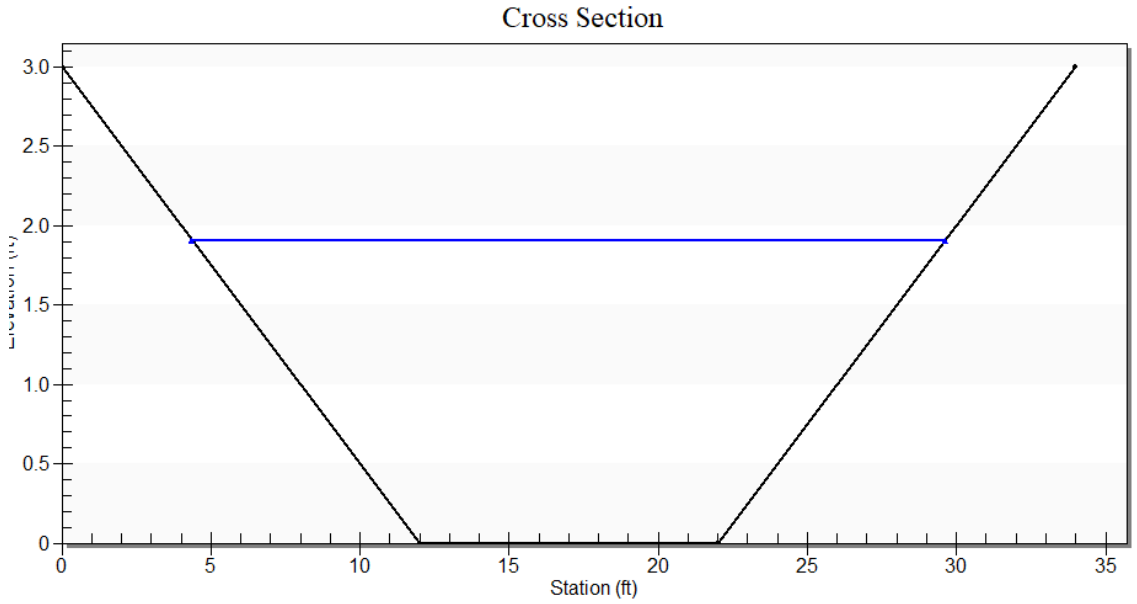
Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	3.00	0.0718
12.00	0.00	0.0718
22.00	0.00	0.0718
34.00	3.00	-----

Longitudinal Slope: 0.0300 ft/ft

Flow 144.2000 cfs



Result Parameters

Depth 1.9076 ft

Area of Flow 33.6325 ft^2

Wetted Perimeter 25.7307 ft

Hydraulic Radius 1.3071 ft

Average Velocity 4.2875 ft/s

Top Width 25.2610 ft

Froude Number: 0.6548

Critical Depth 1.5115 ft

Critical Velocity 5.9456 ft/s

Critical Slope: 0.0744 ft/ft

Critical Top Width 22.09 ft

Calculated Max Shear Stress 3.5711 lb/ft^2

Calculated Avg Shear Stress 2.4469 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0718

Channel Lining Analysis: Swale A-2 - Channel Lining Design Analysis

Notes:

Lining Input Parameters

Channel Lining Type: **Riprap (CDOT Type 'M')**

D50: 304.80 mm (12 in.)

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 2

Calculated Safety Factor: 1.22373

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 1.3314 ft

Manning's n method: Bathurst

Manning's n: 0.0717648

Channel Bottom Shear Results

V*: 1.35749

Reynold's Number: 111544

Shield's Parameter: 0.0930562

Shear stress on channel bottom: 3.57108 lb/ft^2

Permissible shear stress for channel bottom: 9.54757 lb/ft^2

Channel bottom is stable

Stable D50: 228.009 mm

Channel Lining Stability Results 2

The channel is stable

Channel Analysis: Swale OS-1 - Channel Analysis

Notes:

Input Parameters

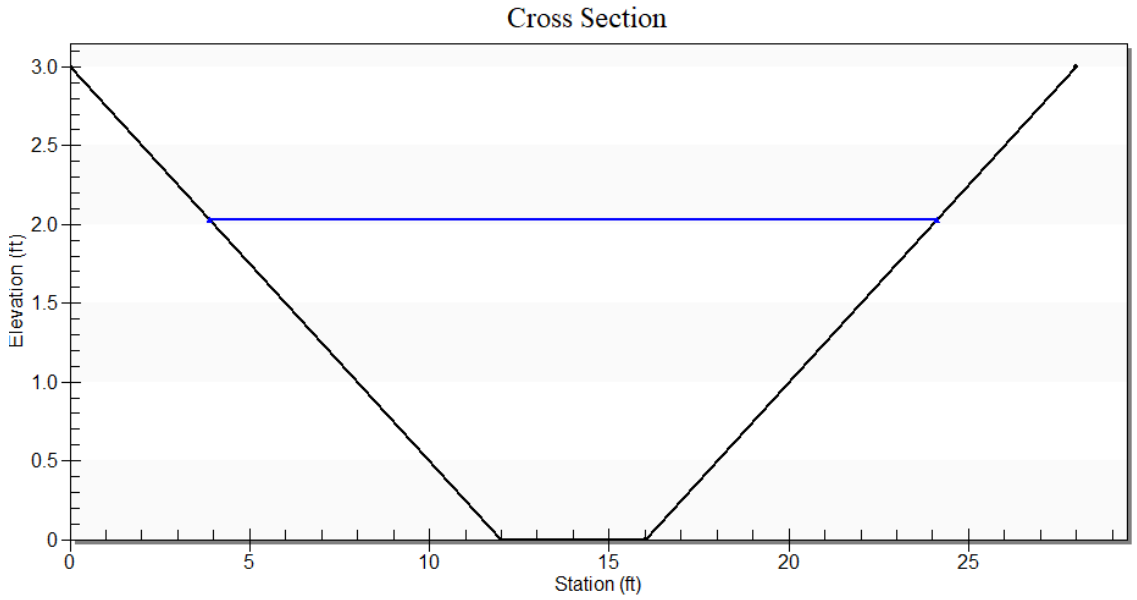
Channel Type: Custom Cross Section

Cross Section Data

Station (ft	Elevation (ft)	Manning's n
0.00	3.00	0.0524
12.00	0.00	0.0524
16.00	0.00	0.0524
28.00	3.00	-----

Longitudinal Slope: 0.0050 ft/ft

Flow 55.3000 cfs



Result Parameters

Depth 2.0297 ft

Area of Flow 24.5972 ft^2

Wetted Perimeter 20.7372 ft

Hydraulic Radius 1.1861 ft

Average Velocity 2.2482 ft/s

Top Width 20.2375 ft

Froude Number: 0.3594

Critical Depth 1.2285 ft

Critical Velocity 5.0498 ft/s

Critical Slope: 0.0445 ft/ft

Critical Top Width 13.83 ft

Calculated Max Shear Stress 0.6333 lb/ft^2

Calculated Avg Shear Stress 0.3701 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0524

Channel Lining Analysis: Swale OS-1 - Channel Lining Design Analysis

Notes:

Lining Input Parameters

Channel Lining Type: **Vegetation**

Specific Weight of Water: 62.4 lb/ft^3

Height of Vegetation: 0.333 ft

Vegetation Condition is good

Growth Form of Vegetation is mixed

Cf: 0.75

See HEC-15, Table 4.5 (default: 0.75 for Good cover factor and Mixed growth form)

soil is noncohesive

D75: 2.54 mm

Safety Factor: 2

Lining Results

Cn: 0.165205

Permissible Soil Shear Stress: 0.04 lb/ft^2

Mean Boundary Shear Stress: 0.370075 lb/ft^2

Maximum Shear Stress on the Channel Bottom: 0.633261 lb/ft^2

Manning's n: 0.0523705

Soil Grain Roughness: 0.0177136

Effective Shear Stress: 0.0147771 lb/ft^2

Permissible Shear Stress on Vegetation: 1.39856 lb/ft^2

This value is compared with the maximum shear stress times the safety factor to determine lining stability

This value is compared with the maximum shear stress times the safety factor to determine lining stability

Channel bottom is stable

Channel Lining Stability Results 2

The channel is stable

APPENDIX D

Water Quality Computations

Detention Pond Tributary Areas

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Reserve
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 3/1/22

Pond A

Basin	Area	% Imp
A-2a	4.42	65
A-2b	2.75	88
A-3	0.36	100
A-4a	6.31	65
A-4b	3.99	65
A-5	0.35	100
A-6	2.76	65
A-7	0.23	100
A-8	5.44	75
A-9	4.91	65
A-10	1.02	65
A-11	3.56	16
Total	**36.10**	**64.3**

Pond B

Basin	Area	% Imp
B-1	3.81	56.8
B-2	4.62	63.5
B-3	4.15	65
B-4	1.37	78.5
B-5	5.12	65
B-6	2.28	65
B-7	0.89	65
B-8	3.23	65
B-9	2.42	65
B-10	1.10	2
Total	**28.99**	**61.9**

Pond C

Basin	Area	% Imp
C-1	4.12	65
C-2	2.71	65
C-4	2.47	65
C-5	3.09	65
C-6	2.10	65
C-7a	0.81	44.7
C-7b	5.91	65
C-8	5.11	65
C-9a	3.50	65
C-9b	3.69	65
C-10	3.47	65
C-11	0.46	65
C-12	1.66	65
C-13	2.37	2
Total	**41.47**	**61.0**

Pond D

Basin	Area	% Imp
D-1	3.48	65
D-2	0.87	65
D-3	3.62	65
D-4	1.77	65
D-5	1.53	35.7
D-7b	0.88	65
Total	**12.15**	**61.3**

Pond E

Basin	Area	% Imp
E-1	5.33	65
E-2	5.42	65
E-3	3.20	65
E-4	6.28	65
E-5	1.13	2
Total	**21.36**	**61.7**

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches	
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches	
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches	
Optional User Defined Storm	CUHP			
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event			
Max Intensity for Optional User Defined Storm	0			

Designer: TJE
Company: Galloway & Co.
Date: May 3, 2022
Project: Grandviewe Reserve
Location: Pond A

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	A-2a	A-2b	A-3	A-4a	A-4b	A-5	A-6	A-7	A-8	A-9	A-10	A-11
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	4.420	2.750	0.360	6.310	3.990	0.350	2.760	0.230	5.440	4.910	1.020	3.560
Directly Connected Impervious Area (DCIA, acres)	2.873	2.420	0.360	4.100	2.590	0.350	1.794	0.230	4.080	3.192	0.663	0.570
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Separate Pervious Area (SPA, acres)	1.547	0.330	0.000	2.210	1.400	0.000	0.966	0.000	1.360	1.718	0.357	2.990
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C	C	C	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	4.420	2.750	0.360	6.310	3.990	0.350	2.760	0.230	5.440	4.910	1.020	3.560
Directly Connected Impervious Area (DCIA, %)	65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Separate Pervious Area (SPA, %)	35.0%	12.0%	0.0%	35.0%	35.1%	0.0%	35.0%	0.0%	25.0%	35.0%	35.0%	84.0%
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
I_a Check	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
f / I for Optional User Defined Storm CUHP:												
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for Optional User Defined Storm CUHP:												
Total Site Imperviousness: I_{total}	65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%
Effective Imperviousness for WQCV Event:	65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%
Effective Imperviousness for 5-Year Event:	65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%
Effective Imperviousness for 100-Year Event:	65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%
Effective Imperviousness for Optional User Defined Storm CUHP:												

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	N/A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	N/A	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**64.3%**
Total Site Effective Imperviousness for WQCV Event:	**64.3%**
Total Site Effective Imperviousness for 5-Year Event:	**64.3%**
Total Site Effective Imperviousness for 100-Year Event:	**64.3%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: TJE
Company: Galloway & Co.
Date: May 4, 2022
Project: Grandview Reserve
Location: Pond B

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10				
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam				
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	3.810	4.620	4.150	1.370	5.120	2.280	0.890	3.230	2.420	1.100				
Directly Connected Impervious Area (DCIA, acres)	2.164	2.934	2.698	1.075	3.328	1.482	0.579	2.100	1.573	0.022				
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
Separate Pervious Area (SPA, acres)	1.646	1.686	1.453	0.295	1.792	0.798	0.312	1.131	0.847	1.078				
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C	C				

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	3.810	4.620	4.150	1.370	5.120	2.280	0.890	3.230	2.420	1.100				
Directly Connected Impervious Area (DCIA, %)	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				
Separate Pervious Area (SPA, %)	43.2%	36.5%	35.0%	21.5%	35.0%	35.0%	35.0%	35.0%	35.0%	98.0%				
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
I_a Check	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7				
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5				
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3				
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Effective Imperviousness for WQCV Event:	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Effective Imperviousness for 5-Year Event:	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Effective Imperviousness for 100-Year Event:	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-364.4%	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**61.9%**
Total Site Effective Imperviousness for WQCV Event:	**61.9%**
Total Site Effective Imperviousness for 5-Year Event:	**61.9%**
Total Site Effective Imperviousness for 100-Year Event:	**61.9%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: TJE
Company: Galloway & Co.
Date: May 4, 2022
Project: Grandview Reserve
Location: Pond C

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	C-1	C-2	C-4	C-5	C-6	C-7a	C-7b	C-8	C-9a	C-9b	C-10	C-11	C-12	C-13
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	4.120	2.710	2.470	3.090	2.100	0.810	5.910	5.110	3.500	3.690	3.470	0.460	1.660	2.370
Directly Connected Impervious Area (DCIA, acres)	2.678	1.762	1.606	2.009	1.365	0.362	3.842	3.322	2.275	2.399	2.256	0.299	1.079	0.047
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Separate Pervious Area (SPA, acres)	1.442	0.949	0.865	1.082	0.735	0.448	2.069	1.789	1.225	1.292	1.215	0.161	0.581	2.323
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C	C	C	C	C	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	4.120	2.710	2.470	3.090	2.100	0.810	5.910	5.110	3.500	3.690	3.470	0.460	1.660	2.370
Directly Connected Impervious Area (DCIA, %)	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Separate Pervious Area (SPA, %)	35.0%	35.0%	35.0%	35.0%	35.0%	55.3%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	98.0%
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
I_a Check	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Effective Imperviousness for WQCV Event:	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Effective Imperviousness for 5-Year Event:	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Effective Imperviousness for 100-Year Event:	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	-169.1%
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**61.0%**
Total Site Effective Imperviousness for WQCV Event:	**61.0%**
Total Site Effective Imperviousness for 5-Year Event:	**61.0%**
Total Site Effective Imperviousness for 100-Year Event:	**61.0%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	**TJE**
Company:	**Galloway & Co.**
Date:	**May 4, 2022**
Project:	**Grandview Reserve**
Location:	**Pond D**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	D-1	D-2	D-3	D-4	D-5	D-7								
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam								
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	3.480	0.870	3.620	1.770	1.530	0.880								
Directly Connected Impervious Area (DCIA, acres)	2.262	0.566	2.353	1.151	0.546	0.572								
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000	0.000								
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000								
Separate Pervious Area (SPA, acres)	1.218	0.305	1.267	0.620	0.984	0.308								
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C								

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	3.480	0.870	3.620	1.770	1.530	0.880								
Directly Connected Impervious Area (DCIA, %)	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%								
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%								
Separate Pervious Area (SPA, %)	35.0%	35.0%	35.0%	35.0%	64.3%	35.0%								
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000	0.000								
I_a Check	1.000	1.000	1.000	1.000	1.000	1.000								
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7	1.7								
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5								
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3								
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00	1.00								
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00								
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00								
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Effective Imperviousness for WQCV Event:	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Effective Imperviousness for 5-Year Event:	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Effective Imperviousness for 100-Year Event:	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**61.3%**
Total Site Effective Imperviousness for WQCV Event:	**61.3%**
Total Site Effective Imperviousness for 5-Year Event:	**61.3%**
Total Site Effective Imperviousness for 100-Year Event:	**61.3%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: TJE
Company: Galloway & Co.
Date: May 4, 2022
Project: Grandview Reserve
Location: Pond E

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	E-1	E-2	E-3	E-4	E-5									
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam									
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	5.330	5.420	3.200	6.280	1.130									
Directly Connected Impervious Area (DCIA, acres)	3.465	3.523	2.080	4.082	0.023									
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000									
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000									
Separate Pervious Area (SPA, acres)	1.866	1.897	1.120	2.198	1.107									
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C									

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	5.330	5.420	3.200	6.280	1.130									
Directly Connected Impervious Area (DCIA, %)	65.0%	65.0%	65.0%	65.0%	2.0%									
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%									
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%									
Separate Pervious Area (SPA, %)	35.0%	35.0%	35.0%	35.0%	98.0%									
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000									
I_a Check	1.000	1.000	1.000	1.000	1.000									
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7									
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5									
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3									
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00									
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00									
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00									
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	65.0%	65.0%	65.0%	65.0%	2.0%									
Effective Imperviousness for WQCV Event:	65.0%	65.0%	65.0%	65.0%	2.0%									
Effective Imperviousness for 5-Year Event:	65.0%	65.0%	65.0%	65.0%	2.0%									
Effective Imperviousness for 100-Year Event:	65.0%	65.0%	65.0%	65.0%	2.0%									
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	-354.7%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**61.7%**
Total Site Effective Imperviousness for WQCV Event:	**61.7%**
Total Site Effective Imperviousness for 5-Year Event:	**61.7%**
Total Site Effective Imperviousness for 100-Year Event:	**61.7%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

				Designer:	**TJE**
				Company:	**Galloway & Co.**
***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches	**Date:**	**May 4, 2022**
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches	**Project:**	**Grandview Reserve**
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches	**Location:**	**Sub-basin A-1**
Optional User Defined Storm	CUHP				
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event				
Max Intensity for Optional User Defined Storm	0				

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**A-1**														
Receiving Pervious Area Soil Type	Sandy Loam														
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	11.670														
Directly Connected Impervious Area (DCIA, acres)	0.233														
Unconnected Impervious Area (UIA, acres)	0.000														
Receiving Pervious Area (RPA, acres)	0.000														
Separate Pervious Area (SPA, acres)	11.437														
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C														

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	11.670														
Directly Connected Impervious Area (DCIA, %)	2.0%														
Unconnected Impervious Area (UIA, %)	0.0%														
Receiving Pervious Area (RPA, %)	0.0%														
Separate Pervious Area (SPA, %)	98.0%														
A_R (RPA / UIA)	0.000														
I_a Check	1.000														
f / I for WQCV Event:	1.7														
f / I for 5-Year Event:	0.5														
f / I for 100-Year Event:	0.3														
f / I for Optional User Defined Storm CUHP:															
IRF for WQCV Event:	1.00														
IRF for 5-Year Event:	1.00														
IRF for 100-Year Event:	1.00														
IRF for Optional User Defined Storm CUHP:															
Total Site Imperviousness: I_{total}	2.0%														
Effective Imperviousness for WQCV Event:	2.0%														
Effective Imperviousness for 5-Year Event:	2.0%														
Effective Imperviousness for 100-Year Event:	2.0%														
Effective Imperviousness for Optional User Defined Storm CUHP:															

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:															

Total Site Imperviousness:	**2.0%**
Total Site Effective Imperviousness for WQCV Event:	**2.0%**
Total Site Effective Imperviousness for 5-Year Event:	**2.0%**
Total Site Effective Imperviousness for 100-Year Event:	**2.0%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

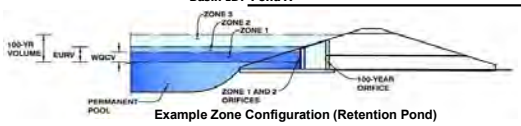
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	36.10	acres
Watershed Length =	2,360	ft
Watershed Length to Centroid =	1,180	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	64.30%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.756	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.872	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.125	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.788	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.319	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.018	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.705	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.540	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	9.026	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	1.867	acre-feet		
Approximate 5-yr Detention Volume =	2.442	acre-feet		
Approximate 10-yr Detention Volume =	2.945	acre-feet		
Approximate 25-yr Detention Volume =	3.546	acre-feet		
Approximate 50-yr Detention Volume =	3.909	acre-feet		
Approximate 100-yr Detention Volume =	4.290	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.756	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.115	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.418	acre-feet
Total Detention Basin Volume =	4.290	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

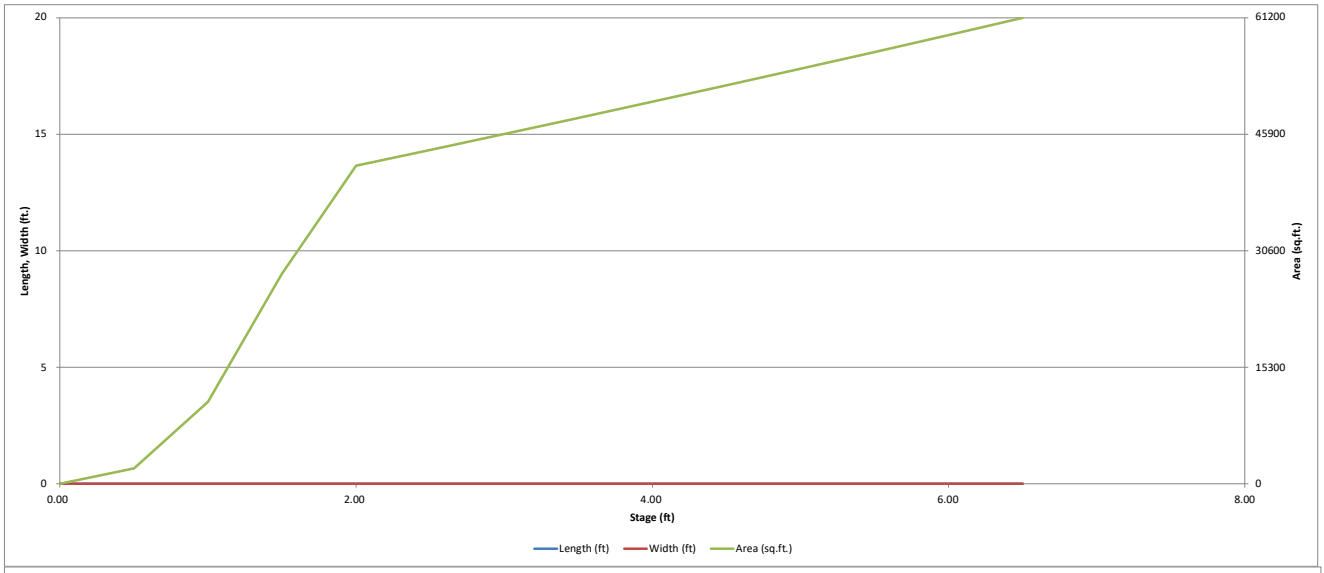
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

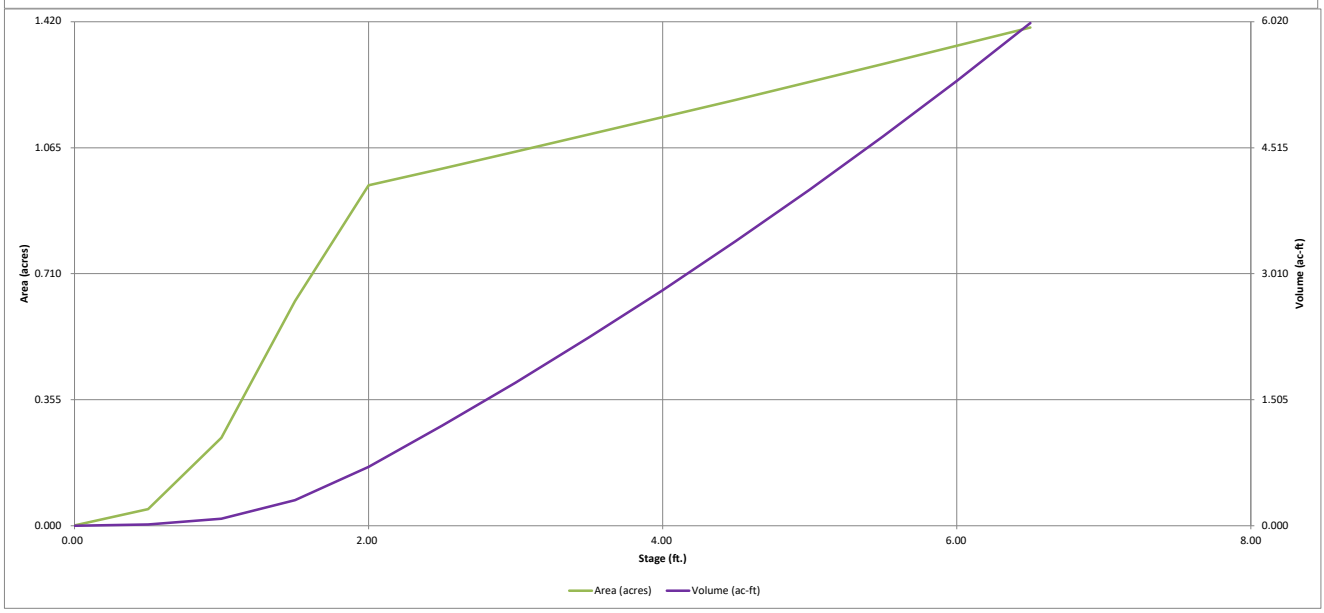
Depth Increment = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	35	0.001		
6971	--	0.50	--	--	--	2,047	0.047	520	0.012
	--	1.00	--	--	--	10,771	0.247	3,725	0.086
6972	--	1.50	--	--	--	27,585	0.633	13,313	0.306
	--	2.00	--	--	--	41,785	0.959	30,656	0.704
6973	--	2.50	--	--	--	43,839	1.006	52,062	1.195
	--	3.00	--	--	--	45,918	1.054	74,501	1.710
6974	--	3.50	--	--	--	48,022	1.102	97,986	2.249
	--	4.00	--	--	--	50,151	1.151	122,529	2.813
6975	--	4.50	--	--	--	52,306	1.201	148,144	3.401
	--	5.00	--	--	--	54,486	1.251	174,842	4.014
6976	--	5.50	--	--	--	56,691	1.301	202,636	4.652
	--	6.00	--	--	--	58,921	1.353	231,538	5.315
6977	--	6.50	--	--	--	61,176	1.404	261,562	6.005

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



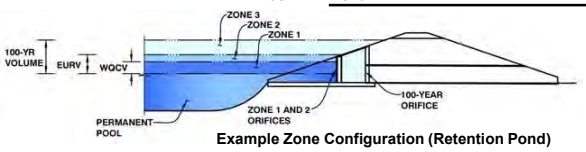


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.06	0.756	Orifice Plate
Zone 2 (EURV)	4.06	2.115	Rectangular Orifice
Zone 3 (100-year)	5.22	1.418	Weir&Pipe (Restrict)
Total (all zones)		4.290	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.083E-02	ft²
Depth at top of Zone using Orifice Plate =	2.06	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.00	sq. inches (diameter = 1-15/16 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.70	1.40					
Orifice Area (sq. inches)	3.00	3.00	3.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected		Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.10	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.06	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Height =	2.00	N/A	inches				
Vertical Orifice Width =	7.00		inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.10	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.85	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.09	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	7.31	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.46	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.23	N/A	ft²
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected		Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.88	N/A	ft²
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.43	N/A	feet
Restrictor Plate Height Above Pipe Invert =	9.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.60	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.57	feet
Spillway Crest Length =	60.00	feet	Stage at Top of Freeboard =	7.17	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.40	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	6.00	acre-ft

Calculated Parameters for Spillway

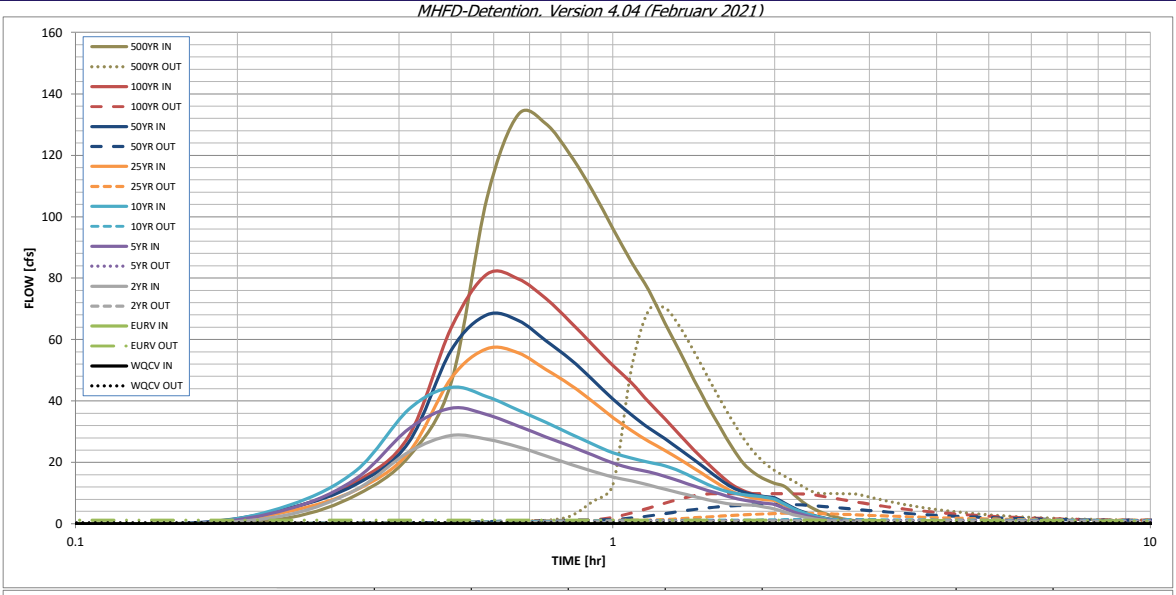
Routed Hydrograph Results

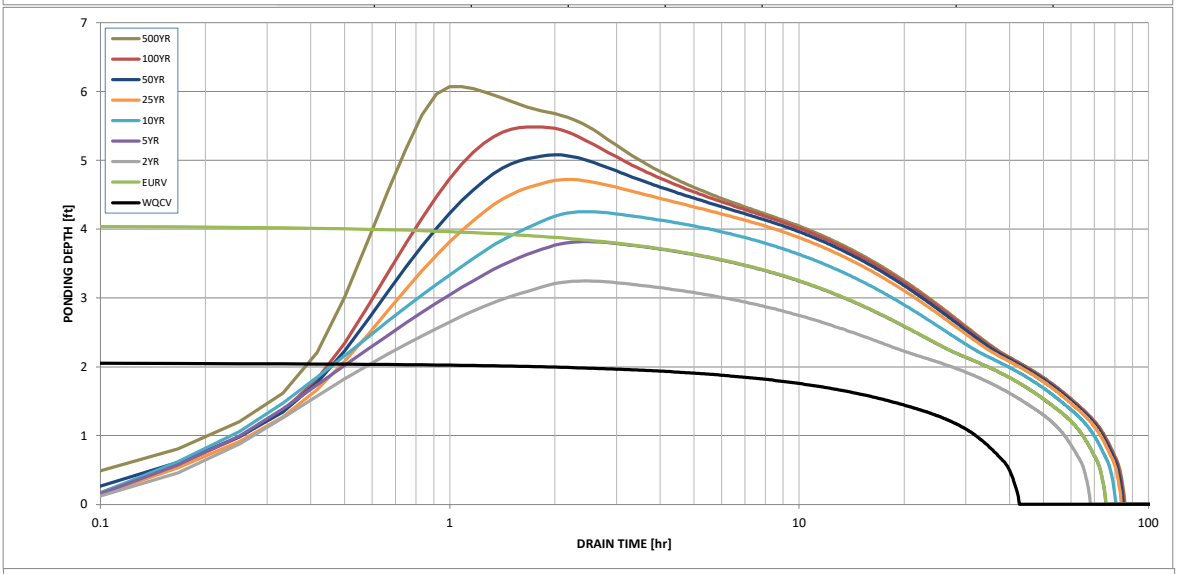
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

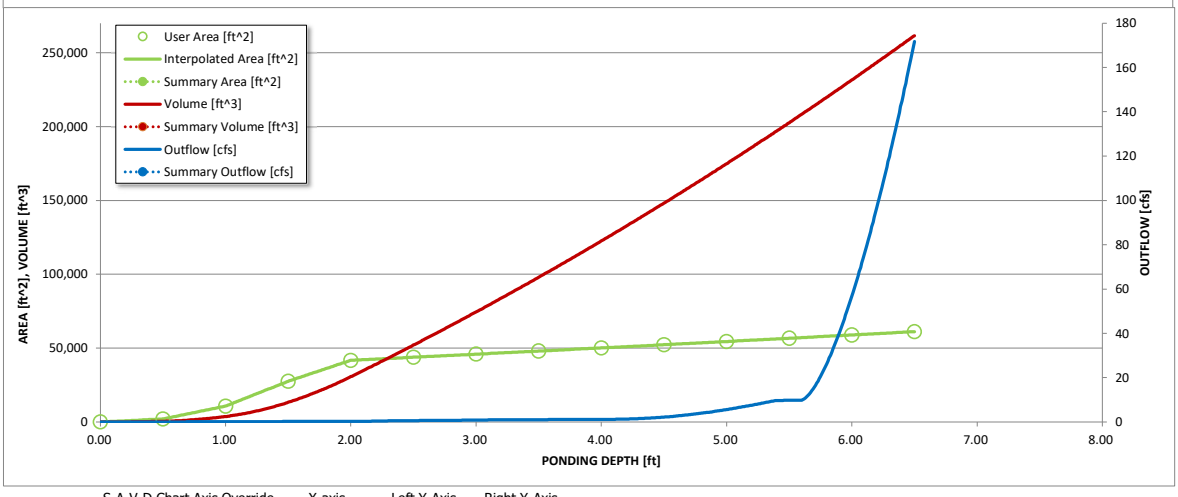
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.756	2.872	2.125	2.788	3.319	4.018	4.705	5.540	9.026
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.125	2.788	3.319	4.018	4.705	5.540	9.026
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.6	5.0	10.1	16.9	44.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.14	0.28	0.47	1.22
Peak Inflow Q (cfs) =	N/A	N/A	28.7	37.7	44.4	57.0	68.0	81.3	133.3
Peak Outflow Q (cfs) =	0.3	1.2	1.0	1.1	1.4	3.4	6.4	9.8	70.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.8	2.6	0.7	0.6	0.6	1.6
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.8	1.3	1.3
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	65	59	65	69	70	70	69	63
Time to Drain 99% of Inflow Volume (hours) =	**41**	70	64	70	75	77	77	77	75
Maximum Ponding Depth (ft) =	2.06	4.06	3.25	3.82	4.25	4.72	5.08	5.49	6.07
Area at Maximum Ponding Depth (acres) =	0.96	1.16	1.08	1.13	1.18	1.22	1.26	1.30	1.36
Maximum Volume Stored (acre-ft) =	0.761	2.882	1.966	2.596	3.104	3.668	4.114	4.626	5.410

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.03	2.02
	0:15:00	0.00	0.00	3.00	4.88	6.06	4.07	5.14	4.98	9.37
	0:20:00	0.00	0.00	11.17	14.80	17.46	11.06	12.95	13.80	21.83
	0:25:00	0.00	0.00	23.37	30.89	37.17	23.12	26.44	28.44	45.91
	0:30:00	0.00	0.00	28.73	37.68	44.43	47.38	56.52	63.76	106.09
	0:35:00	0.00	0.00	27.51	35.49	41.42	57.02	68.02	81.26	133.30
	0:40:00	0.00	0.00	25.06	31.80	37.01	55.62	66.23	79.74	130.23
	0:45:00	0.00	0.00	22.09	28.29	33.04	50.24	59.65	73.33	120.11
	0:50:00	0.00	0.00	19.43	25.32	29.30	45.28	53.56	65.81	108.39
	0:55:00	0.00	0.00	17.14	22.37	25.94	39.80	46.90	58.26	96.14
	1:00:00	0.00	0.00	15.25	19.80	23.14	34.65	40.63	51.57	85.17
	1:05:00	0.00	0.00	13.98	18.08	21.34	30.38	35.43	45.88	75.95
	1:10:00	0.00	0.00	12.57	16.86	20.05	26.79	31.15	39.58	65.30
	1:15:00	0.00	0.00	11.24	15.45	18.85	23.90	27.69	34.19	55.97
	1:20:00	0.00	0.00	10.04	13.84	17.12	20.93	24.17	28.86	46.85
	1:25:00	0.00	0.00	8.90	12.27	14.88	18.09	20.81	23.97	38.57
	1:30:00	0.00	0.00	7.83	10.85	12.81	15.24	17.47	19.68	31.36
	1:35:00	0.00	0.00	6.96	9.70	11.15	12.64	14.40	15.87	24.93
	1:40:00	0.00	0.00	6.42	8.54	10.11	10.51	11.88	12.70	19.61
	1:45:00	0.00	0.00	6.15	7.71	9.50	9.16	10.33	10.73	16.45
	1:50:00	0.00	0.00	6.01	7.15	9.09	8.36	9.41	9.55	14.50
	1:55:00	0.00	0.00	5.41	6.72	8.65	7.84	8.82	8.79	13.19
	2:00:00	0.00	0.00	4.82	6.27	7.99	7.48	8.41	8.24	12.25
	2:05:00	0.00	0.00	3.86	5.05	6.43	6.05	6.80	6.56	9.68
	2:10:00	0.00	0.00	2.98	3.88	4.95	4.63	5.19	4.93	7.22
	2:15:00	0.00	0.00	2.30	2.99	3.80	3.54	3.97	3.72	5.41
	2:20:00	0.00	0.00	1.76	2.28	2.88	2.69	3.02	2.82	4.10
	2:25:00	0.00	0.00	1.33	1.73	2.17	2.03	2.28	2.14	3.10
	2:30:00	0.00	0.00	1.01	1.28	1.61	1.51	1.69	1.60	2.31
	2:35:00	0.00	0.00	0.74	0.93	1.20	1.11	1.24	1.19	1.71
	2:40:00	0.00	0.00	0.54	0.68	0.89	0.83	0.93	0.89	1.28
	2:45:00	0.00	0.00	0.38	0.48	0.63	0.61	0.68	0.64	0.92
	2:50:00	0.00	0.00	0.24	0.33	0.42	0.41	0.46	0.44	0.62
	2:55:00	0.00	0.00	0.14	0.20	0.26	0.26	0.28	0.27	0.38
	3:00:00	0.00	0.00	0.07	0.11	0.13	0.14	0.15	0.14	0.20
	3:05:00	0.00	0.00	0.03	0.04	0.05	0.06	0.06	0.05	0.07
	3:10:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

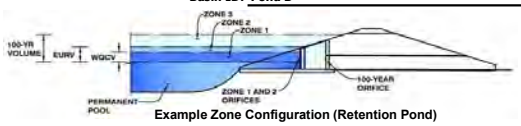
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	28.99	acres
Watershed Length =	1,700	ft
Watershed Length to Centroid =	850	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.90%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.586	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	2.197	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.628	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.140	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.552	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	3.104	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.648	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.314	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.68 in.) =	7.093	acre-feet	3.68 inches
Approximate 2-yr Detention Volume =	1.426	acre-feet	
Approximate 5-yr Detention Volume =	1.867	acre-feet	
Approximate 10-yr Detention Volume =	2.255	acre-feet	
Approximate 25-yr Detention Volume =	2.722	acre-feet	
Approximate 50-yr Detention Volume =	3.006	acre-feet	
Approximate 100-yr Detention Volume =	3.310	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.586	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.610	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.114	acre-feet
Total Detention Basin Volume =	3.310	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

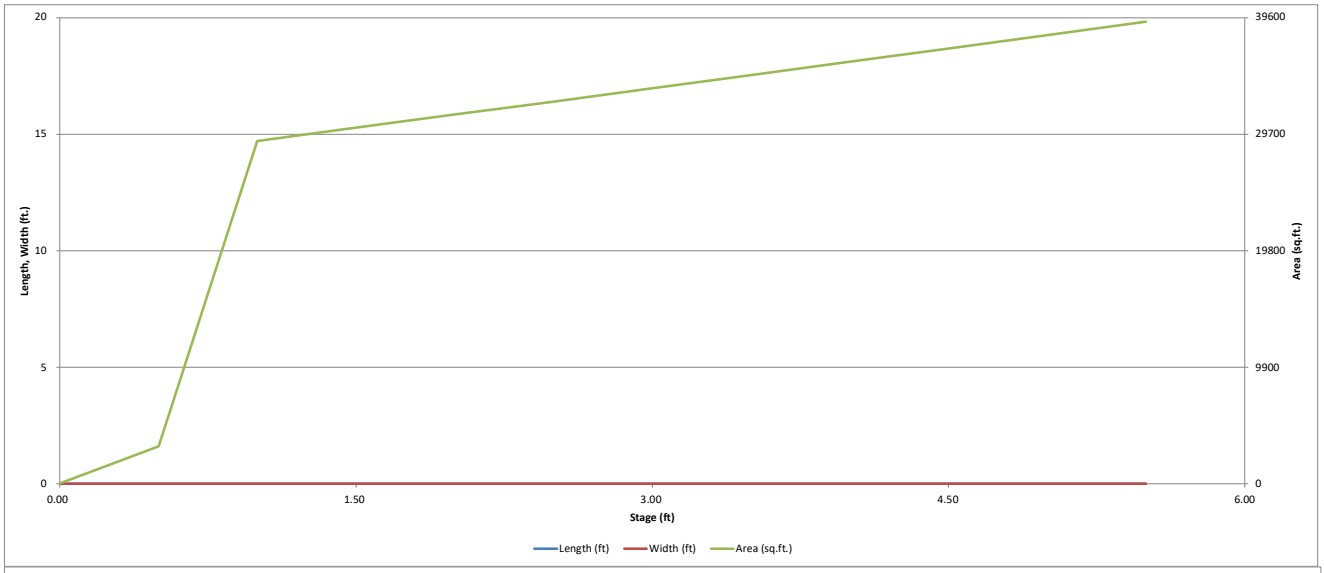
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

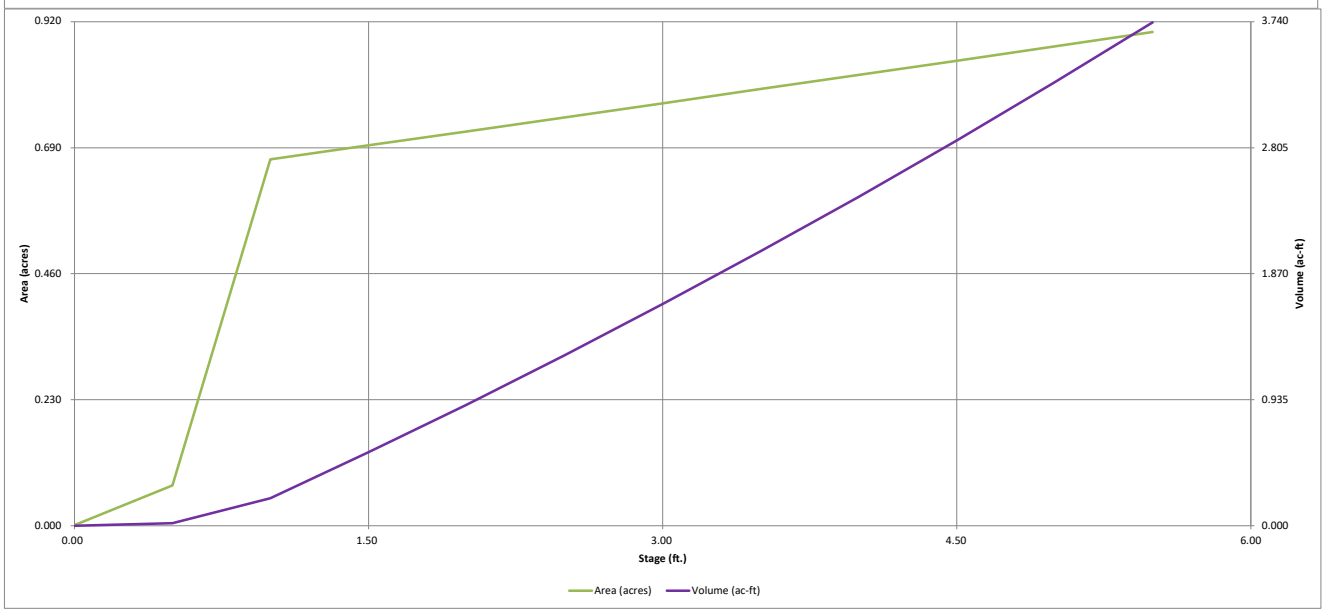
Depth Increment = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	35	0.001		
	--	0.50	--	--	--	3,203	0.074	809	0.019
6964	--	1.00	--	--	--	29,135	0.669	8,894	0.204
	--	1.50	--	--	--	30,250	0.694	23,740	0.545
6965	--	2.00	--	--	--	31,366	0.720	39,144	0.899
	--	2.50	--	--	--	32,485	0.746	55,107	1.265
6966	--	3.00	--	--	--	33,606	0.771	71,629	1.644
	--	3.50	--	--	--	34,729	0.797	88,713	2.037
6967	--	4.00	--	--	--	35,856	0.823	106,360	2.442
	--	4.50	--	--	--	36,987	0.849	124,570	2.860
6968	--	5.00	--	--	--	38,126	0.875	143,348	3.291
6968.5	--	5.50	--	--	--	39,275	0.902	162,698	3.735

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



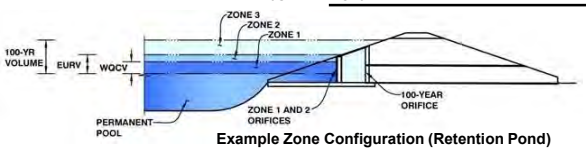


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.56	0.586	Orifice Plate
Zone 2 (EURV)	3.70	1.610	Rectangular Orifice
Zone 3 (100-year)	5.03	1.114	Weir&Pipe (Restrict)
Total (all zones)		3.310	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.875E-02	ft^2
Depth at top of Zone using Orifice Plate =	1.57	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	6.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.70	sq. inches (diameter = 1-13/16 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.52	1.05					
Orifice Area (sq. inches)	2.70	2.70	2.70					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected		Calculated Parameters for Vertical Orifice: Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	1.60	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.06	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.76	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.06	N/A	feet
Vertical Orifice Height =	1.50	N/A	inches				
Vertical Orifice Width =	6.00		inches				

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir: Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.80	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.55	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	3.09	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.04	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	8.61	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	4.30	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate: Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.07	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.50	N/A	feet
Restrictor Plate Height Above Pipe Invert =	10.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.74	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.25	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.49	feet
Spillway Crest Length =	68.00	feet	Stage at Top of Freeboard =	6.74	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.90	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.74	acre-ft

Calculated Parameters for Spillway

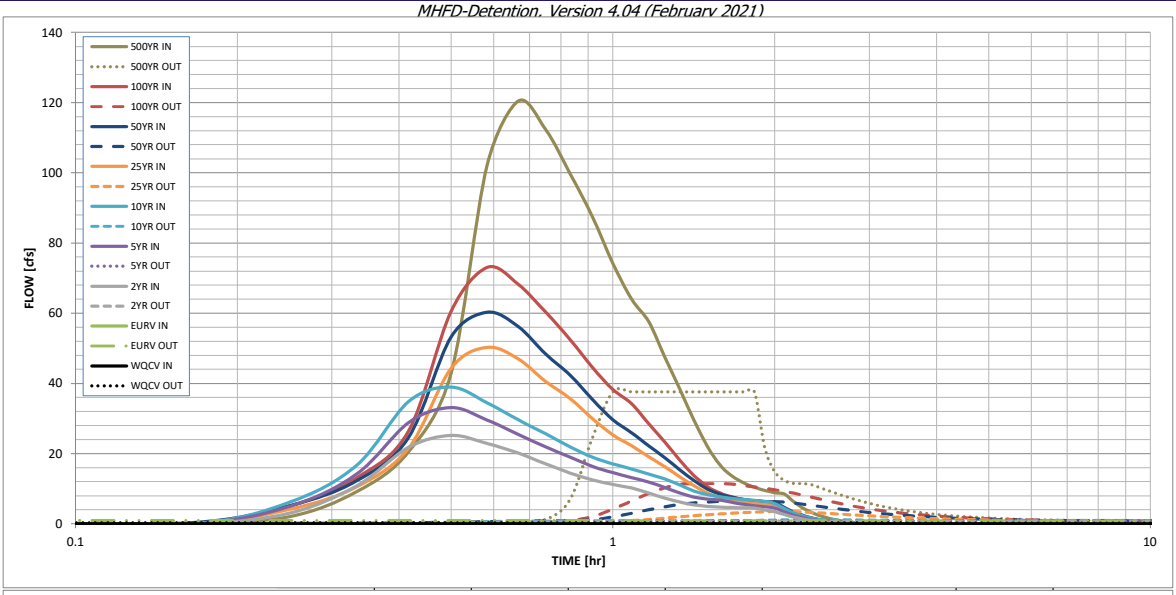
Routed Hydrograph Results

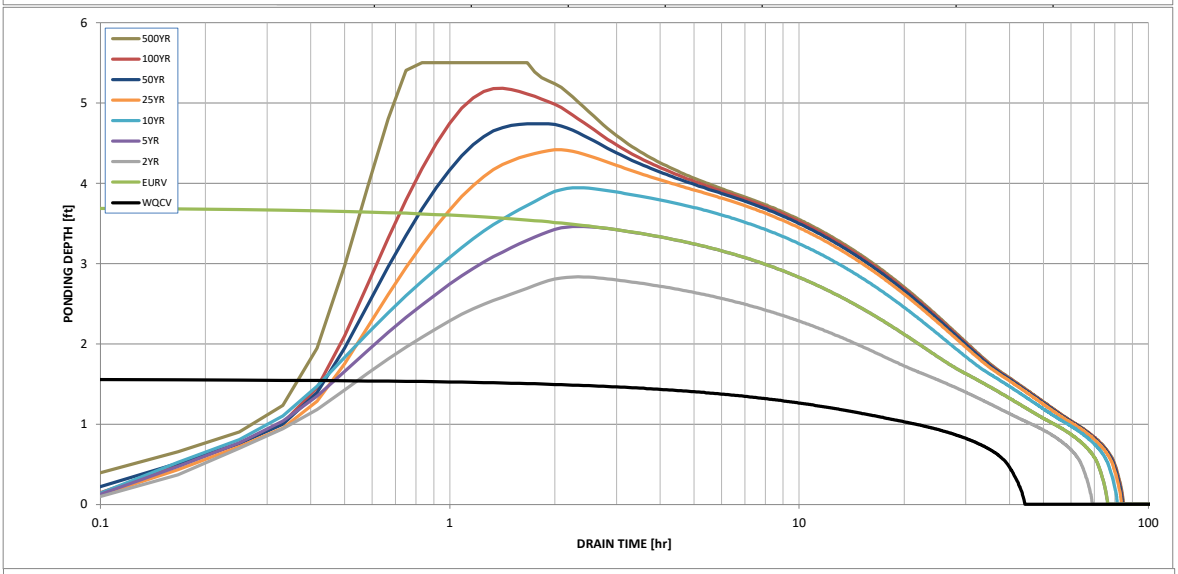
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

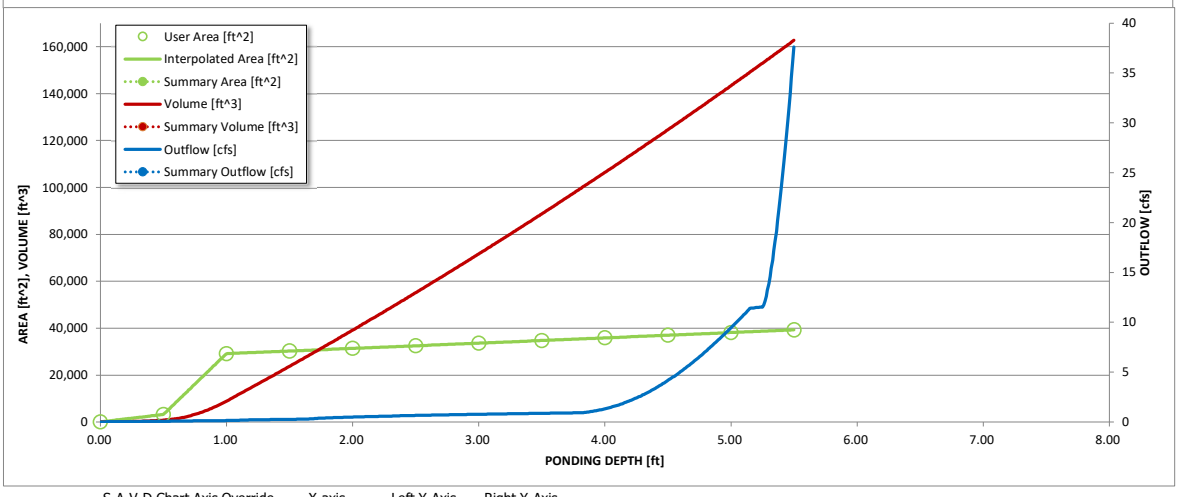
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.586	2.197	1.628	2.140	2.552	3.104	3.648	4.314	7.093
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.628	2.140	2.552	3.104	3.648	4.314	7.093
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.5	5.0	9.9	16.2	42.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.17	0.34	0.56	1.45
Peak Inflow Q (cfs) =	N/A	N/A	25.2	33.1	38.9	50.3	60.3	73.0	120.5
Peak Outflow Q (cfs) =	0.3	0.9	0.7	0.9	1.2	3.5	6.5	11.4	37.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.2	2.1	0.7	0.7	0.7	0.9
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.6	1.2	1.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	66	60	66	70	71	70	68	62
Time to Drain 99% of Inflow Volume (hours) =	**42**	71	65	71	76	77	77	77	74
Maximum Ponding Depth (ft) =	1.56	3.70	2.84	3.46	3.94	4.42	4.74	5.18	5.50
Area at Maximum Ponding Depth (acres) =	0.70	0.81	0.76	0.80	0.82	0.84	0.86	0.88	0.90
Maximum Volume Stored (acre-ft) =	0.587	2.197	1.514	2.005	2.392	2.784	3.065	3.449	3.735

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.03	2.04
	0:15:00	0.00	0.00	3.02	4.91	6.09	4.10	5.12	5.00	9.11
	0:20:00	0.00	0.00	10.77	14.11	16.60	10.48	12.21	13.09	20.49
	0:25:00	0.00	0.00	21.79	28.81	34.81	21.55	24.59	26.44	42.94
	0:30:00	0.00	0.00	25.16	33.07	38.94	44.29	53.29	60.57	102.02
	0:35:00	0.00	0.00	22.90	29.59	34.51	50.29	60.28	73.00	120.48
	0:40:00	0.00	0.00	20.14	25.48	29.62	46.96	56.21	68.24	112.28
	0:45:00	0.00	0.00	17.06	21.91	25.61	40.51	48.31	60.24	99.69
	0:50:00	0.00	0.00	14.44	18.97	21.87	35.63	42.32	52.43	87.38
	0:55:00	0.00	0.00	12.47	16.33	18.94	29.94	35.34	44.54	74.23
	1:00:00	0.00	0.00	11.19	14.55	17.09	25.32	29.67	38.26	63.98
	1:05:00	0.00	0.00	10.18	13.18	15.62	22.22	25.93	34.19	57.50
	1:10:00	0.00	0.00	8.72	11.88	14.16	19.09	22.17	28.45	47.40
	1:15:00	0.00	0.00	7.35	10.29	12.75	16.28	18.81	23.27	38.32
	1:20:00	0.00	0.00	6.19	8.73	11.02	13.32	15.30	18.09	29.42
	1:25:00	0.00	0.00	5.40	7.62	9.32	10.84	12.35	13.72	21.96
	1:30:00	0.00	0.00	4.97	7.05	8.31	8.74	9.89	10.55	16.67
	1:35:00	0.00	0.00	4.76	6.73	7.68	7.47	8.43	8.72	13.60
	1:40:00	0.00	0.00	4.63	6.08	7.23	6.70	7.54	7.63	11.71
	1:45:00	0.00	0.00	4.55	5.54	6.90	6.19	6.96	6.89	10.41
	1:50:00	0.00	0.00	4.49	5.15	6.68	5.84	6.56	6.38	9.52
	1:55:00	0.00	0.00	3.94	4.86	6.36	5.60	6.30	6.02	8.89
	2:00:00	0.00	0.00	3.46	4.51	5.79	5.43	6.11	5.78	8.46
	2:05:00	0.00	0.00	2.61	3.41	4.35	4.12	4.63	4.36	6.36
	2:10:00	0.00	0.00	1.91	2.48	3.15	2.98	3.35	3.16	4.59
	2:15:00	0.00	0.00	1.39	1.80	2.28	2.17	2.43	2.30	3.34
	2:20:00	0.00	0.00	1.00	1.29	1.65	1.57	1.76	1.67	2.43
	2:25:00	0.00	0.00	0.71	0.90	1.16	1.10	1.24	1.18	1.71
	2:30:00	0.00	0.00	0.48	0.61	0.81	0.77	0.86	0.82	1.19
	2:35:00	0.00	0.00	0.32	0.42	0.56	0.54	0.60	0.57	0.83
	2:40:00	0.00	0.00	0.19	0.27	0.35	0.35	0.39	0.37	0.53
	2:45:00	0.00	0.00	0.10	0.16	0.19	0.20	0.22	0.21	0.30
	2:50:00	0.00	0.00	0.04	0.07	0.08	0.09	0.10	0.10	0.13
	2:55:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.03
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (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'.

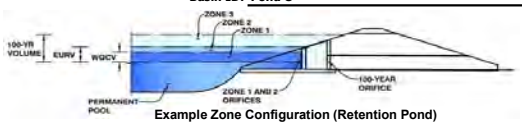
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond C



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	41.47	acres
Watershed Length =	1,890	ft
Watershed Length to Centroid =	1,050	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.828	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	3.084	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.295	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.020	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.602	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	4.390	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.166	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.119	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.68 in.) =	10.099	acre-feet	3.68 inches
Approximate 2-yr Detention Volume =	2.001	acre-feet	
Approximate 5-yr Detention Volume =	2.620	acre-feet	
Approximate 10-yr Detention Volume =	3.167	acre-feet	
Approximate 25-yr Detention Volume =	3.827	acre-feet	
Approximate 50-yr Detention Volume =	4.228	acre-feet	
Approximate 100-yr Detention Volume =	4.663	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.828	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.256	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.579	acre-feet
Total Detention Basin Volume =	4.663	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

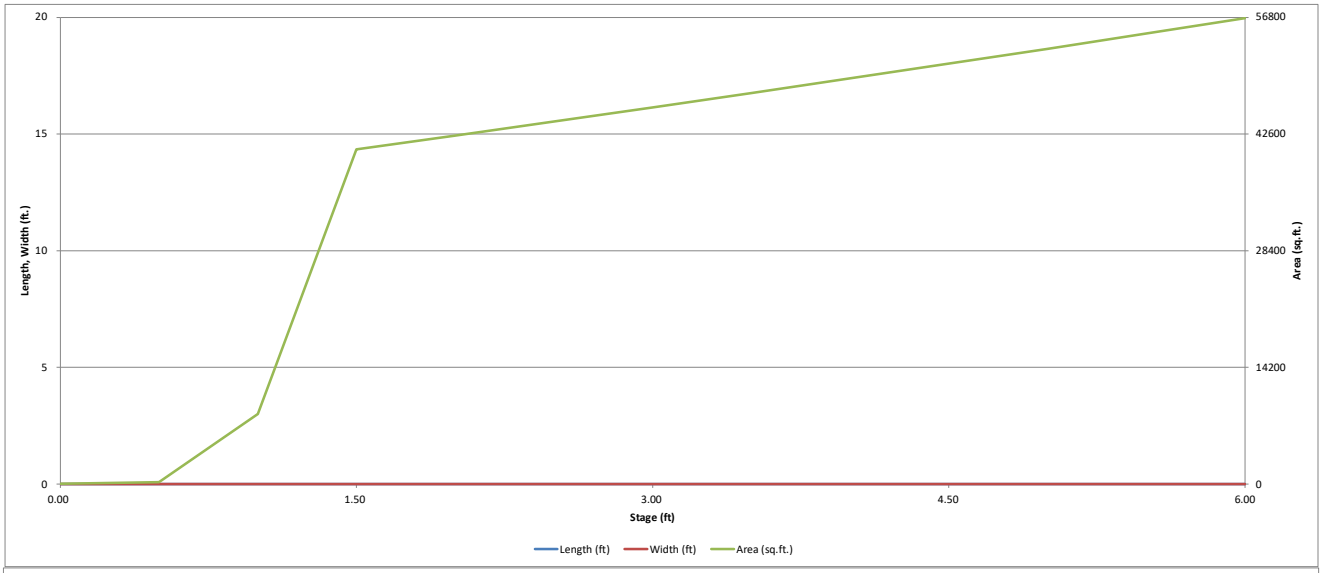
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

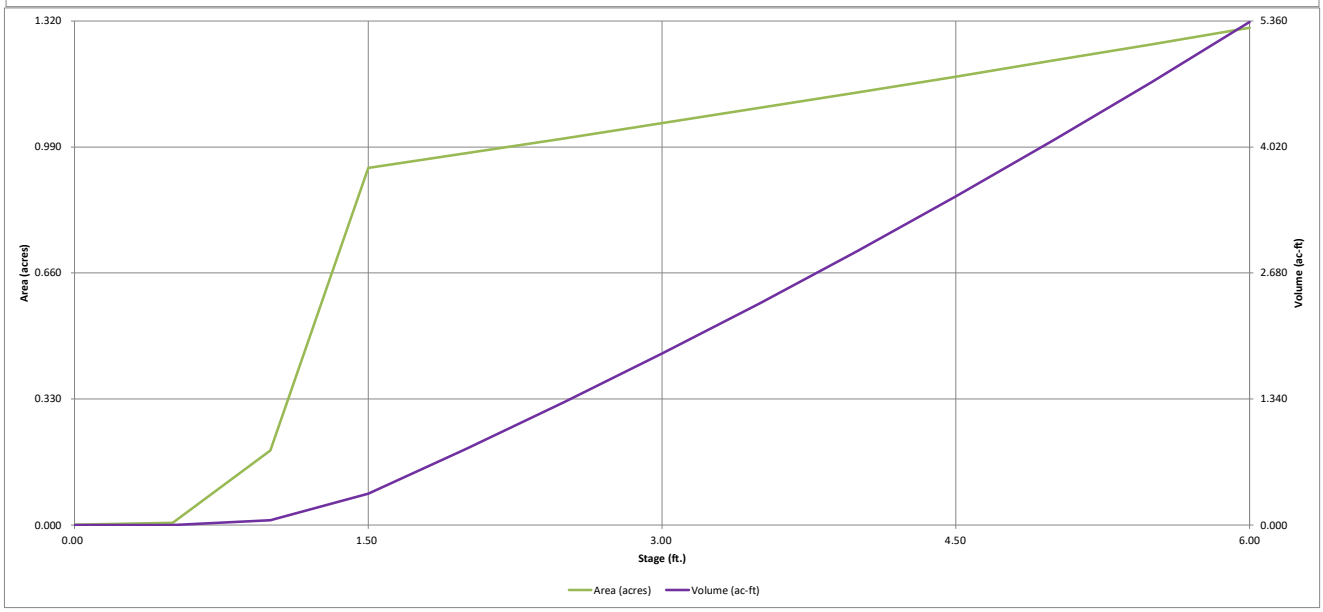
Depth Increment = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	35	0.001		
6927	--	0.50	--	--	--	246	0.006	70	0.002
	--	1.00	--	--	--	8,508	0.195	2,258	0.052
6928	--	1.50	--	--	--	40,729	0.935	14,567	0.334
	--	2.00	--	--	--	42,406	0.974	35,351	0.812
6929	--	2.50	--	--	--	44,107	1.013	56,979	1.308
	--	3.00	--	--	--	45,833	1.052	79,464	1.824
6930	--	3.50	--	--	--	47,584	1.092	102,818	2.360
	--	4.00	--	--	--	49,360	1.133	127,054	2.917
6931	--	4.50	--	--	--	51,160	1.174	152,184	3.494
	--	5.00	--	--	--	52,986	1.216	178,221	4.091
6932	--	5.50	--	--	--	54,836	1.259	205,176	4.710
6932.5	--	6.00	--	--	--	56,711	1.302	233,063	5.350

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



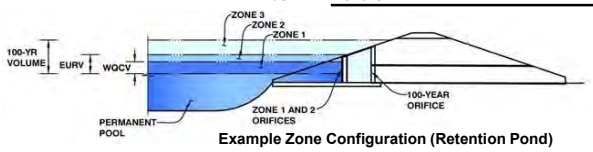


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond C



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.02	0.828	Orifice Plate
Zone 2 (EURV)	4.15	2.256	Rectangular Orifice
Zone 3 (100-year)	5.47	1.579	Weir&Pipe (Restrict)
Total (all zones)		4.663	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.083E-02	ft^2
Depth at top of Zone using Orifice Plate =	2.02	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.00	sq. inches (diameter = 1-15/16 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.67	1.35					
Orifice Area (sq. inches)	3.00	3.00	3.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected		Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.02	N/A	ft (relative to basin bottom at Stage = 0 ft)	0.10	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	4.15	N/A	ft (relative to basin bottom at Stage = 0 ft)	0.10	N/A	feet
Vertical Orifice Height =	2.50	N/A	inches			
Vertical Orifice Width =	6.00		inches			

Calculated Parameters for Vertical Orifice — Vertical Orifice Area = / Vertical Orifice Centroid =

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

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.20	N/A	ft (relative to basin bottom at Stage = 0 ft)	4.95	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	3.09	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	6.00	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	6.46	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		3.23	N/A	ft^2
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow Weir — Height of Grate Upper Edge, H_t = / Overflow Weir Slope Length = / Grate Open Area / 100-yr Orifice Area = / Overflow Grate Open Area w/o Debris = / Overflow Grate Open Area w/ Debris =

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

	Zone 3 Restrictor	Not Selected		Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	1.08	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	0.44	N/A	feet
Restrictor Plate Height Above Pipe Invert =	9.00		inches	1.32	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate — Outlet Orifice Area = / Outlet Orifice Centroid = / Half-Central Angle of Restrictor Plate on Pipe =

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.67	feet
Spillway Crest Length =	60.00	feet	Stage at Top of Freeboard =	7.67	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.30	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	5.35	acre-ft

Calculated Parameters for Spillway

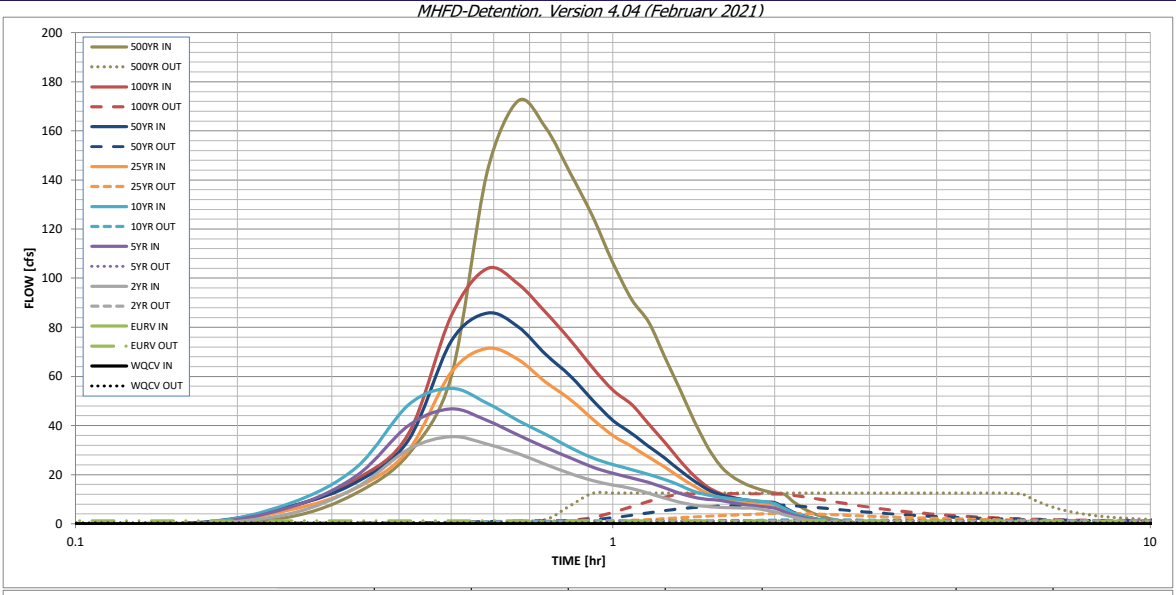
Routed Hydrograph Results

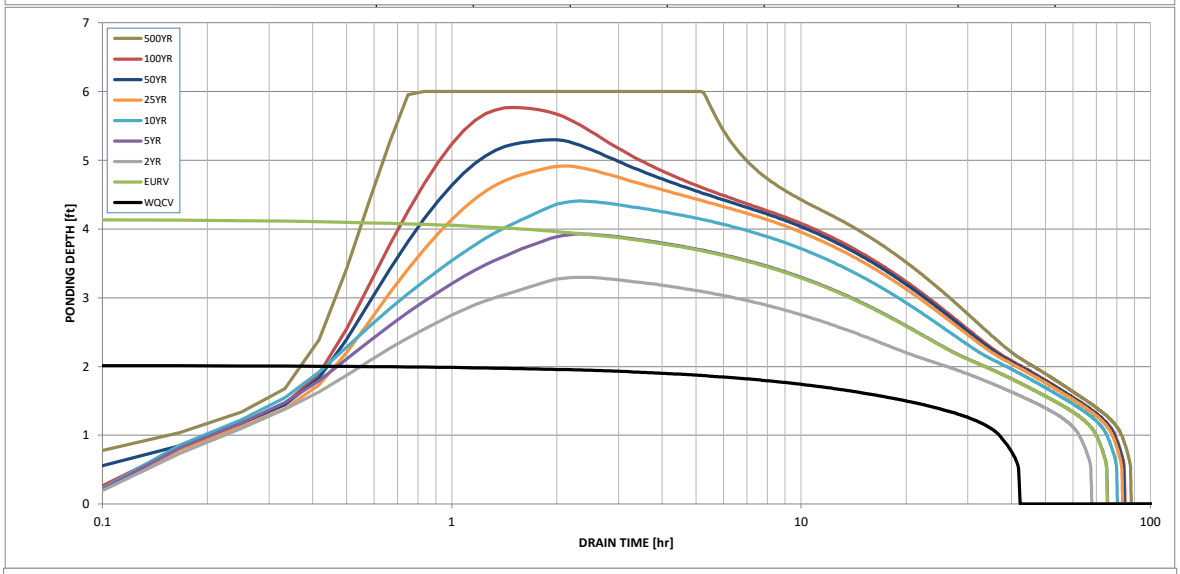
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

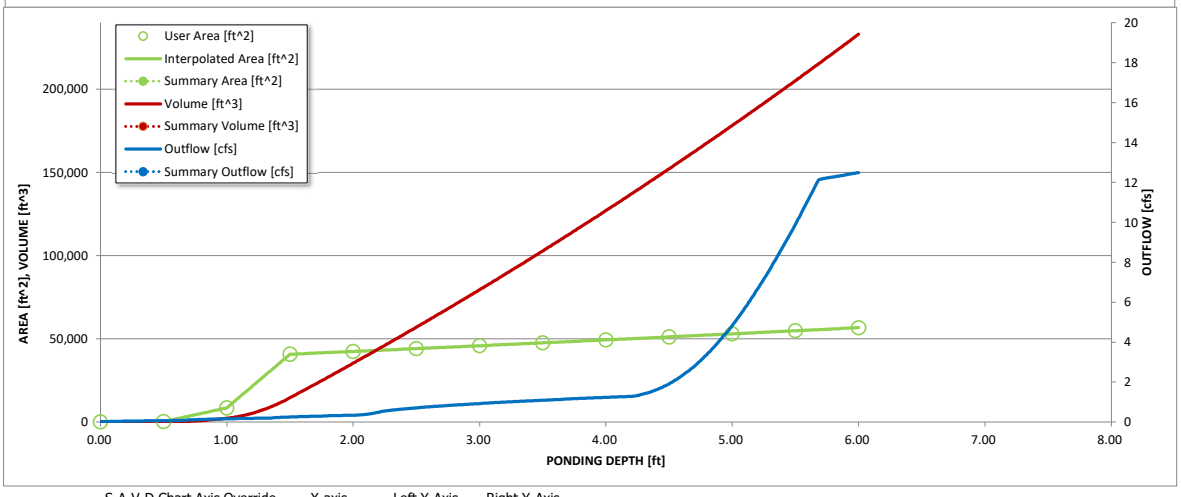
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.828	3.084	2.295	3.020	3.602	4.390	5.166	6.119	10.099
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.295	3.020	3.602	4.390	5.166	6.119	10.099
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.6	0.8	7.2	14.3	23.5	61.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.17	0.34	0.57	1.47
Peak Inflow Q (cfs) =	N/A	N/A	35.5	46.7	55.2	71.4	85.8	103.9	172.3
Peak Outflow Q (cfs) =	0.3	1.3	1.0	1.2	1.6	4.2	7.6	12.2	12.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.2	2.1	0.6	0.5	0.5	0.2
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.4	1.0	1.6	1.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	67	61	67	71	72	72	70	67
Time to Drain 99% of Inflow Volume (hours) =	**41**	72	65	72	76	78	79	79	79
Maximum Ponding Depth (ft) =	2.02	4.15	3.30	3.93	4.40	4.92	5.30	5.77	6.00
Area at Maximum Ponding Depth (acres) =	0.98	1.15	1.08	1.13	1.17	1.21	1.24	1.28	1.30
Maximum Volume Stored (acre-ft) =	0.831	3.088	2.133	2.826	3.377	3.982	4.448	5.040	5.350

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.05	2.77
	0:15:00	0.00	0.00	4.11	6.67	8.28	5.57	6.99	6.81	12.53
	0:20:00	0.00	0.00	14.84	19.53	23.00	14.54	16.96	18.16	28.48
	0:25:00	0.00	0.00	30.31	40.06	48.42	29.97	34.20	36.77	59.81
	0:30:00	0.00	0.00	35.49	46.73	55.15	61.71	74.34	84.53	142.93
	0:35:00	0.00	0.00	32.45	42.04	49.08	71.41	85.81	103.91	172.29
	0:40:00	0.00	0.00	28.50	36.14	42.03	66.86	80.18	97.61	161.15
	0:45:00	0.00	0.00	24.17	31.05	36.32	57.67	68.91	86.01	142.85
	0:50:00	0.00	0.00	20.44	26.87	31.02	50.61	60.24	74.82	125.19
	0:55:00	0.00	0.00	17.63	23.10	26.80	42.59	50.37	63.54	106.35
	1:00:00	0.00	0.00	15.80	20.57	24.16	35.91	42.16	54.43	91.39
	1:05:00	0.00	0.00	14.38	18.63	22.07	31.48	36.78	48.56	82.03
	1:10:00	0.00	0.00	12.34	16.79	20.01	27.07	31.47	40.52	67.82
	1:15:00	0.00	0.00	10.39	14.56	18.01	23.07	26.68	33.08	54.71
	1:20:00	0.00	0.00	8.76	12.35	15.60	18.89	21.72	25.74	42.02
	1:25:00	0.00	0.00	7.62	10.77	13.20	15.35	17.50	19.50	31.32
	1:30:00	0.00	0.00	7.02	9.95	11.74	12.37	14.01	14.96	23.71
	1:35:00	0.00	0.00	6.71	9.50	10.85	10.57	11.92	12.34	19.28
	1:40:00	0.00	0.00	6.54	8.59	10.21	9.47	10.66	10.78	16.58
	1:45:00	0.00	0.00	6.42	7.83	9.74	8.74	9.83	9.73	14.72
	1:50:00	0.00	0.00	6.33	7.27	9.42	8.24	9.27	9.02	13.46
	1:55:00	0.00	0.00	5.58	6.86	8.98	7.90	8.89	8.50	12.55
	2:00:00	0.00	0.00	4.89	6.37	8.19	7.66	8.62	8.16	11.95
	2:05:00	0.00	0.00	3.72	4.86	6.20	5.87	6.60	6.21	9.07
	2:10:00	0.00	0.00	2.72	3.52	4.48	4.24	4.76	4.49	6.53
	2:15:00	0.00	0.00	1.97	2.56	3.24	3.07	3.45	3.27	4.74
	2:20:00	0.00	0.00	1.42	1.84	2.34	2.22	2.49	2.38	3.44
	2:25:00	0.00	0.00	1.01	1.28	1.65	1.57	1.75	1.68	2.42
	2:30:00	0.00	0.00	0.69	0.87	1.15	1.09	1.22	1.17	1.69
	2:35:00	0.00	0.00	0.46	0.60	0.79	0.76	0.85	0.81	1.17
	2:40:00	0.00	0.00	0.28	0.39	0.50	0.49	0.55	0.52	0.75
	2:45:00	0.00	0.00	0.14	0.22	0.27	0.28	0.31	0.30	0.42
	2:50:00	0.00	0.00	0.06	0.10	0.12	0.13	0.14	0.14	0.19
	2:55:00	0.00	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (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'.

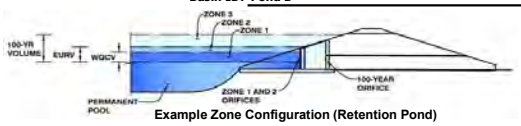
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond D



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	12.15	acres
Watershed Length =	1,200	ft
Watershed Length to Centroid =	600	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.30%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.244 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.909 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.666 acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.876 acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.045 acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.272 acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.496 acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.770 acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	2.916 acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.590 acre-feet		
Approximate 5-yr Detention Volume =	0.772 acre-feet		
Approximate 10-yr Detention Volume =	0.934 acre-feet		
Approximate 25-yr Detention Volume =	1.128 acre-feet		
Approximate 50-yr Detention Volume =	1.246 acre-feet		
Approximate 100-yr Detention Volume =	1.373 acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.244	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.666	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.464	acre-feet
Total Detention Basin Volume =	1.373	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	35	0.001		
6969	--	0.50	--	--	--	35	0.001	18	0.000
	--	1.00	--	--	--	5,514	0.127	1,404	0.032
6970	--	1.50	--	--	--	13,763	0.316	6,223	0.143
	--	2.00	--	--	--	14,669	0.337	13,331	0.306
6971	--	2.50	--	--	--	15,600	0.358	20,899	0.480
	--	3.00	--	--	--	16,556	0.380	28,938	0.664
6972	--	3.50	--	--	--	17,537	0.403	37,461	0.860
	--	4.00	--	--	--	18,542	0.426	46,481	1.067
6973	--	4.50	--	--	--	19,573	0.449	56,009	1.286
	--	5.00	--	--	--	20,628	0.474	66,059	1.517
6974	--	5.50	--	--	--	21,708	0.498	76,643	1.759

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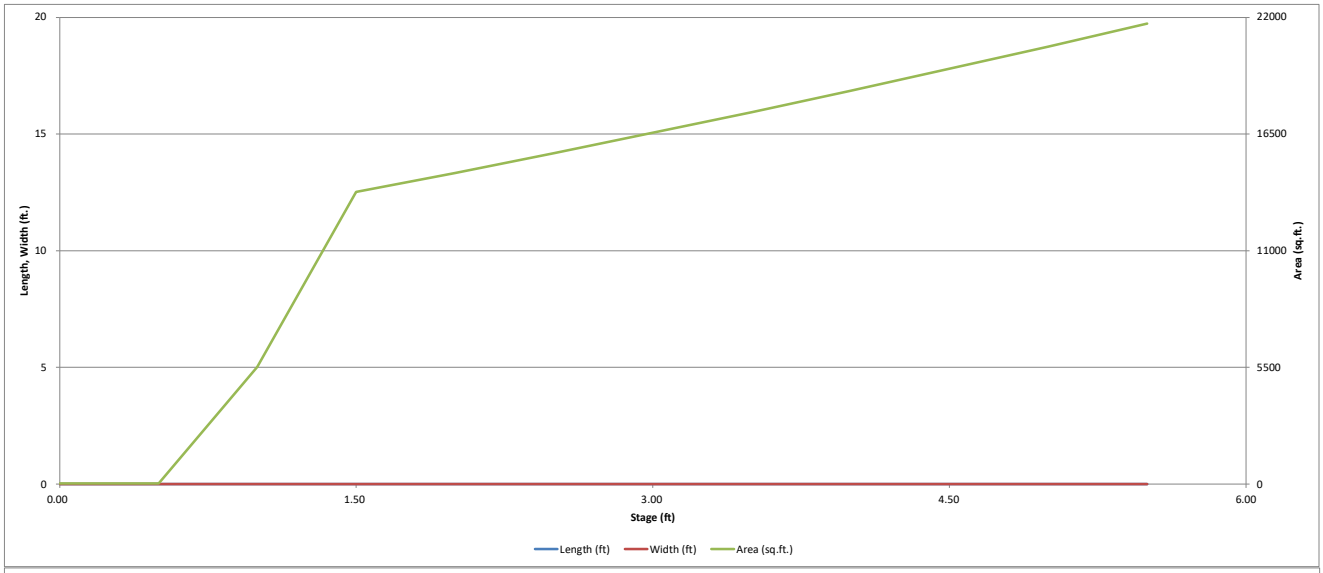
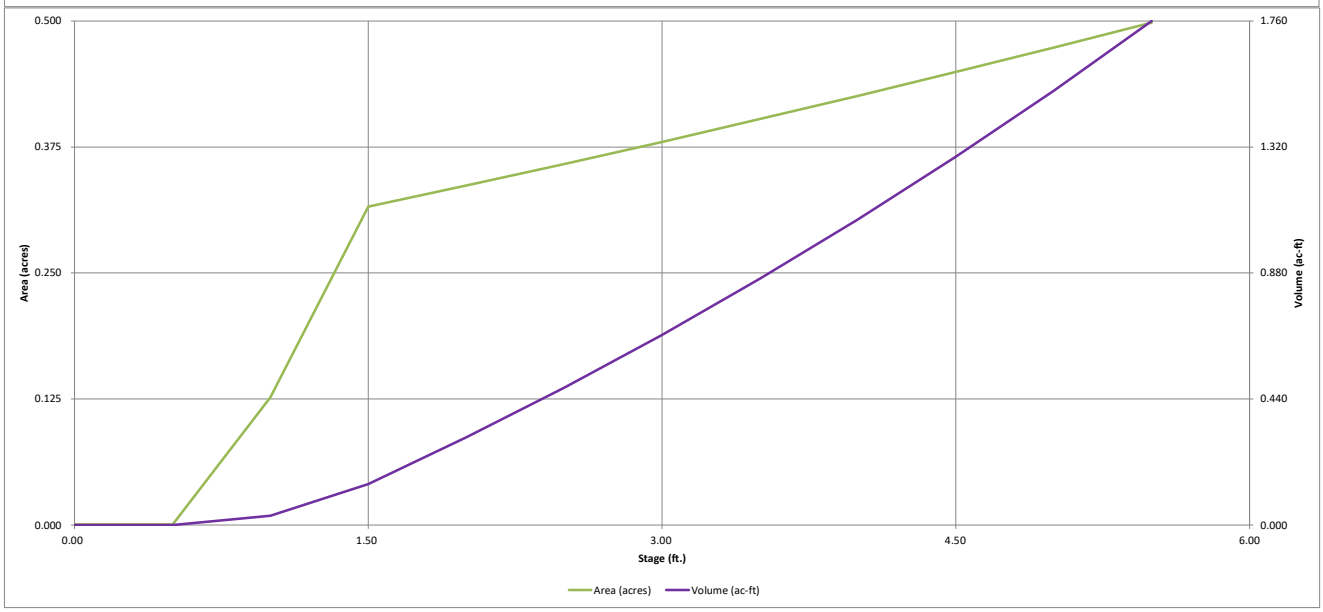
MHFD-Detention, Version 4.04 (February 2021)



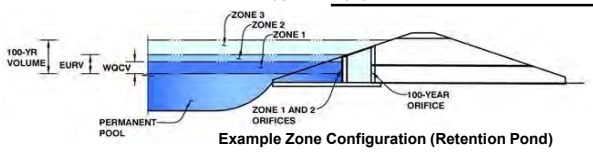


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond D



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.82	0.244	Orifice Plate
Zone 2 (EURV)	3.63	0.666	Circular Orifice
Zone 3 (100-year)	4.70	0.464	Weir&Pipe (Restrict)
Total (all zones)		1.373	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.597E-03	ft^2
Depth at top of Zone using Orifice Plate =	1.82	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	7.10	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.95	sq. inches (diameter = 1-1/16 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.61	1.21					
Orifice Area (sq. inches)	0.95	0.95	0.95					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected		Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.90	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.03	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.63	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.10	N/A	feet
Vertical Orifice Diameter =	2.50	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.67	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.42	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.09	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	9.78	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.46	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.23	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected		Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.66	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.35	N/A	feet
Restrictor Plate Height Above Pipe Invert =	7.20		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.37	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.75	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.32	feet
Spillway Crest Length =	50.00	feet	Stage at Top of Freeboard =	6.07	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.50	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.76	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.244	0.909	0.666	0.876	1.045	1.272	1.496	1.770	2.916
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.666	0.876	1.045	1.272	1.496	1.770	2.916
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.0	4.0	6.5	16.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.16	0.33	0.53	1.38
Peak Inflow Q (cfs) =	N/A	N/A	9.8	12.9	15.2	19.7	23.7	28.7	47.5
Peak Outflow Q (cfs) =	0.1	0.4	0.3	0.4	0.5	1.7	3.1	5.8	29.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.3	2.4	0.9	0.8	0.9	1.8
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.4	0.8	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	68	62	68	72	72	71	70	63
Time to Drain 99% of Inflow Volume (hours) =	**41**	73	66	73	78	79	78	78	75
Maximum Ponding Depth (ft) =	1.82	3.63	2.89	3.40	3.79	4.14	4.38	4.69	5.03
Area at Maximum Ponding Depth (acres) =	0.33	0.41	0.37	0.40	0.42	0.43	0.44	0.46	0.48
Maximum Volume Stored (acre-ft) =	0.246	0.913	0.619	0.820	0.979	1.127	1.228	1.372	1.531

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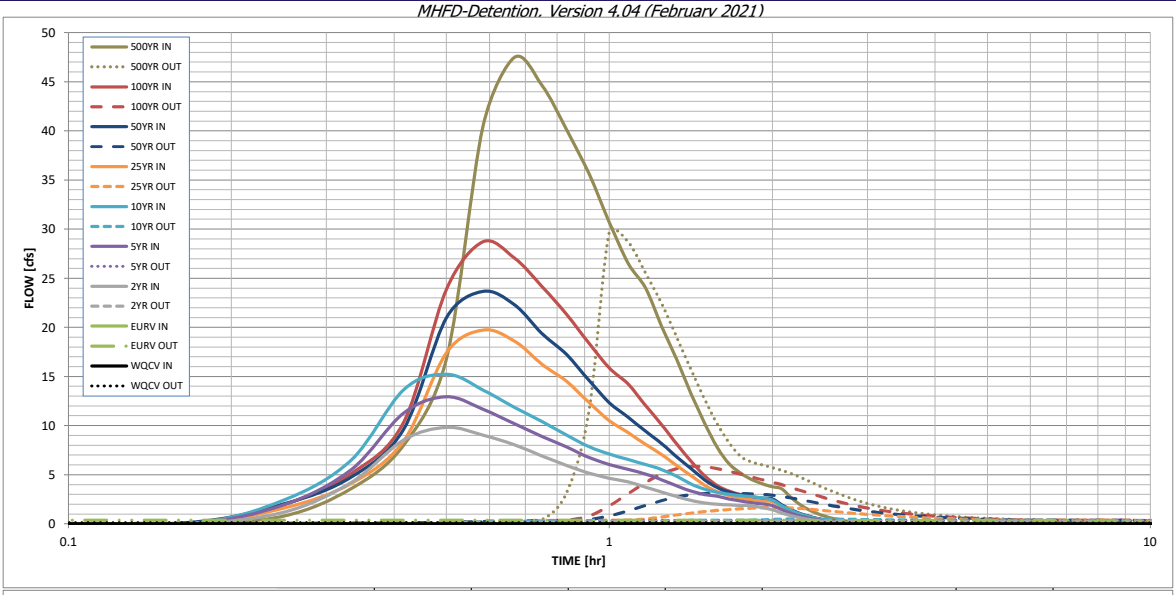
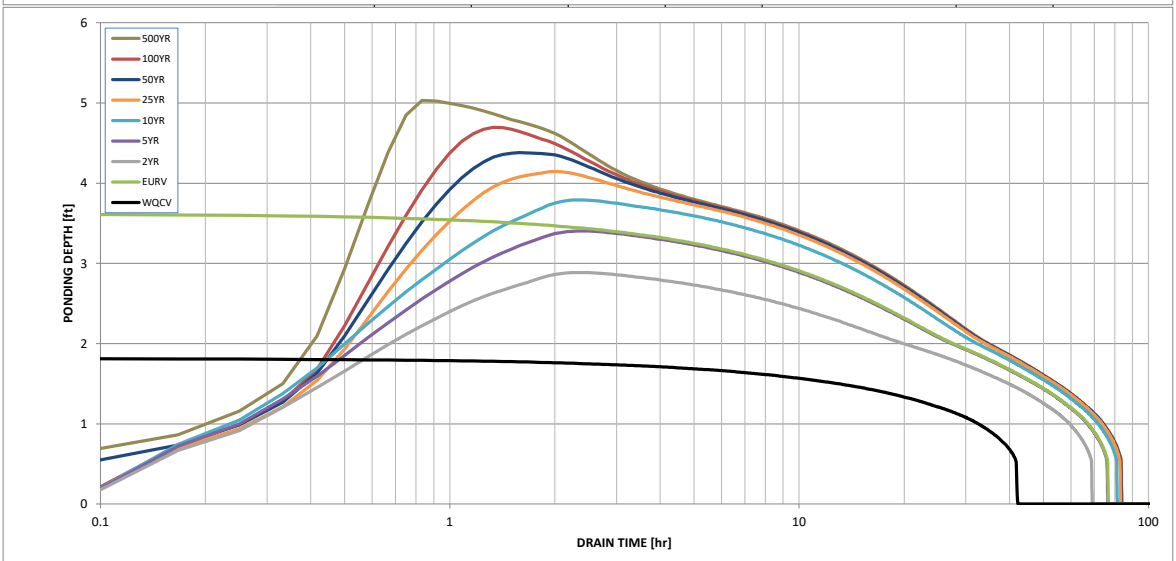
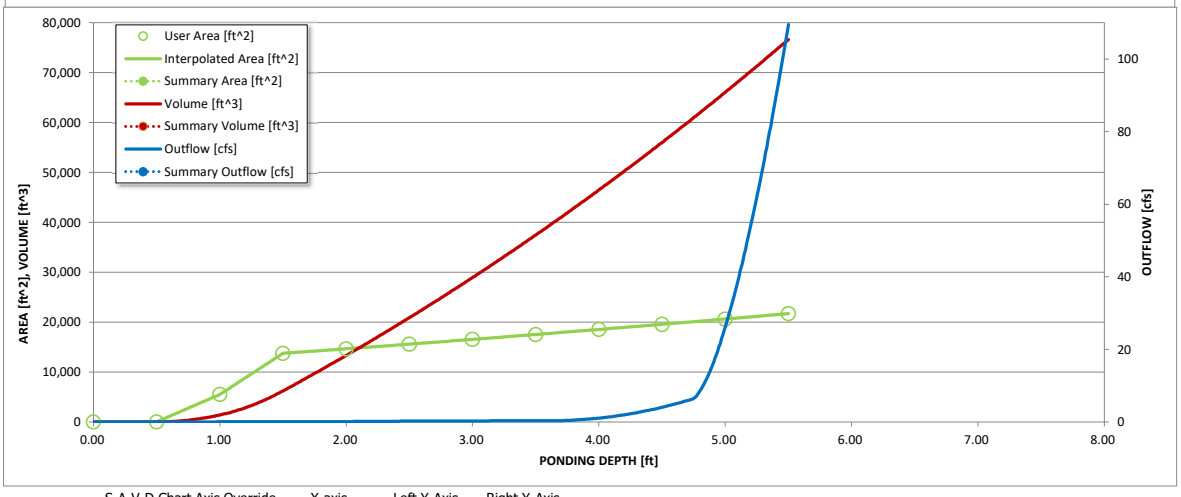






S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.01	0.80
	0:15:00	0.00	0.00	1.19	1.94	2.41	1.62	2.02	1.98	3.58
	0:20:00	0.00	0.00	4.23	5.53	6.50	4.10	4.78	5.12	8.02
	0:25:00	0.00	0.00	8.53	11.29	13.66	8.45	9.65	10.36	16.88
	0:30:00	0.00	0.00	9.83	12.93	15.22	17.43	21.01	23.91	40.39
	0:35:00	0.00	0.00	9.02	11.68	13.64	19.73	23.67	28.70	47.46
	0:40:00	0.00	0.00	8.05	10.21	11.88	18.62	22.32	27.08	44.68
	0:45:00	0.00	0.00	6.92	8.91	10.43	16.25	19.40	24.18	40.12
	0:50:00	0.00	0.00	5.95	7.82	9.03	14.49	17.24	21.32	35.63
	0:55:00	0.00	0.00	5.17	6.77	7.85	12.35	14.60	18.38	30.71
	1:00:00	0.00	0.00	4.65	6.05	7.10	10.51	12.33	15.86	26.53
	1:05:00	0.00	0.00	4.27	5.53	6.55	9.28	10.85	14.23	23.97
	1:10:00	0.00	0.00	3.73	5.07	6.04	8.09	9.41	12.03	20.09
	1:15:00	0.00	0.00	3.23	4.49	5.53	7.04	8.16	10.09	16.66
	1:20:00	0.00	0.00	2.76	3.86	4.82	5.90	6.80	8.09	13.22
	1:25:00	0.00	0.00	2.38	3.33	4.05	4.90	5.61	6.35	10.25
	1:30:00	0.00	0.00	2.12	2.99	3.51	3.93	4.47	4.89	7.75
	1:35:00	0.00	0.00	1.99	2.81	3.21	3.26	3.68	3.89	6.09
	1:40:00	0.00	0.00	1.92	2.53	3.01	2.86	3.23	3.32	5.14
	1:45:00	0.00	0.00	1.88	2.31	2.87	2.62	2.94	2.96	4.51
	1:50:00	0.00	0.00	1.85	2.15	2.77	2.45	2.76	2.72	4.09
	1:55:00	0.00	0.00	1.63	2.03	2.64	2.34	2.63	2.55	3.78
	2:00:00	0.00	0.00	1.44	1.88	2.41	2.26	2.54	2.43	3.57
	2:05:00	0.00	0.00	1.10	1.44	1.84	1.73	1.94	1.83	2.67
	2:10:00	0.00	0.00	0.83	1.07	1.36	1.28	1.44	1.35	1.96
	2:15:00	0.00	0.00	0.62	0.80	1.01	0.95	1.07	1.00	1.45
	2:20:00	0.00	0.00	0.46	0.59	0.74	0.70	0.79	0.75	1.08
	2:25:00	0.00	0.00	0.33	0.42	0.54	0.51	0.57	0.54	0.78
	2:30:00	0.00	0.00	0.24	0.30	0.39	0.36	0.41	0.39	0.56
	2:35:00	0.00	0.00	0.17	0.21	0.28	0.26	0.30	0.28	0.41
	2:40:00	0.00	0.00	0.11	0.14	0.19	0.18	0.20	0.19	0.28
	2:45:00	0.00	0.00	0.06	0.09	0.12	0.12	0.13	0.12	0.17
	2:50:00	0.00	0.00	0.03	0.05	0.06	0.07	0.07	0.07	0.10
	2:55:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.04
	3:00:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (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'.

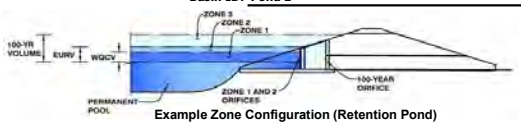
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond E



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	21.36	acres
Watershed Length =	1,800	ft
Watershed Length to Centroid =	900	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.70%	percent
Percentage Hydrologic Soil Group A =	90.0%	percent
Percentage Hydrologic Soil Group B =	10.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.431	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.594	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.208	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.585	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.887	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	2.347	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.751	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.260	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.68 in.) =	5.338	acre-feet	3.68 inches
Approximate 2-yr Detention Volume =	1.052	acre-feet	
Approximate 5-yr Detention Volume =	1.381	acre-feet	
Approximate 10-yr Detention Volume =	1.680	acre-feet	
Approximate 25-yr Detention Volume =	2.004	acre-feet	
Approximate 50-yr Detention Volume =	2.201	acre-feet	
Approximate 100-yr Detention Volume =	2.421	acre-feet	

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.431	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.163	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.828	acre-feet
Total Detention Basin Volume =	2.421	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

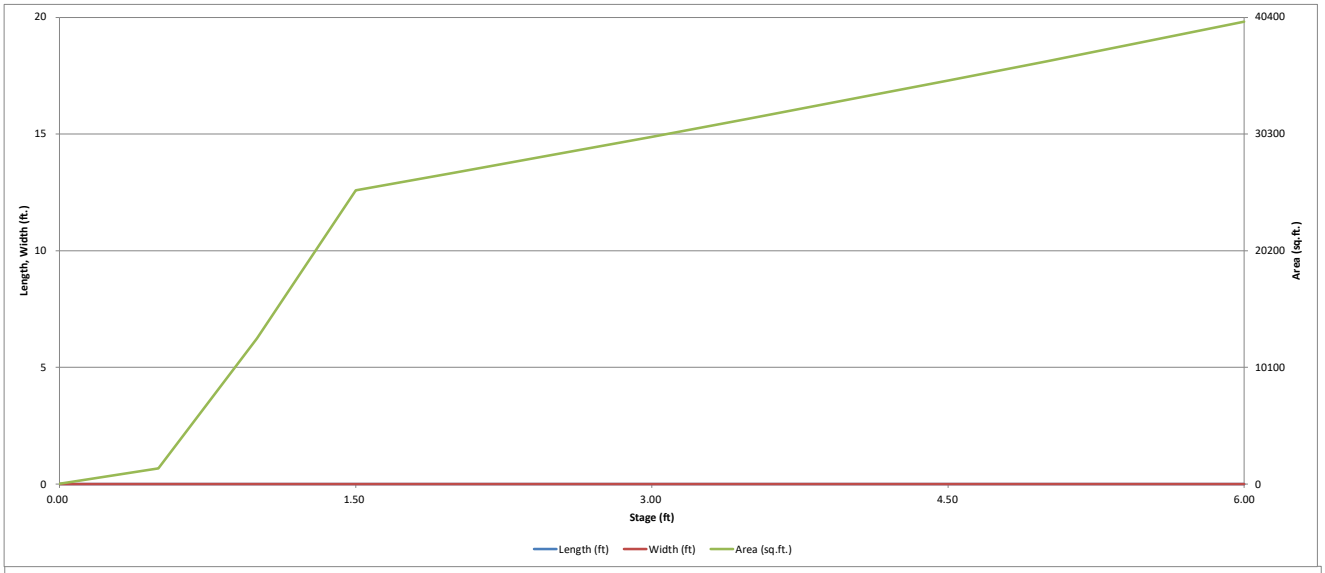
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

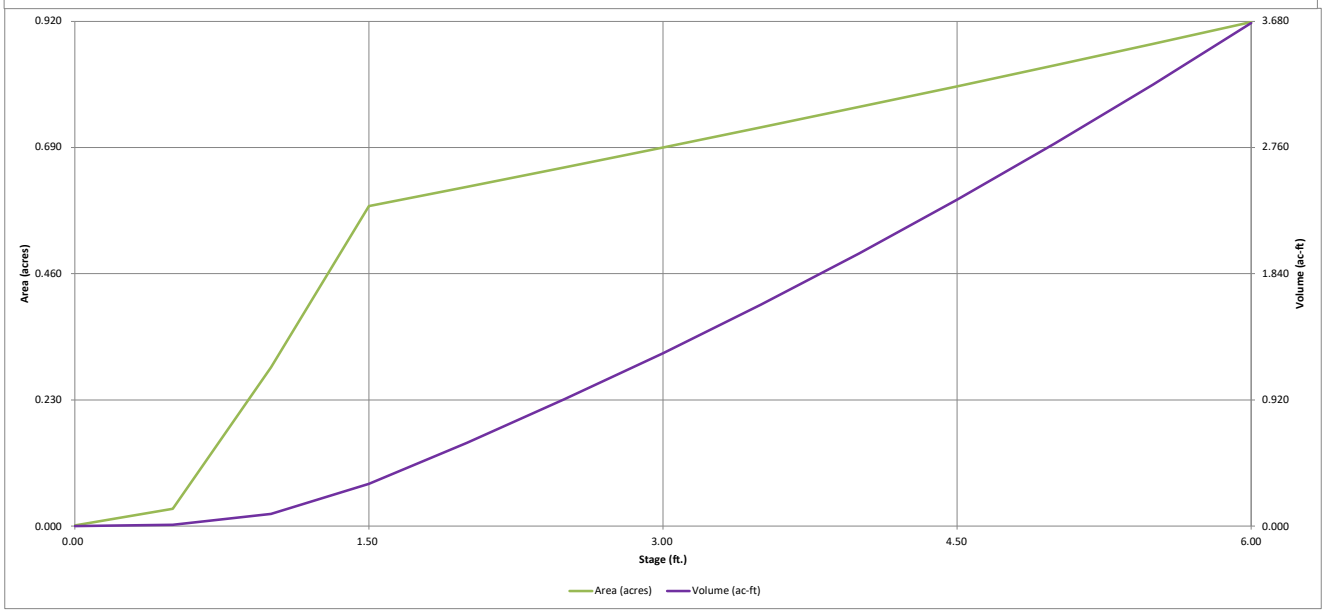
Depth Increment = 0.50 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	35	0.001		
	--	0.50	--	--	--	1,362	0.031	349	0.008
6947	--	1.00	--	--	--	12,615	0.290	3,843	0.088
	--	1.50	--	--	--	25,422	0.584	13,352	0.307
6948	--	2.00	--	--	--	26,944	0.619	26,443	0.607
	--	2.50	--	--	--	28,490	0.654	40,302	0.925
6949	--	3.00	--	--	--	30,062	0.690	54,940	1.261
	--	3.50	--	--	--	31,660	0.727	70,370	1.615
6950	--	4.00	--	--	--	33,282	0.764	86,606	1.988
	--	4.50	--	--	--	34,931	0.802	103,659	2.380
6951	--	5.00	--	--	--	36,604	0.840	121,543	2.790
	--	5.50	--	--	--	38,303	0.879	140,270	3.220
6952	--	6.00	--	--	--	40,027	0.919	159,852	3.670

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



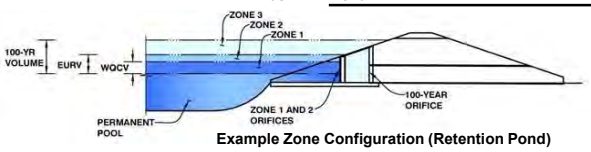


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview**

Basin ID: **Pond E**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.72	0.431	Orifice Plate
Zone 2 (EURV)	3.48	1.163	Rectangular Orifice
Zone 3 (100-year)	4.56	0.828	Weir&Pipe (Restrict)
Total (all zones)		2.421	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.250E-02	ft^2
Depth at top of Zone using Orifice Plate =	1.72	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	6.80	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.80	sq. inches (diameter = 1-1/2 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.57	1.15					
Orifice Area (sq. inches)	1.80	1.80	1.80					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected		Calculated Parameters for Vertical Orifice: Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	1.75	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.06	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.48	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.06	N/A	feet
Vertical Orifice Height =	1.50	N/A	inches				
Vertical Orifice Width =	6.00		inches				

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

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir: Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.25	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.09	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.40	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.46	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.23	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate: Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.01	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.48	N/A	feet
Restrictor Plate Height Above Pipe Invert =	10.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.68	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.40	feet
Spillway Crest Length =	60.00	feet	Stage at Top of Freeboard =	6.20	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.92	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.67	acre-ft

Calculated Parameters for Spillway

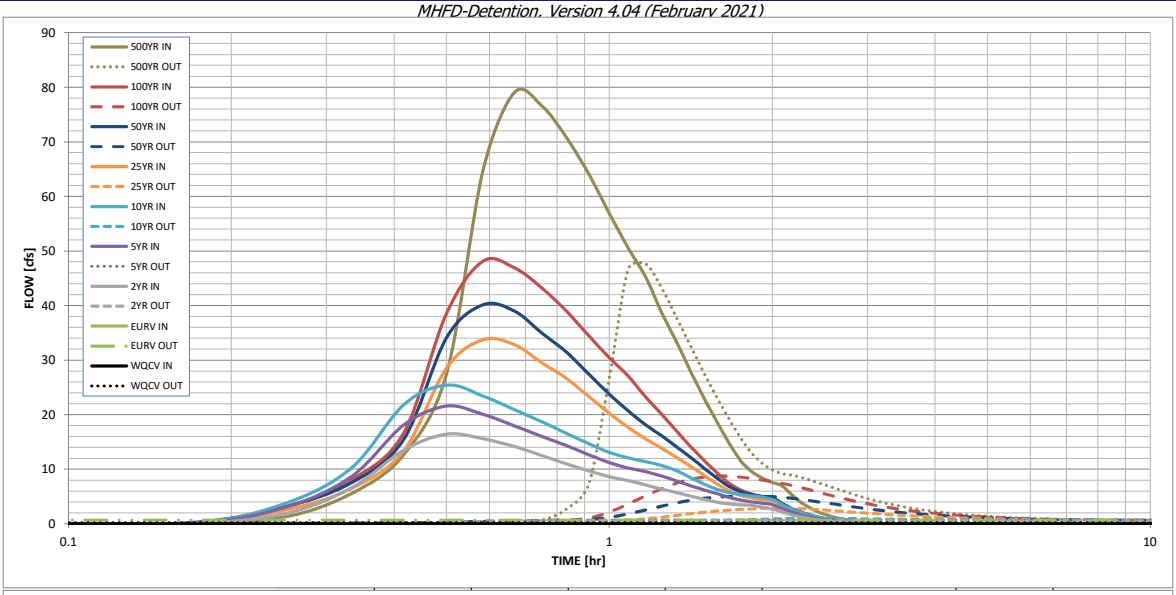
Routed Hydrograph Results

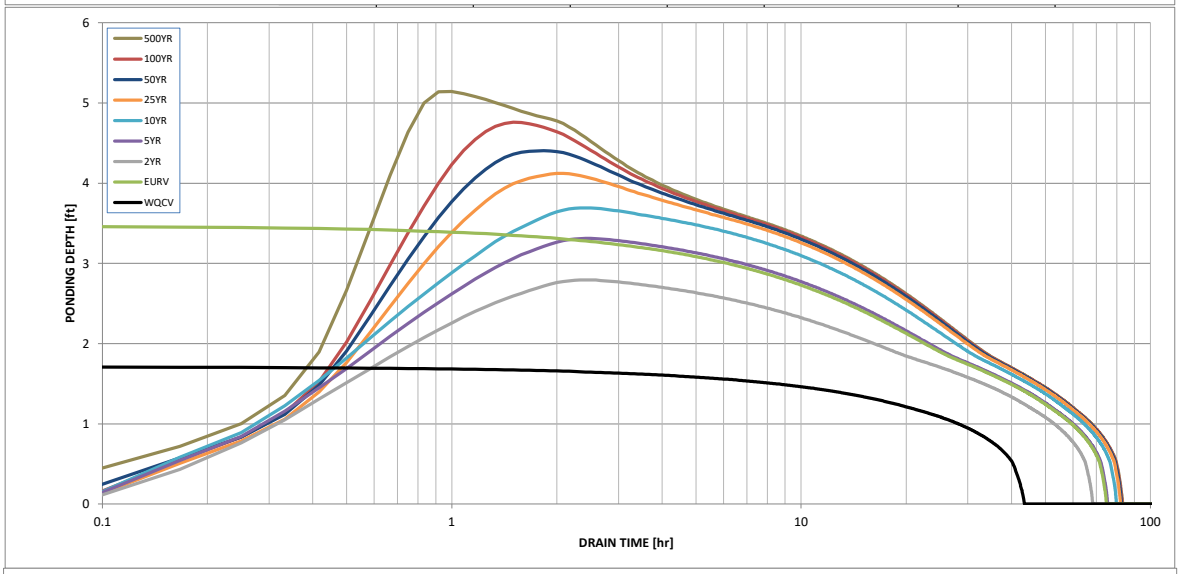
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

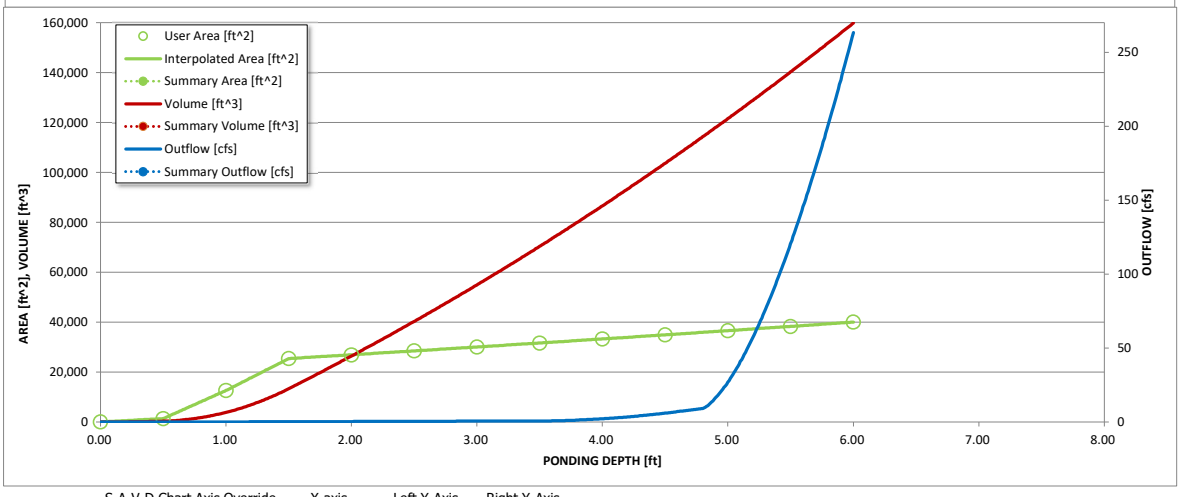
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.431	1.594	1.208	1.585	1.887	2.347	2.751	3.260	5.338
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.208	1.585	1.887	2.347	2.751	3.260	5.338
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.3	0.4	4.6	7.7	12.0	28.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.22	0.36	0.56	1.34
Peak Inflow Q (cfs) =	N/A	N/A	16.4	21.6	25.4	33.7	40.1	48.1	79.0
Peak Outflow Q (cfs) =	0.2	0.7	0.6	0.7	1.0	2.9	5.1	8.8	47.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.5	2.7	0.6	0.7	0.7	1.7
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.7	1.2	1.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	65	60	65	69	69	68	67	60
Time to Drain 99% of Inflow Volume (hours) =	**42**	70	64	70	74	76	76	75	72
Maximum Ponding Depth (ft) =	1.72	3.48	2.79	3.31	3.69	4.12	4.40	4.76	5.14
Area at Maximum Ponding Depth (acres) =	0.60	0.73	0.67	0.71	0.74	0.77	0.79	0.82	0.85
Maximum Volume Stored (acre-ft) =	0.437	1.601	1.118	1.472	1.755	2.080	2.300	2.583	2.909

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.02	1.22
	0:15:00	0.00	0.00	1.81	2.94	3.65	2.46	3.08	3.00	5.54
	0:20:00	0.00	0.00	6.56	8.65	10.19	6.44	7.52	8.04	12.67
	0:25:00	0.00	0.00	13.50	18.10	21.83	13.40	15.46	16.66	27.54
	0:30:00	0.00	0.00	16.45	21.57	25.41	28.55	34.13	38.59	64.65
	0:35:00	0.00	0.00	15.58	20.07	23.43	33.71	40.14	48.11	78.96
	0:40:00	0.00	0.00	14.18	17.96	20.91	32.82	39.01	46.90	76.61
	0:45:00	0.00	0.00	12.48	15.99	18.69	29.51	34.96	43.23	70.73
	0:50:00	0.00	0.00	11.00	14.33	16.57	26.62	31.43	38.92	64.02
	0:55:00	0.00	0.00	9.71	12.64	14.68	23.28	27.41	34.41	56.89
	1:00:00	0.00	0.00	8.65	11.20	13.09	20.22	23.75	30.43	50.54
	1:05:00	0.00	0.00	7.93	10.23	12.08	17.68	20.71	27.08	45.20
	1:10:00	0.00	0.00	7.11	9.55	11.36	15.54	18.15	23.23	38.67
	1:15:00	0.00	0.00	6.37	8.75	10.68	13.85	16.11	20.05	33.16
	1:20:00	0.00	0.00	5.71	7.84	9.69	12.10	14.03	16.89	27.70
	1:25:00	0.00	0.00	5.07	6.96	8.41	10.46	12.08	14.04	22.81
	1:30:00	0.00	0.00	4.46	6.16	7.25	8.79	10.11	11.53	18.54
	1:35:00	0.00	0.00	3.96	5.50	6.30	7.28	8.32	9.28	14.71
	1:40:00	0.00	0.00	3.63	4.81	5.70	6.02	6.83	7.40	11.53
	1:45:00	0.00	0.00	3.48	4.34	5.35	5.21	5.89	6.19	9.59
	1:50:00	0.00	0.00	3.39	4.03	5.12	4.73	5.34	5.47	8.39
	1:55:00	0.00	0.00	3.04	3.79	4.87	4.43	5.00	5.01	7.58
	2:00:00	0.00	0.00	2.71	3.53	4.49	4.22	4.76	4.68	7.00
	2:05:00	0.00	0.00	2.16	2.81	3.58	3.37	3.79	3.67	5.44
	2:10:00	0.00	0.00	1.67	2.17	2.76	2.58	2.90	2.76	4.05
	2:15:00	0.00	0.00	1.29	1.68	2.12	1.98	2.22	2.08	3.03
	2:20:00	0.00	0.00	0.99	1.28	1.62	1.51	1.69	1.58	2.30
	2:25:00	0.00	0.00	0.75	0.97	1.22	1.14	1.28	1.20	1.74
	2:30:00	0.00	0.00	0.57	0.72	0.91	0.85	0.95	0.90	1.30
	2:35:00	0.00	0.00	0.42	0.53	0.67	0.63	0.70	0.67	0.96
	2:40:00	0.00	0.00	0.31	0.39	0.50	0.47	0.53	0.50	0.73
	2:45:00	0.00	0.00	0.22	0.27	0.36	0.34	0.38	0.37	0.53
	2:50:00	0.00	0.00	0.14	0.19	0.24	0.24	0.26	0.25	0.36
	2:55:00	0.00	0.00	0.08	0.12	0.15	0.15	0.16	0.16	0.22
	3:00:00	0.00	0.00	0.04	0.06	0.08	0.08	0.09	0.08	0.12
	3:05:00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.03	0.04
	3:10:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

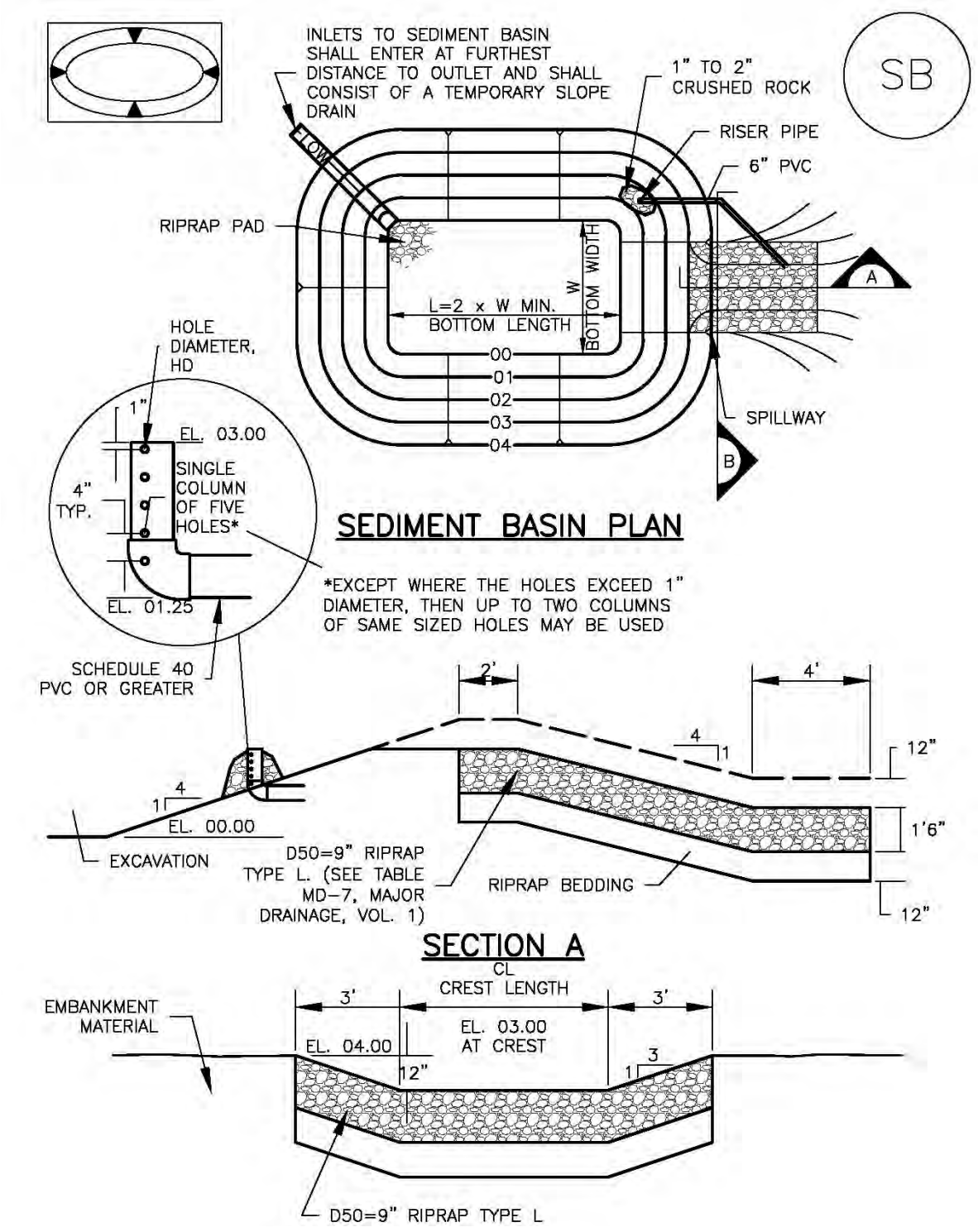
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

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).

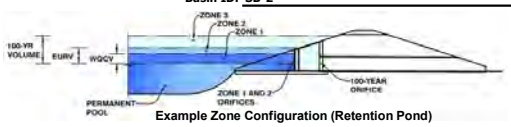

INLETS TO SEDIMENT BASIN SHALL ENTER AT FURTHEST DISTANCE TO OUTLET AND SHALL CONSIST OF A TEMPORARY SLOPE DRAIN
1" TO 2" CRUSHED ROCK
SB
RISER PIPE
6" PVC
FLOW
RIPRAP PAD
W BOTTOM WIDTH
L=2 x W MIN. BOTTOM LENGTH
00
01
02
03
04
A
B
SPILLWAY
HOLE DIAMETER, HD
1"
EL. 03.00
4" TYP.
SINGLE COLUMN OF FIVE HOLES*
EL. 01.25
SEDIMENT BASIN PLAN
*EXCEPT WHERE THE HOLES EXCEED 1" DIAMETER, THEN UP TO TWO COLUMNS OF SAME SIZED HOLES MAY BE USED
SCHEDULE 40 PVC OR GREATER
2'
4'
4
1
12"
4
1
EL. 00.00
1'6"
EXCAVATION
D50=9" RIPRAP TYPE L. (SEE TABLE MD-7, MAJOR DRAINAGE, VOL. 1)
RIPRAP BEDDING
12"
SECTION A
CL
CREST LENGTH
3'
3'
EMBANKMENT MATERIAL
EL. 04.00
EL. 03.00 AT CREST
12"
3
1
D50=9" RIPRAP TYPE L

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview - Proposed**

Basin ID: **SB-2**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	11.67	acres
Watershed Length =	930	ft
Watershed Length to Centroid =	465	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.015	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.011	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.006	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.012	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.016	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.146	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.294	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.496	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.453	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.006	acre-feet		
Approximate 5-yr Detention Volume =	0.009	acre-feet		
Approximate 10-yr Detention Volume =	0.012	acre-feet		
Approximate 25-yr Detention Volume =	0.019	acre-feet		
Approximate 50-yr Detention Volume =	0.046	acre-feet		
Approximate 100-yr Detention Volume =	0.126	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.015	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.015	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

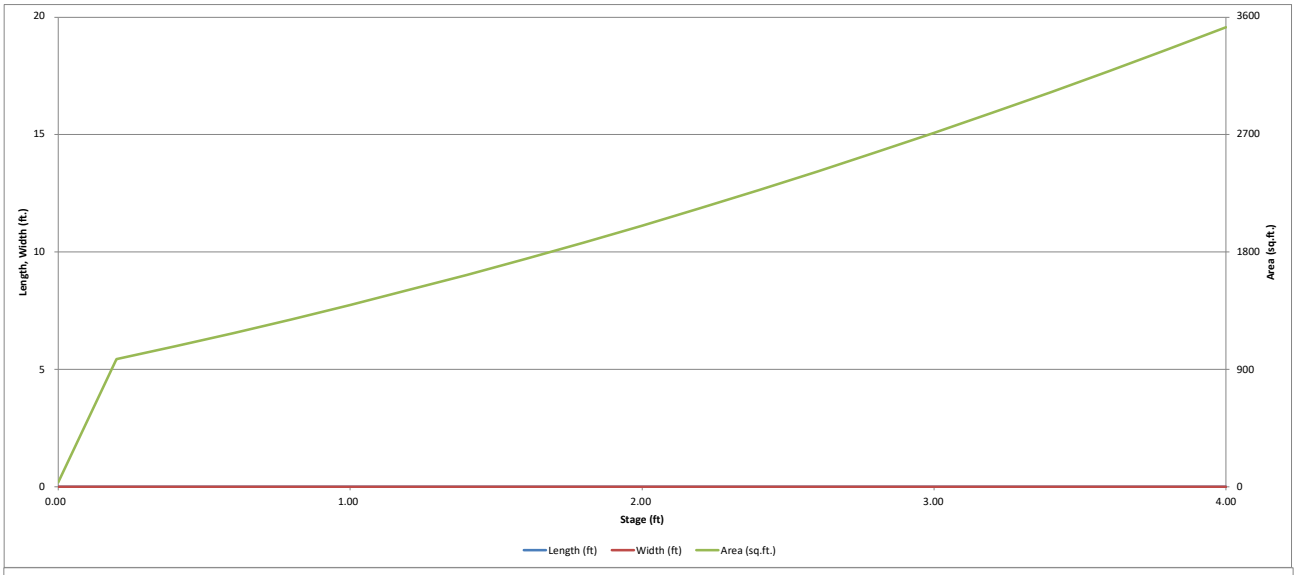
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

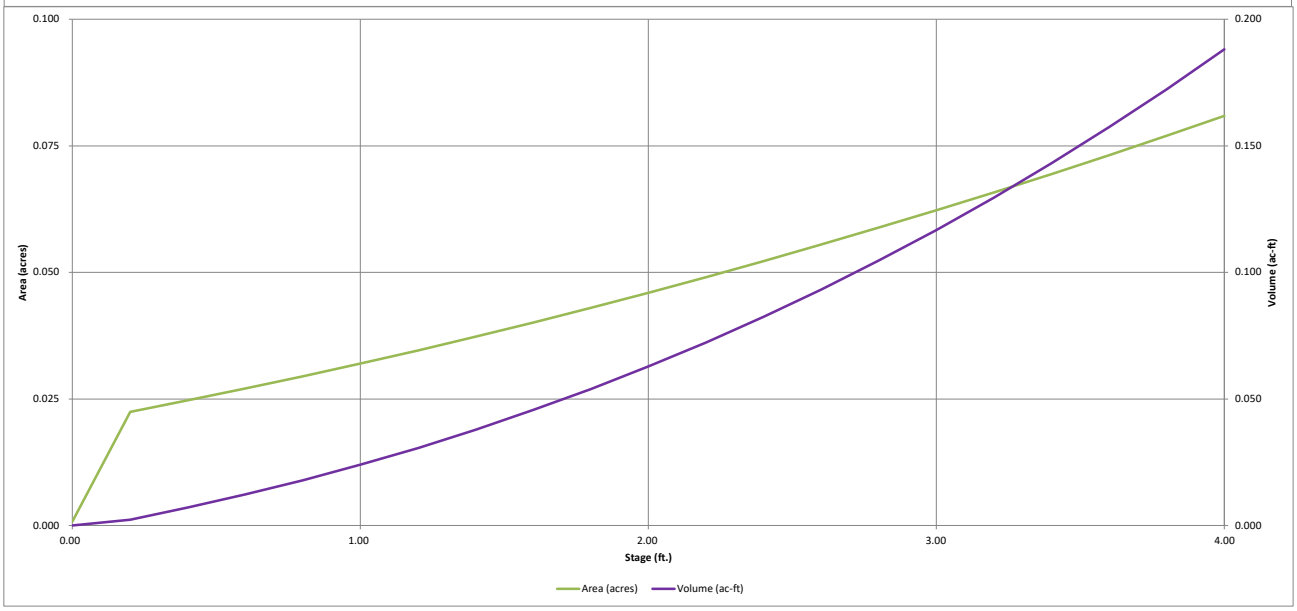
Depth Increment = 0.20 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	35	0.001		
	--	0.20	--	--	--	979	0.022	101	0.002
	--	0.40	--	--	--	1,076	0.025	307	0.007
	--	0.60	--	--	--	1,178	0.027	532	0.012
	--	0.80	--	--	--	1,284	0.029	778	0.018
	--	1.00	--	--	--	1,394	0.032	1,046	0.024
	--	1.20	--	--	--	1,508	0.035	1,336	0.031
	--	1.40	--	--	--	1,626	0.037	1,650	0.038
	--	1.60	--	--	--	1,748	0.040	1,987	0.046
	--	1.80	--	--	--	1,874	0.043	2,349	0.054
	--	2.00	--	--	--	2,003	0.046	2,737	0.063
	--	2.20	--	--	--	2,138	0.049	3,151	0.072
	--	2.40	--	--	--	2,276	0.052	3,592	0.082
	--	2.60	--	--	--	2,418	0.056	4,062	0.093
	--	2.80	--	--	--	2,564	0.059	4,560	0.105
	--	3.00	--	--	--	2,714	0.062	5,087	0.117
	--	3.20	--	--	--	2,868	0.066	5,646	0.130
	--	3.40	--	--	--	3,026	0.069	6,235	0.143
	--	3.60	--	--	--	3,188	0.073	6,856	0.157
	--	3.80	--	--	--	3,354	0.077	7,511	0.172
	--	4.00	--	--	--	3,525	0.081	8,199	0.188

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



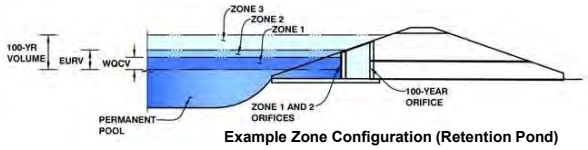


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview - Proposed**

Basin ID: **SB-2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.70	0.015	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.015	

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.451E-03	ft²
Depth at top of Zone using Orifice Plate =	0.70	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.79	sq. inches (diameter = 1 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60					
Orifice Area (sq. inches)	0.79	0.79	0.79					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.26	feet
Spillway Crest Length =	18.00	feet	Stage at Top of Freeboard =	4.26	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.08	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.19	acre-ft

Calculated Parameters for Spillway

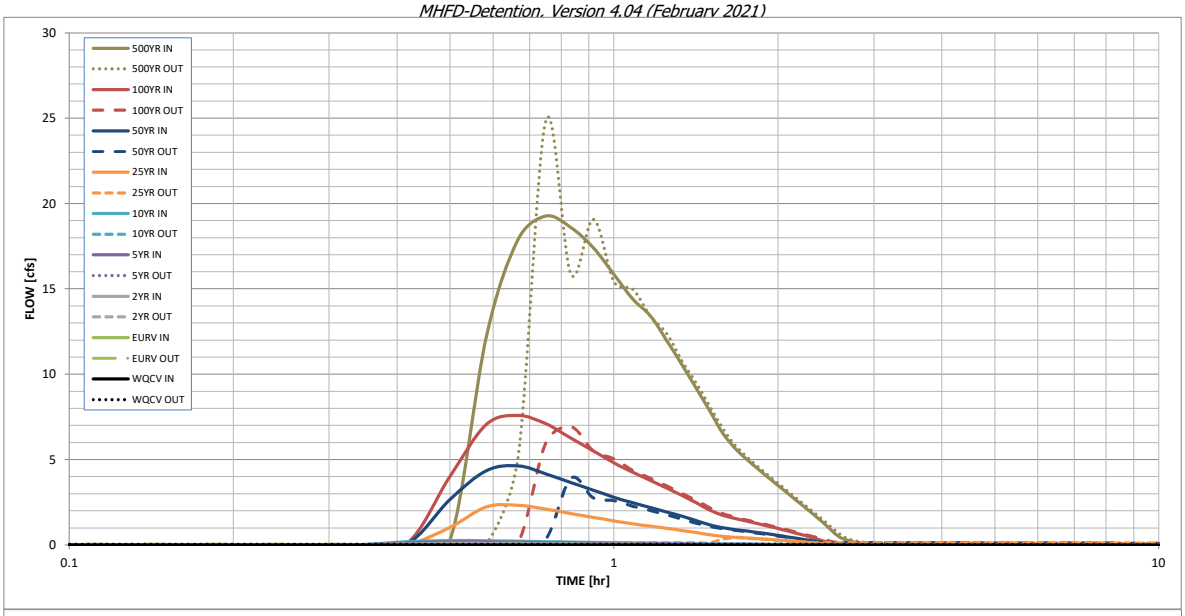
Routed Hydrograph Results

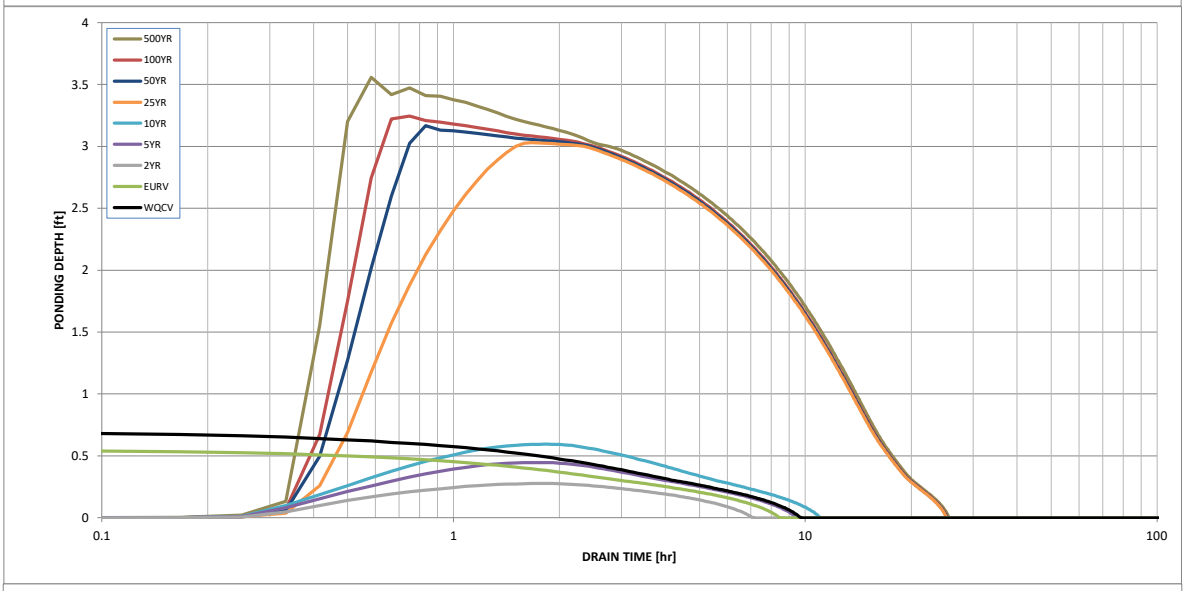
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

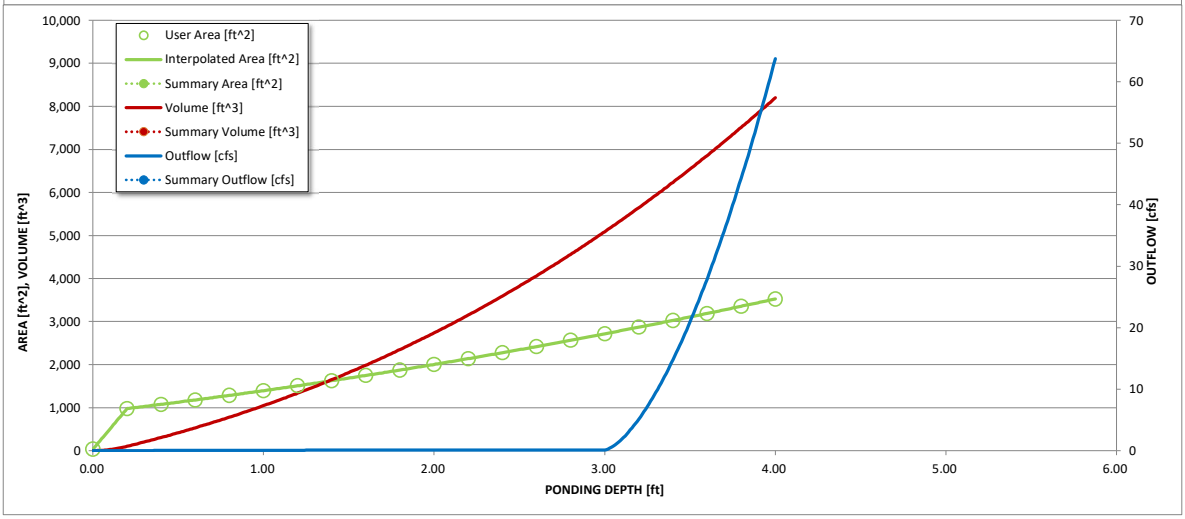
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.015	0.011	0.006	0.012	0.016	0.146	0.294	0.496	1.453
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.006	0.012	0.016	0.146	0.294	0.496	1.453
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.3	4.6	7.6	19.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.20	0.40	0.65	1.65
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.3	4.6	7.6	19.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.4	3.9	6.9	24.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.2	0.8	0.9	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Spillway	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	9	8	7	9	10	20	18	16	11
Time to Drain 99% of Inflow Volume (hours) =	9	8	7	9	11	23	21	20	16
Maximum Ponding Depth (ft) =	0.71	0.56	0.28	0.45	0.59	3.03	3.17	3.24	3.56
Area at Maximum Ponding Depth (acres) =	0.03	0.03	0.02	0.03	0.03	0.06	0.07	0.07	0.07
Maximum Volume Stored (acre-ft) =	0.015	0.011	0.004	0.008	0.012	0.119	0.127	0.132	0.154

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.05	0.12	0.18	0.03	0.07	0.09	0.30
	0:30:00	0.00	0.00	0.09	0.19	0.25	1.02	2.66	4.01	12.22
	0:35:00	0.00	0.00	0.09	0.18	0.25	2.23	4.35	7.06	17.90
	0:40:00	0.00	0.00	0.08	0.16	0.22	2.32	4.63	7.58	19.26
	0:45:00	0.00	0.00	0.07	0.14	0.19	2.10	4.16	7.09	18.60
	0:50:00	0.00	0.00	0.06	0.12	0.17	1.84	3.66	6.26	17.41
	0:55:00	0.00	0.00	0.05	0.10	0.15	1.62	3.21	5.51	15.85
	1:00:00	0.00	0.00	0.05	0.09	0.13	1.41	2.79	4.81	14.39
	1:05:00	0.00	0.00	0.04	0.08	0.12	1.23	2.46	4.25	13.42
	1:10:00	0.00	0.00	0.04	0.07	0.10	1.10	2.19	3.77	11.98
	1:15:00	0.00	0.00	0.03	0.06	0.09	0.97	1.93	3.33	10.56
	1:20:00	0.00	0.00	0.03	0.05	0.08	0.85	1.68	2.89	9.17
	1:25:00	0.00	0.00	0.02	0.05	0.07	0.72	1.42	2.46	7.84
	1:30:00	0.00	0.00	0.02	0.04	0.06	0.60	1.17	2.04	6.55
	1:35:00	0.00	0.00	0.02	0.04	0.05	0.50	1.01	1.74	5.68
	1:40:00	0.00	0.00	0.02	0.03	0.05	0.45	0.90	1.56	5.04
	1:45:00	0.00	0.00	0.02	0.03	0.04	0.41	0.82	1.40	4.48
	1:50:00	0.00	0.00	0.01	0.03	0.04	0.37	0.73	1.25	3.97
	1:55:00	0.00	0.00	0.01	0.02	0.03	0.32	0.64	1.11	3.49
	2:00:00	0.00	0.00	0.01	0.02	0.03	0.28	0.56	0.96	3.02
	2:05:00	0.00	0.00	0.01	0.02	0.02	0.24	0.47	0.82	2.58
	2:10:00	0.00	0.00	0.01	0.01	0.02	0.20	0.39	0.67	2.16
	2:15:00	0.00	0.00	0.01	0.01	0.01	0.16	0.30	0.53	1.74
	2:20:00	0.00	0.00	0.00	0.01	0.01	0.11	0.22	0.39	1.32
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	0.25	0.90
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.11	0.50
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.29
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.18
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.11
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (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).

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	**Treven Edwards**
Company:	**Galloway & Company**
Date:	**May 4, 2022**
Project:	**Grandview**
Location:	**Basins C-3 & C-15**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	C-3	C-15												
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam												
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	1.560	0.160												
Directly Connected Impervious Area (DCIA, acres)	0.000	0.000												
Unconnected Impervious Area (UIA, acres)	0.109	0.013												
Receiving Pervious Area (RPA, acres)	1.451	0.147												
Separate Pervious Area (SPA, acres)	0.000	0.000												
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C												

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	1.560	0.160												
Directly Connected Impervious Area (DCIA, %)	0.0%	0.0%												
Unconnected Impervious Area (UIA, %)	7.0%	8.2%												
Receiving Pervious Area (RPA, %)	93.0%	91.8%												
Separate Pervious Area (SPA, %)	0.0%	0.0%												
A_R (RPA / UIA)	13.286	11.195												
I_a Check	0.070	0.080												
f / I for WQCV Event:	1.7	1.7												
f / I for 5-Year Event:	0.5	0.5												
f / I for 100-Year Event:	0.3	0.3												
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.18	0.21												
IRF for 5-Year Event:	0.30	0.34												
IRF for 100-Year Event:	0.31	0.35												
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	7.0%	8.2%												
Effective Imperviousness for WQCV Event:	1.3%	1.7%												
Effective Imperviousness for 5-Year Event:	2.1%	2.8%												
Effective Imperviousness for 100-Year Event:	2.2%	2.9%												
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	80.1%	77.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	96.6%	87.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**7.1%**
Total Site Effective Imperviousness for WQCV Event:	**1.3%**
Total Site Effective Imperviousness for 5-Year Event:	**2.1%**
Total Site Effective Imperviousness for 100-Year Event:	**2.2%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

				Designer:	**TJE**
				Company:	**Galloway & Co.**
***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches	**Date:**	**May 4, 2022**
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches	**Project:**	**Grandview Reserve**
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches	**Location:**	**Basin D-7a**
Optional User Defined Storm	CUHP				
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event				
Max Intensity for Optional User Defined Storm	0				

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**D-7a**														
Receiving Pervious Area Soil Type	Sandy Loam														
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.250														
Directly Connected Impervious Area (DCIA, acres)	0.000														
Unconnected Impervious Area (UIA, acres)	0.025														
Receiving Pervious Area (RPA, acres)	0.226														
Separate Pervious Area (SPA, acres)	0.000														
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C														

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	0.250														
Directly Connected Impervious Area (DCIA, %)	0.0%														
Unconnected Impervious Area (UIA, %)	9.8%														
Receiving Pervious Area (RPA, %)	90.2%														
Separate Pervious Area (SPA, %)	0.0%														
A_R (RPA / UIA)	9.204														
I_a Check	0.100														
f / I for WQCV Event:	1.7														
f / I for 5-Year Event:	0.5														
f / I for 100-Year Event:	0.3														
f / I for Optional User Defined Storm CUHP:															
IRF for WQCV Event:	0.26														
IRF for 5-Year Event:	0.42														
IRF for 100-Year Event:	0.44														
IRF for Optional User Defined Storm CUHP:															
Total Site Imperviousness: I_{total}	9.8%														
Effective Imperviousness for WQCV Event:	2.6%														
Effective Imperviousness for 5-Year Event:	4.1%														
Effective Imperviousness for 100-Year Event:	4.3%														
Effective Imperviousness for Optional User Defined Storm CUHP:															

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	70.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	69.7%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:															

Total Site Imperviousness:	**9.8%**
Total Site Effective Imperviousness for WQCV Event:	**2.6%**
Total Site Effective Imperviousness for 5-Year Event:	**4.1%**
Total Site Effective Imperviousness for 100-Year Event:	**4.3%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

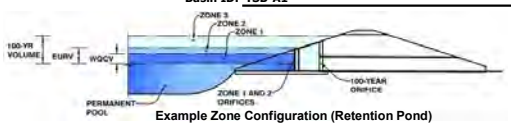
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-A1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	10.67	acres
Watershed Length =	1,001	ft
Watershed Length to Centroid =	501	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.013	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.010	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.005	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.011	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.015	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.134	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.269	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.454	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.330	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.006	acre-feet		
Approximate 5-yr Detention Volume =	0.008	acre-feet		
Approximate 10-yr Detention Volume =	0.011	acre-feet		
Approximate 25-yr Detention Volume =	0.017	acre-feet		
Approximate 50-yr Detention Volume =	0.042	acre-feet		
Approximate 100-yr Detention Volume =	0.115	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.013	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.013	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

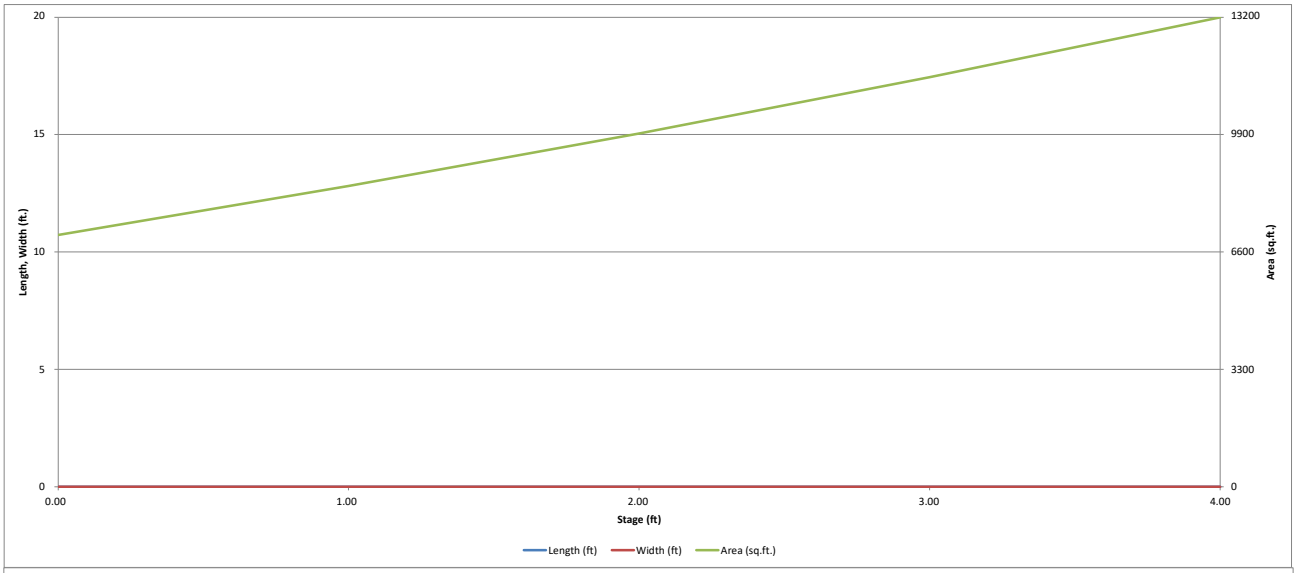
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

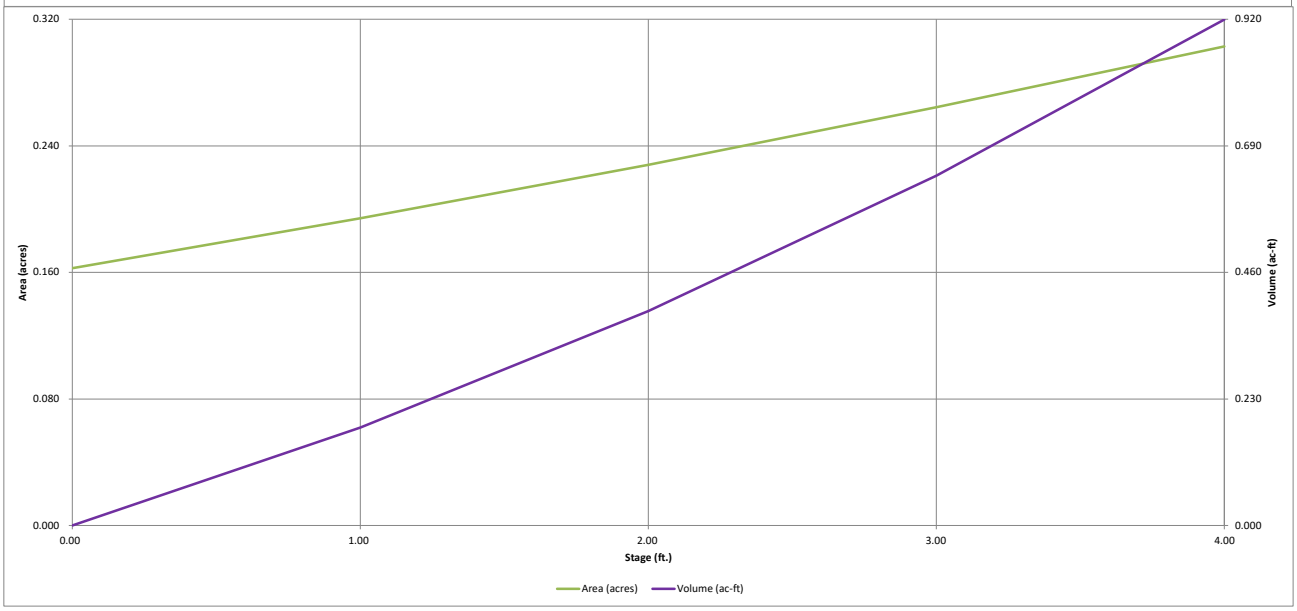
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	7,084	0.163		
	--	1.00	--	--	--	8,460	0.194	7,772	0.178
	--	2.00	--	--	--	9,937	0.228	16,970	0.390
	--	3.00	--	--	--	11,515	0.264	27,696	0.636
	--	4.00	--	--	--	13,194	0.303	40,051	0.919

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



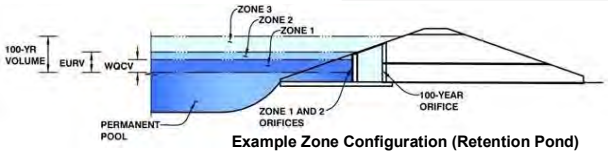


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-A1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.09	0.013	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.013	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.139E-03	ft²
Depth at top of Zone using Orifice Plate =	0.11	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.74	sq. inches (diameter = 15/16 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.74	0.74	0.74	0.74	0.74			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.25	feet
Spillway Crest Length =	24.00	feet	Stage at Top of Freeboard =	4.25	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.30	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.92	acre-ft

Calculated Parameters for Spillway

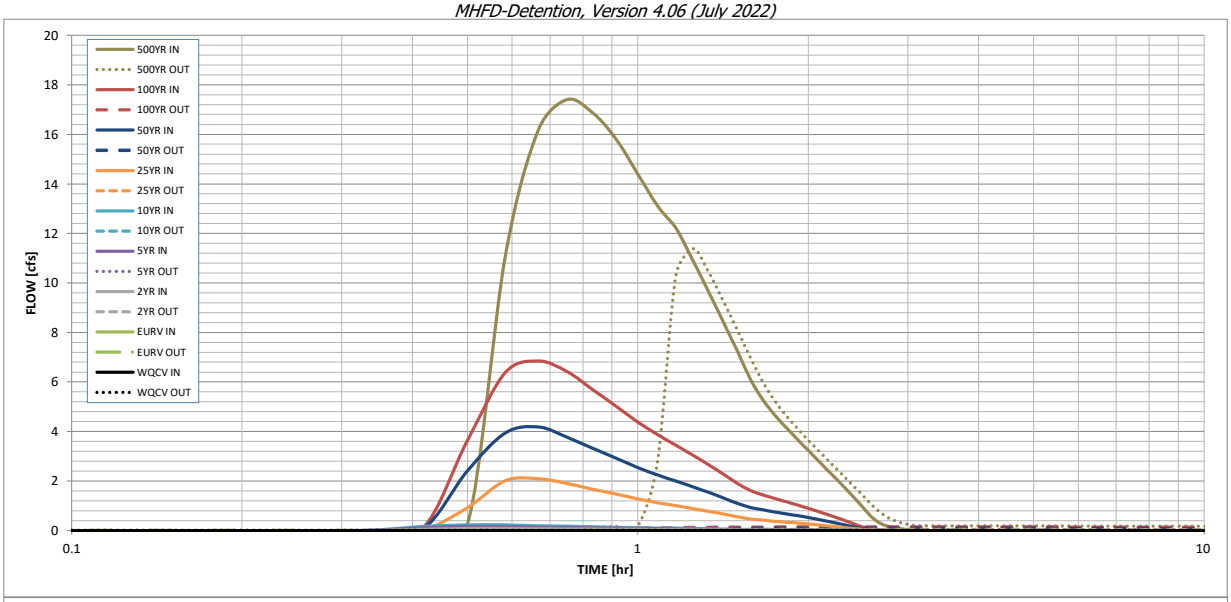
Routed Hydrograph Results

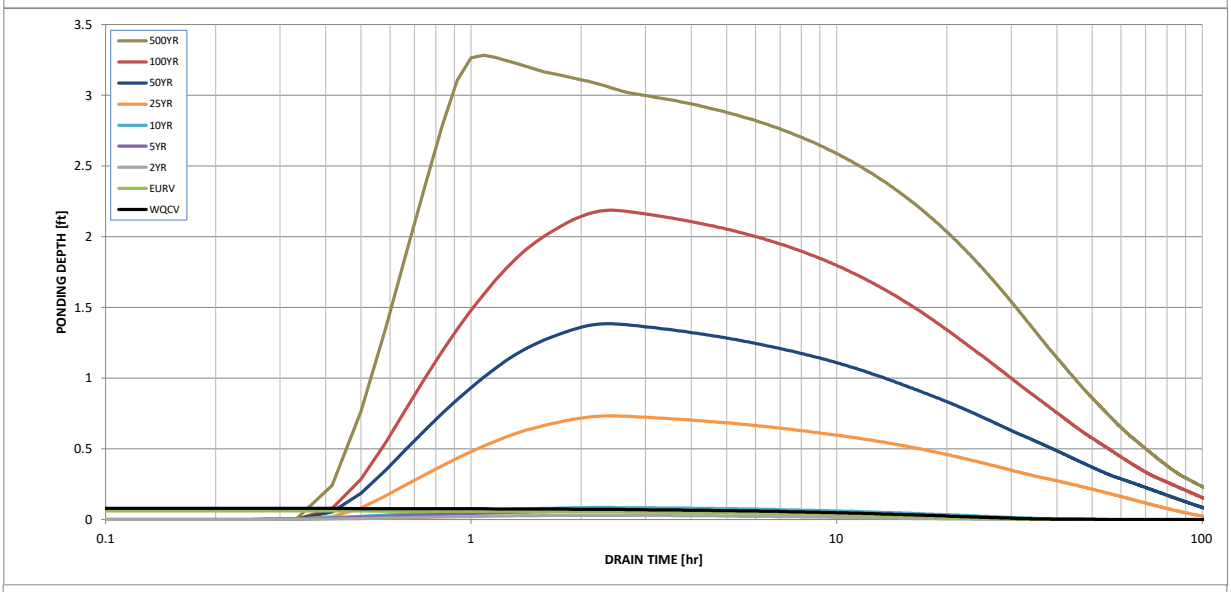
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

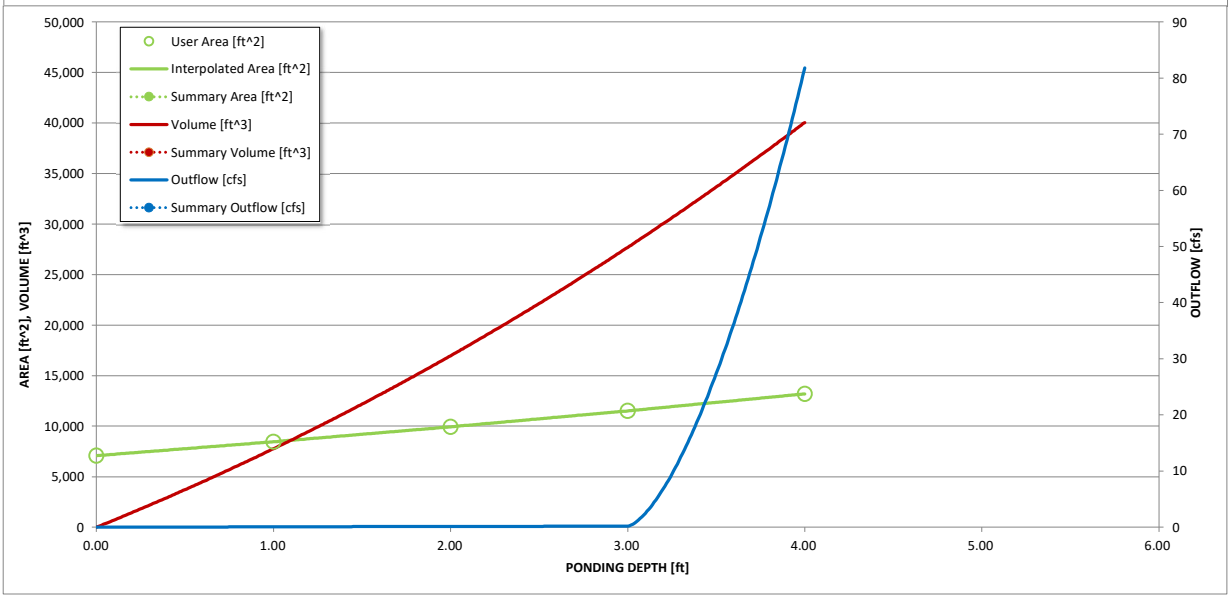
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.013	0.010	0.005	0.011	0.015	0.134	0.269	0.454	1.330
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.005	0.011	0.015	0.134	0.269	0.454	1.330
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.1	4.2	6.8	17.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.20	0.39	0.64	1.63
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.1	4.2	6.8	17.4
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	11.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	37	32	39	44	100	111	117	99
Time to Drain 99% of Inflow Volume (hours) =	**49**	46	41	47	52	111	>120	>120	>120
Maximum Ponding Depth (ft) =	0.08	0.07	0.03	0.06	0.09	0.73	1.38	2.19	3.28
Area at Maximum Ponding Depth (acres) =	0.17	0.16	0.16	0.16	0.17	0.19	0.21	0.23	0.28
Maximum Volume Stored (acre-ft) =	0.013	0.011	0.003	0.008	0.013	0.127	0.255	0.431	0.711

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.04	0.11	0.17	0.03	0.06	0.08	0.27
	0:30:00	0.00	0.00	0.08	0.17	0.23	0.93	2.41	3.64	11.07
	0:35:00	0.00	0.00	0.08	0.16	0.22	2.02	3.93	6.38	16.17
	0:40:00	0.00	0.00	0.07	0.14	0.20	2.09	4.18	6.85	17.41
	0:45:00	0.00	0.00	0.06	0.12	0.17	1.90	3.76	6.43	16.85
	0:50:00	0.00	0.00	0.06	0.11	0.15	1.67	3.32	5.68	15.79
	0:55:00	0.00	0.00	0.05	0.09	0.13	1.47	2.91	5.01	14.40
	1:00:00	0.00	0.00	0.04	0.08	0.12	1.28	2.54	4.38	13.11
	1:05:00	0.00	0.00	0.04	0.08	0.11	1.13	2.25	3.88	12.22
	1:10:00	0.00	0.00	0.04	0.07	0.10	1.00	2.00	3.45	10.92
	1:15:00	0.00	0.00	0.03	0.06	0.09	0.89	1.77	3.05	9.65
	1:20:00	0.00	0.00	0.03	0.05	0.07	0.78	1.54	2.66	8.41
	1:25:00	0.00	0.00	0.02	0.04	0.06	0.67	1.32	2.28	7.23
	1:30:00	0.00	0.00	0.02	0.04	0.05	0.55	1.09	1.90	6.08
	1:35:00	0.00	0.00	0.02	0.03	0.05	0.47	0.93	1.62	5.25
	1:40:00	0.00	0.00	0.02	0.03	0.04	0.42	0.83	1.43	4.64
	1:45:00	0.00	0.00	0.02	0.03	0.04	0.38	0.75	1.29	4.13
	1:50:00	0.00	0.00	0.01	0.02	0.04	0.34	0.67	1.16	3.67
	1:55:00	0.00	0.00	0.01	0.02	0.03	0.30	0.60	1.03	3.24
	2:00:00	0.00	0.00	0.01	0.02	0.03	0.26	0.52	0.90	2.82
	2:05:00	0.00	0.00	0.01	0.02	0.02	0.23	0.45	0.77	2.43
	2:10:00	0.00	0.00	0.01	0.01	0.02	0.19	0.37	0.64	2.05
	2:15:00	0.00	0.00	0.01	0.01	0.01	0.15	0.30	0.52	1.68
	2:20:00	0.00	0.00	0.00	0.01	0.01	0.11	0.22	0.39	1.30
	2:25:00	0.00	0.00	0.00	0.00	0.01	0.08	0.15	0.26	0.93
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.14	0.56
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.32
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.19
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.12
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

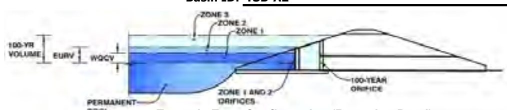
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-A2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	4.56	acres
Watershed Length =	912	ft
Watershed Length to Centroid =	456	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.006	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.004	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.002	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.004	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.006	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.057	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.115	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.194	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	0.569	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.002	acre-feet		
Approximate 5-yr Detention Volume =	0.003	acre-feet		
Approximate 10-yr Detention Volume =	0.005	acre-feet		
Approximate 25-yr Detention Volume =	0.007	acre-feet		
Approximate 50-yr Detention Volume =	0.018	acre-feet		
Approximate 100-yr Detention Volume =	0.049	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.006	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.006	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Total detention volume is less than 100-year volume.

Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	2,830	0.065		
	--	1.00	--	--	--	3,712	0.085	3,271	0.075
	--	2.00	--	--	--	4,693	0.108	7,473	0.172
	--	3.00	--	--	--	5,772	0.133	12,706	0.292
	--	4.00	--	--	--	6,962	0.160	19,073	0.438
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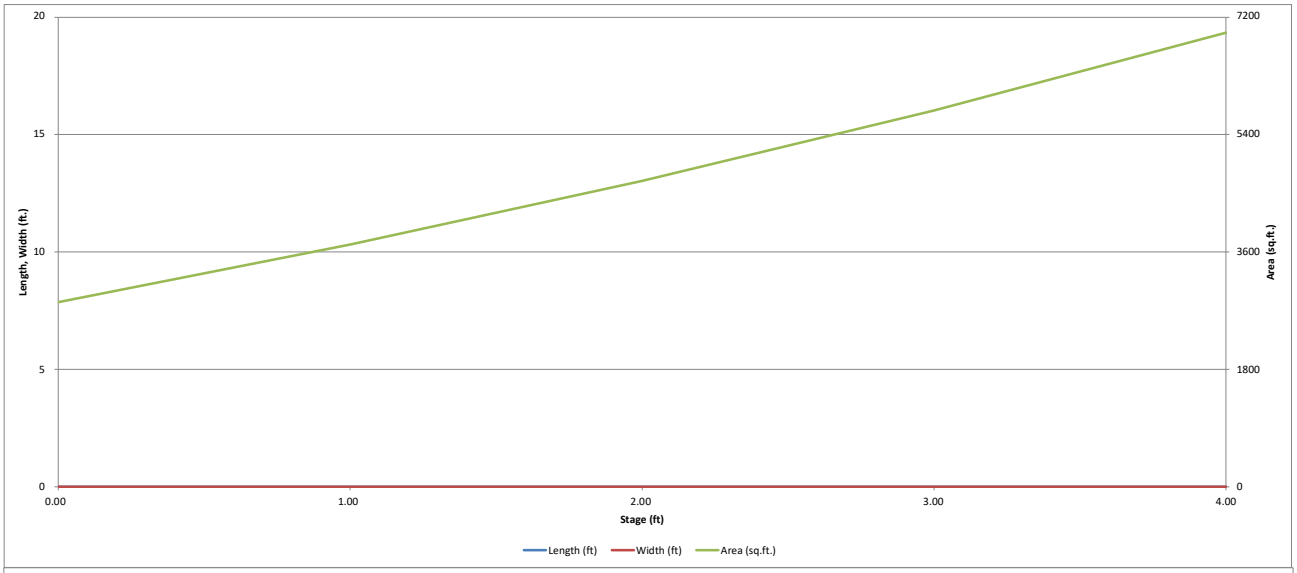
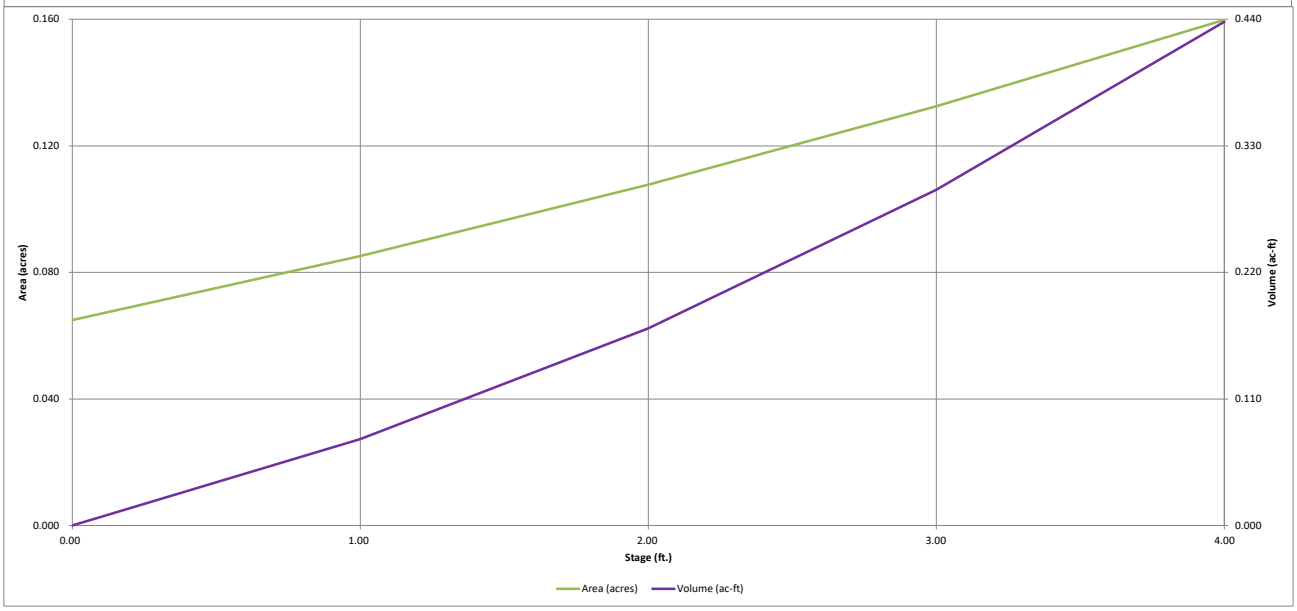
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



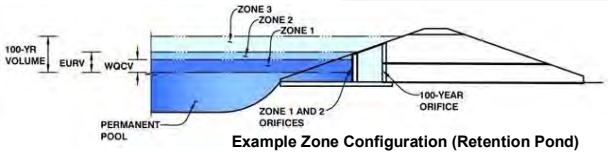


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-A2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.09	0.006	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.006	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.361E-03	ft²
Depth at top of Zone using Orifice Plate =	0.09	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.34	sq. inches (diameter = 5/8 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.34	0.34	0.34	0.34	0.34			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.18	feet
Spillway Crest Length =	8.00	feet	Stage at Top of Freeboard =	4.18	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.16	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.44	acre-ft

Calculated Parameters for Spillway

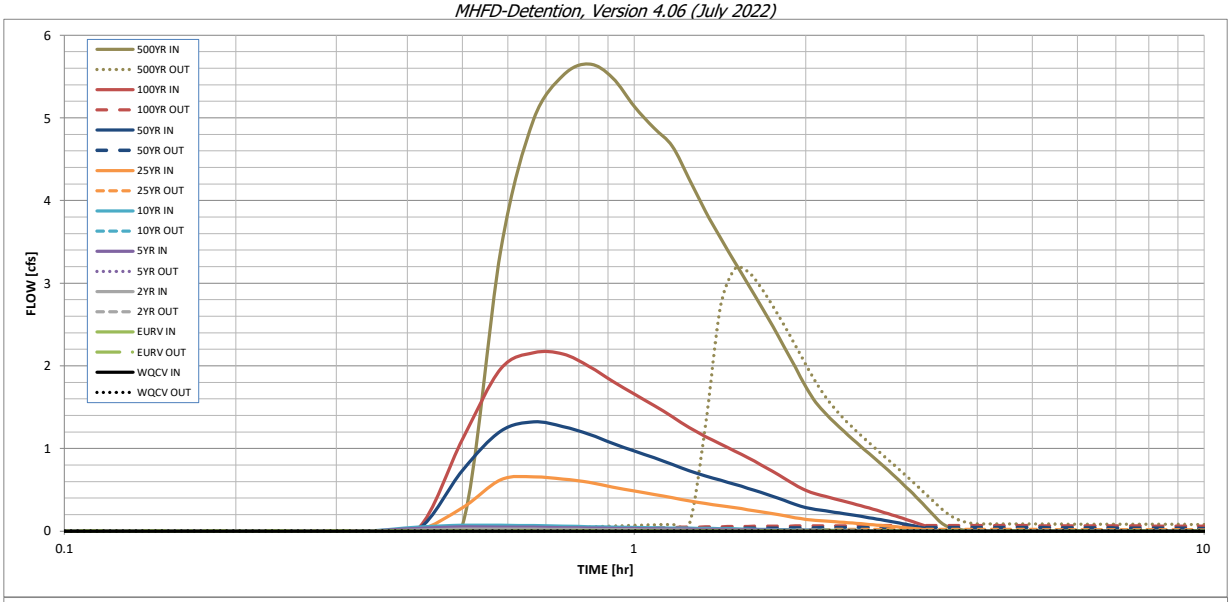
Routed Hydrograph Results

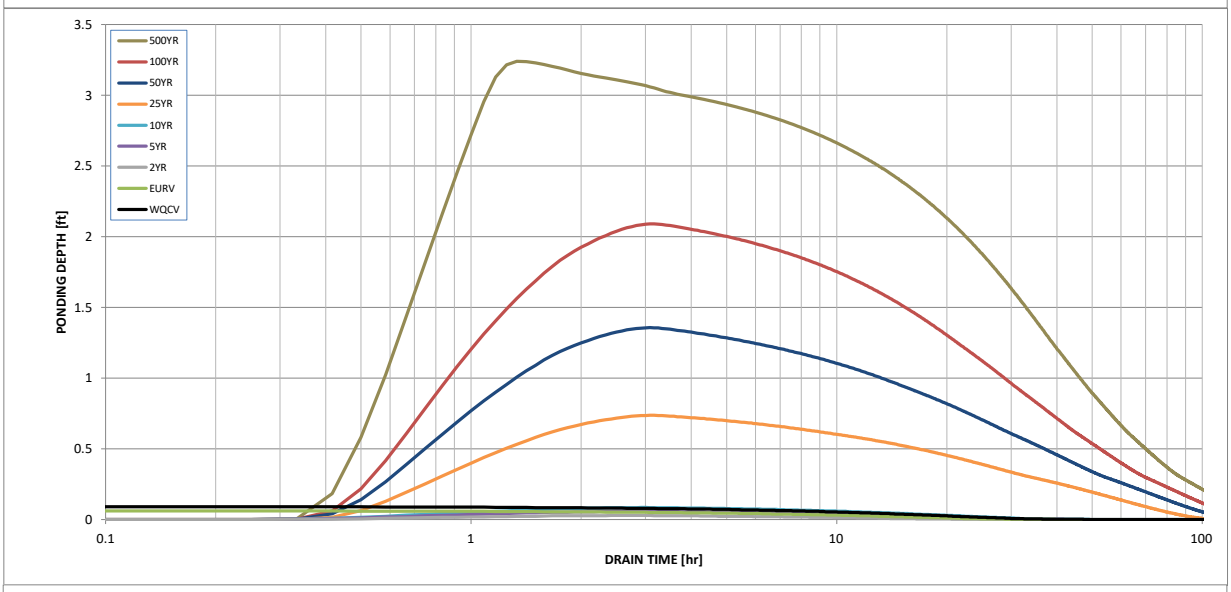
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

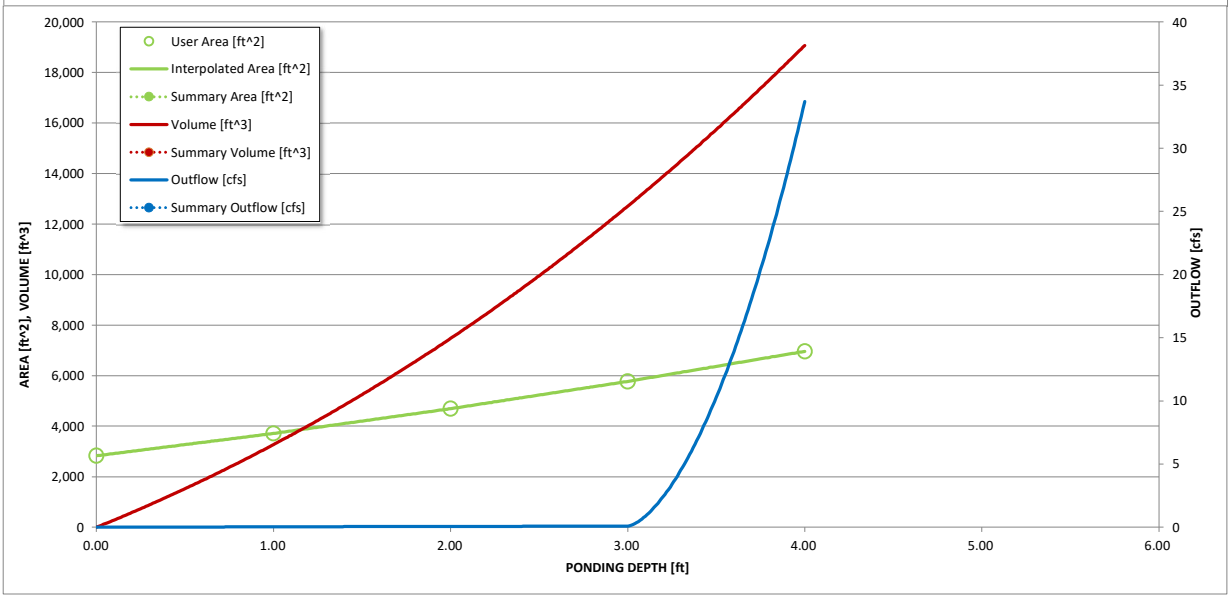
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.006	0.004	0.002	0.004	0.006	0.057	0.115	0.194	0.569
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.002	0.004	0.006	0.057	0.115	0.194	0.569
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.1	0.7	1.3	2.2	5.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.14	0.29	0.47	1.24
Peak Inflow Q (cfs) =	N/A	N/A	0.0	0.1	0.1	0.7	1.3	2.2	5.7
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.0	0.0	0.0	0.0	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	32	28	34	39	90	101	106	94
Time to Drain 99% of Inflow Volume (hours) =	**45**	40	36	42	46	99	114	>120	>120
Maximum Ponding Depth (ft) =	0.10	0.07	0.03	0.06	0.08	0.74	1.36	2.09	3.24
Area at Maximum Ponding Depth (acres) =	0.07	0.07	0.07	0.07	0.07	0.08	0.09	0.11	0.14
Maximum Volume Stored (acre-ft) =	0.007	0.005	0.001	0.003	0.005	0.053	0.106	0.181	0.323

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:25:00	0.00	0.00	0.01	0.03	0.05	0.01	0.02	0.03	0.08
	0:30:00	0.00	0.00	0.03	0.05	0.07	0.29	0.74	1.12	3.40
	0:35:00	0.00	0.00	0.03	0.05	0.07	0.62	1.21	1.96	4.98
	0:40:00	0.00	0.00	0.02	0.05	0.07	0.66	1.32	2.16	5.51
	0:45:00	0.00	0.00	0.02	0.04	0.06	0.63	1.27	2.14	5.65
	0:50:00	0.00	0.00	0.02	0.04	0.06	0.59	1.17	1.99	5.49
	0:55:00	0.00	0.00	0.02	0.04	0.05	0.53	1.06	1.81	5.14
	1:00:00	0.00	0.00	0.02	0.03	0.05	0.49	0.97	1.66	4.88
	1:05:00	0.00	0.00	0.02	0.03	0.04	0.45	0.89	1.52	4.66
	1:10:00	0.00	0.00	0.01	0.03	0.04	0.40	0.81	1.38	4.26
	1:15:00	0.00	0.00	0.01	0.02	0.04	0.37	0.73	1.25	3.87
	1:20:00	0.00	0.00	0.01	0.02	0.03	0.33	0.67	1.15	3.55
	1:25:00	0.00	0.00	0.01	0.02	0.03	0.31	0.62	1.06	3.26
	1:30:00	0.00	0.00	0.01	0.02	0.03	0.28	0.57	0.97	2.99
	1:35:00	0.00	0.00	0.01	0.02	0.03	0.26	0.52	0.89	2.73
	1:40:00	0.00	0.00	0.01	0.02	0.02	0.24	0.47	0.81	2.48
	1:45:00	0.00	0.00	0.01	0.01	0.02	0.21	0.42	0.72	2.23
	1:50:00	0.00	0.00	0.01	0.01	0.02	0.19	0.37	0.64	1.99
	1:55:00	0.00	0.00	0.01	0.01	0.02	0.16	0.32	0.56	1.75
	2:00:00	0.00	0.00	0.00	0.01	0.01	0.14	0.29	0.49	1.56
	2:05:00	0.00	0.00	0.00	0.01	0.01	0.13	0.26	0.45	1.42
	2:10:00	0.00	0.00	0.00	0.01	0.01	0.12	0.25	0.42	1.31
	2:15:00	0.00	0.00	0.00	0.01	0.01	0.11	0.23	0.39	1.21
	2:20:00	0.00	0.00	0.00	0.01	0.01	0.11	0.21	0.36	1.12
	2:25:00	0.00	0.00	0.00	0.01	0.01	0.10	0.20	0.34	1.03
	2:30:00	0.00	0.00	0.00	0.01	0.01	0.09	0.18	0.31	0.94
	2:35:00	0.00	0.00	0.00	0.01	0.01	0.08	0.16	0.28	0.86
	2:40:00	0.00	0.00	0.00	0.00	0.01	0.07	0.15	0.25	0.78
	2:45:00	0.00	0.00	0.00	0.00	0.01	0.07	0.13	0.23	0.70
	2:50:00	0.00	0.00	0.00	0.00	0.01	0.06	0.11	0.20	0.62
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.17	0.54
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.14	0.45
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.12	0.37
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.09	0.29
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.06	0.21
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.13
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.08
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

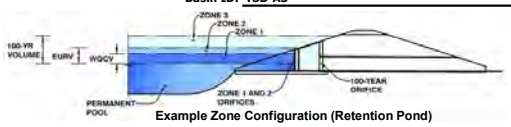
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-A3



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	13.72	acres
Watershed Length =	1,379	ft
Watershed Length to Centroid =	690	ft
Watershed Slope =	0.023	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.017	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.013	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.007	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.014	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.019	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.172	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.346	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.585	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.715	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.007	acre-feet		
Approximate 5-yr Detention Volume =	0.010	acre-feet		
Approximate 10-yr Detention Volume =	0.015	acre-feet		
Approximate 25-yr Detention Volume =	0.022	acre-feet		
Approximate 50-yr Detention Volume =	0.054	acre-feet		
Approximate 100-yr Detention Volume =	0.148	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.017	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.017	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

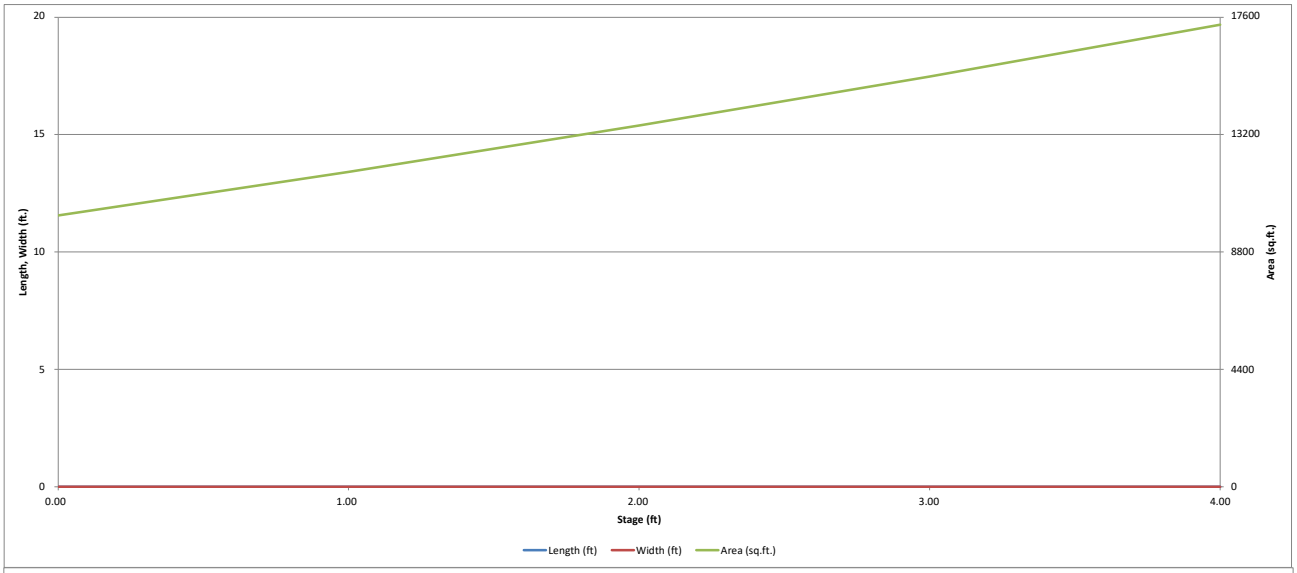
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

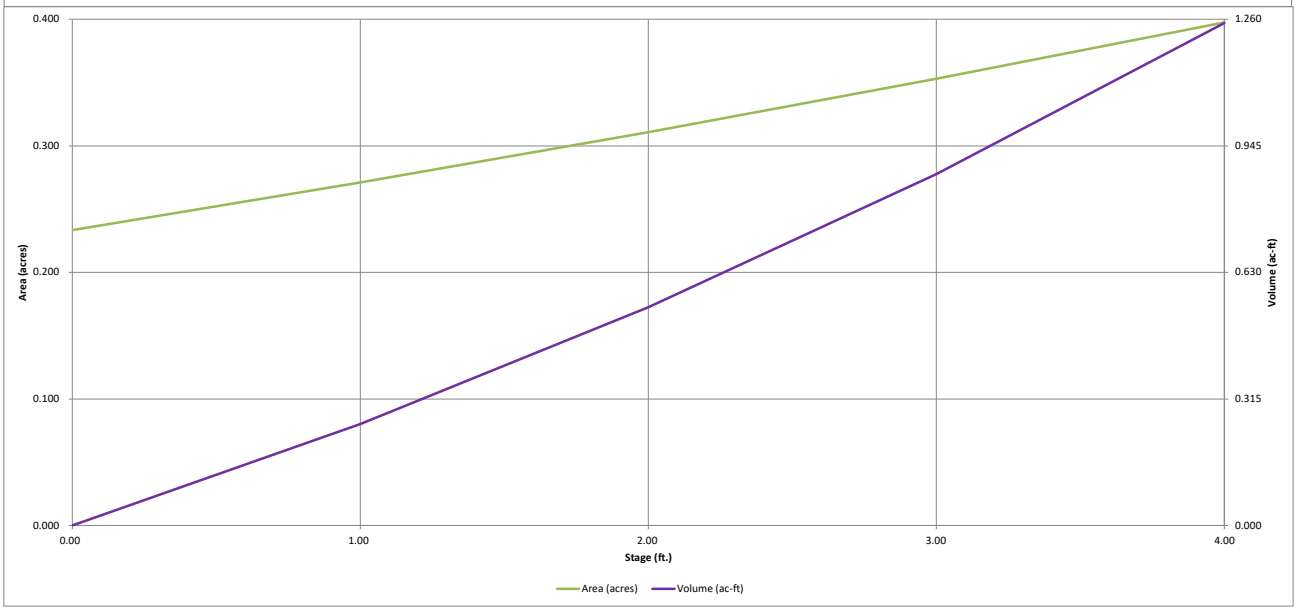
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10,173	0.234		
	--	1.00	--	--	--	11,808	0.271	10,990	0.252
	--	2.00	--	--	--	13,544	0.311	23,666	0.543
	--	3.00	--	--	--	15,382	0.353	38,129	0.875
	--	4.00	--	--	--	17,320	0.398	54,480	1.251

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



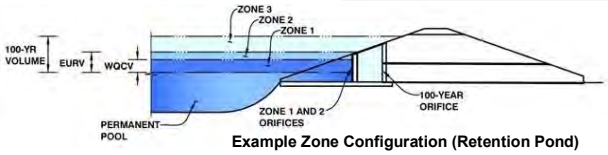


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-A3**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.08	0.017	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.017	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.875E-03	ft²
Depth at top of Zone using Orifice Plate =	0.08	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.99	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.99	0.99	0.99	0.99	0.99			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.19	feet
Spillway Crest Length =	13.00	feet	Stage at Top of Freeboard =	4.19	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.40	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.25	acre-ft

Calculated Parameters for Spillway

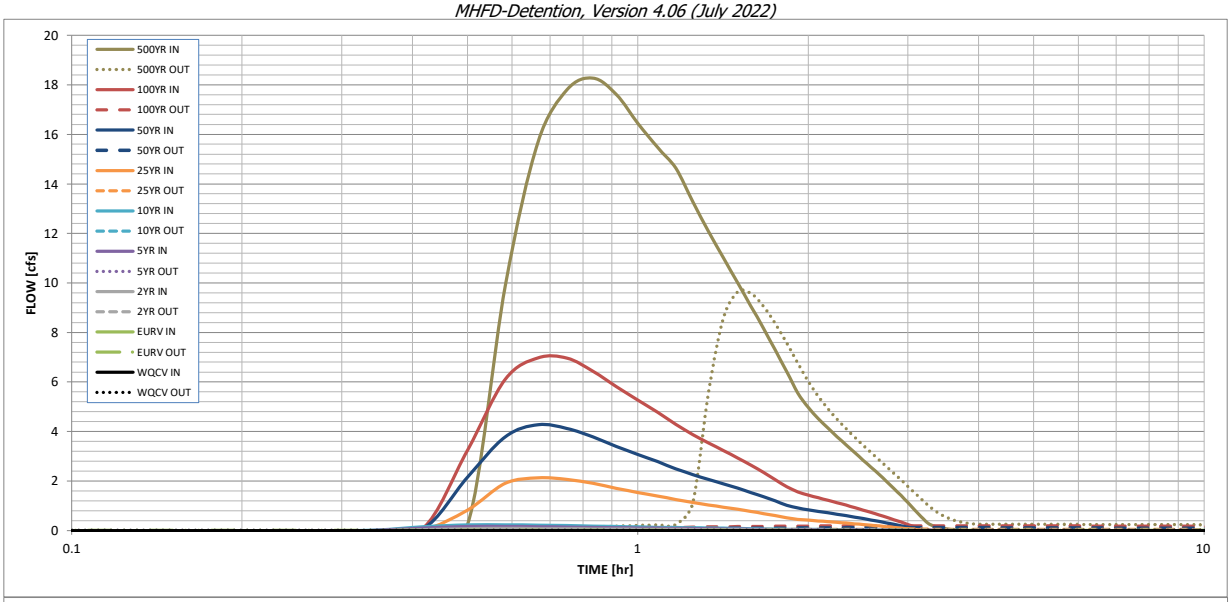
Routed Hydrograph Results

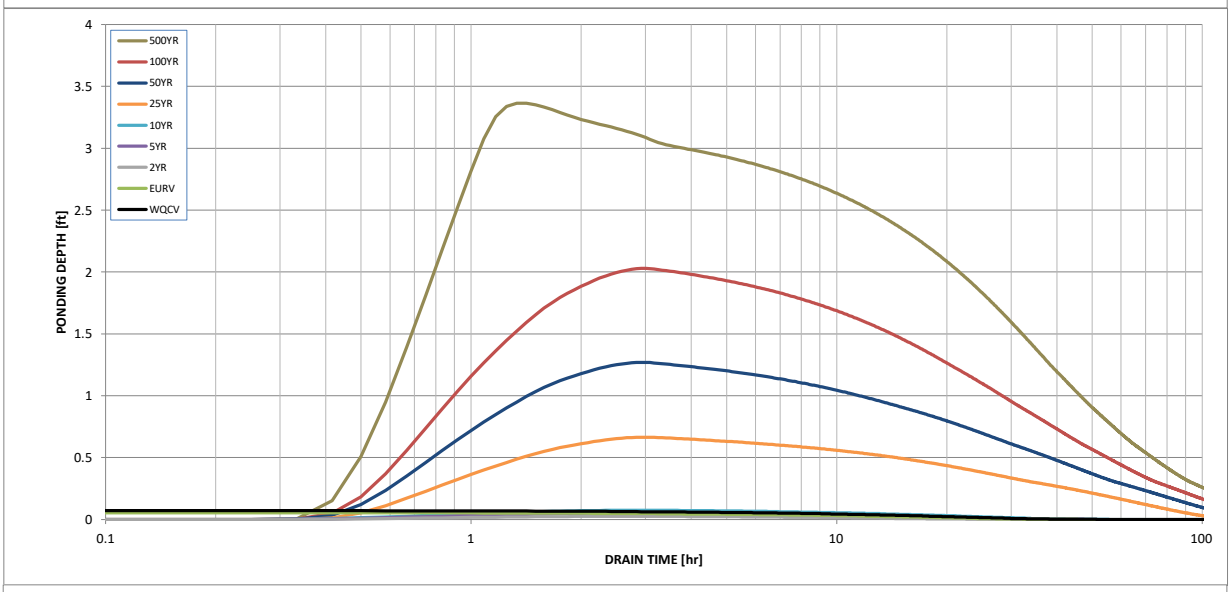
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

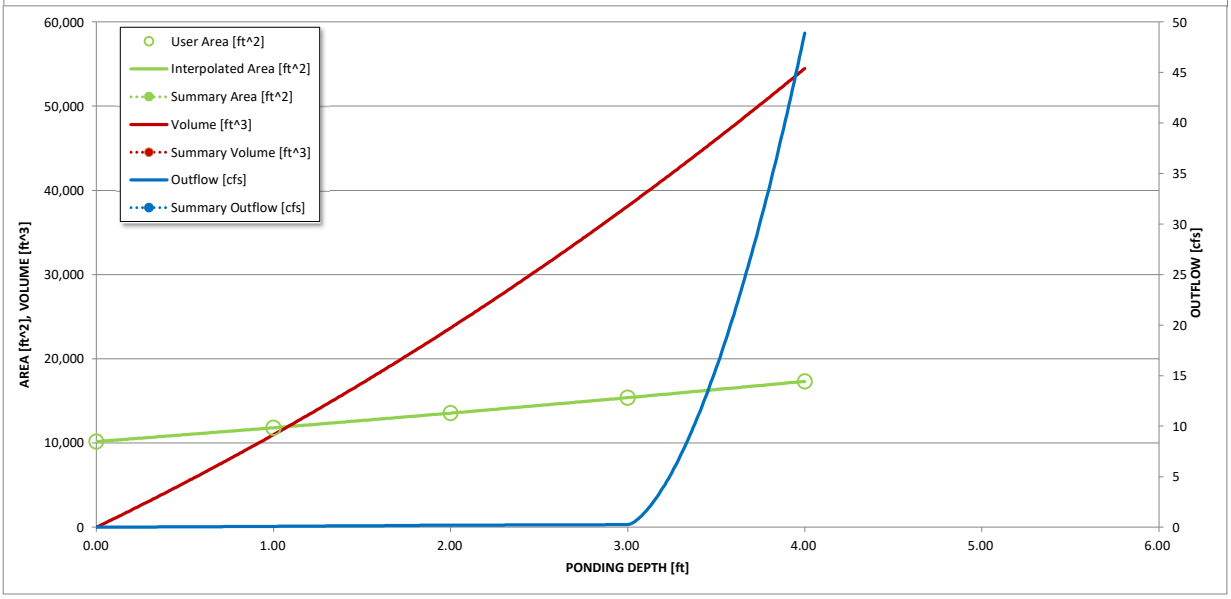
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.017	0.013	0.007	0.014	0.019	0.172	0.346	0.585	1.715
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.007	0.014	0.019	0.172	0.346	0.585	1.715
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.1	4.3	7.0	18.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.16	0.31	0.51	1.33
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.1	4.3	7.0	18.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	9.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	42	39	34	40	45	104	117	>120	108
Time to Drain 99% of Inflow Volume (hours) =	**52**	48	44	49	54	115	>120	>120	>120
Maximum Ponding Depth (ft) =	0.08	0.06	0.03	0.05	0.08	0.66	1.27	2.03	3.36
Area at Maximum Ponding Depth (acres) =	0.24	0.24	0.23	0.24	0.24	0.26	0.28	0.31	0.37
Maximum Volume Stored (acre-ft) =	0.019	0.014	0.005	0.012	0.016	0.162	0.324	0.550	1.005

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.04	0.10	0.15	0.03	0.06	0.07	0.24
	0:30:00	0.00	0.00	0.08	0.16	0.22	0.83	2.15	3.24	9.88
	0:35:00	0.00	0.00	0.08	0.17	0.23	1.90	3.79	6.11	15.71
	0:40:00	0.00	0.00	0.08	0.16	0.22	2.13	4.28	6.98	17.80
	0:45:00	0.00	0.00	0.07	0.14	0.20	2.06	4.12	6.96	18.27
	0:50:00	0.00	0.00	0.07	0.13	0.18	1.90	3.78	6.43	17.61
	0:55:00	0.00	0.00	0.06	0.12	0.16	1.71	3.40	5.81	16.44
	1:00:00	0.00	0.00	0.05	0.10	0.15	1.54	3.07	5.27	15.47
	1:05:00	0.00	0.00	0.05	0.09	0.13	1.40	2.78	4.78	14.63
	1:10:00	0.00	0.00	0.05	0.09	0.12	1.26	2.50	4.29	13.28
	1:15:00	0.00	0.00	0.04	0.08	0.11	1.13	2.26	3.88	12.08
	1:20:00	0.00	0.00	0.04	0.07	0.11	1.03	2.06	3.54	11.01
	1:25:00	0.00	0.00	0.04	0.07	0.10	0.95	1.89	3.23	10.01
	1:30:00	0.00	0.00	0.03	0.06	0.09	0.86	1.71	2.94	9.07
	1:35:00	0.00	0.00	0.03	0.05	0.08	0.77	1.54	2.64	8.17
	1:40:00	0.00	0.00	0.03	0.05	0.07	0.69	1.37	2.35	7.28
	1:45:00	0.00	0.00	0.02	0.04	0.06	0.60	1.19	2.06	6.41
	1:50:00	0.00	0.00	0.02	0.04	0.05	0.52	1.02	1.77	5.55
	1:55:00	0.00	0.00	0.02	0.03	0.05	0.45	0.91	1.56	4.97
	2:00:00	0.00	0.00	0.02	0.03	0.05	0.42	0.84	1.43	4.53
	2:05:00	0.00	0.00	0.02	0.03	0.04	0.39	0.78	1.32	4.14
	2:10:00	0.00	0.00	0.01	0.03	0.04	0.36	0.72	1.22	3.79
	2:15:00	0.00	0.00	0.01	0.02	0.04	0.33	0.66	1.12	3.46
	2:20:00	0.00	0.00	0.01	0.02	0.03	0.30	0.60	1.03	3.15
	2:25:00	0.00	0.00	0.01	0.02	0.03	0.27	0.54	0.93	2.84
	2:30:00	0.00	0.00	0.01	0.02	0.03	0.24	0.48	0.83	2.56
	2:35:00	0.00	0.00	0.01	0.01	0.02	0.21	0.43	0.73	2.27
	2:40:00	0.00	0.00	0.01	0.01	0.02	0.19	0.37	0.63	1.98
	2:45:00	0.00	0.00	0.01	0.01	0.01	0.16	0.31	0.54	1.70
	2:50:00	0.00	0.00	0.00	0.01	0.01	0.13	0.25	0.44	1.41
	2:55:00	0.00	0.00	0.00	0.01	0.01	0.10	0.20	0.34	1.13
	3:00:00	0.00	0.00	0.00	0.00	0.01	0.07	0.14	0.25	0.84
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.15	0.56
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.06	0.31
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.18
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.11
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

Stage - Storage Description	Stage [ft]	Area [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

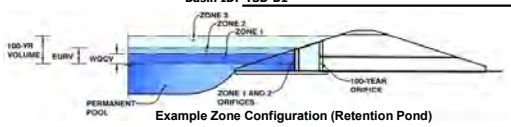
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-B1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	14.03	acres
Watershed Length =	1,247	ft
Watershed Length to Centroid =	624	ft
Watershed Slope =	0.032	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.018	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.013	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.007	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.014	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.020	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.176	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.354	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.598	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.753	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.007	acre-feet		
Approximate 5-yr Detention Volume =	0.010	acre-feet		
Approximate 10-yr Detention Volume =	0.015	acre-feet		
Approximate 25-yr Detention Volume =	0.022	acre-feet		
Approximate 50-yr Detention Volume =	0.055	acre-feet		
Approximate 100-yr Detention Volume =	0.152	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.018	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.018	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

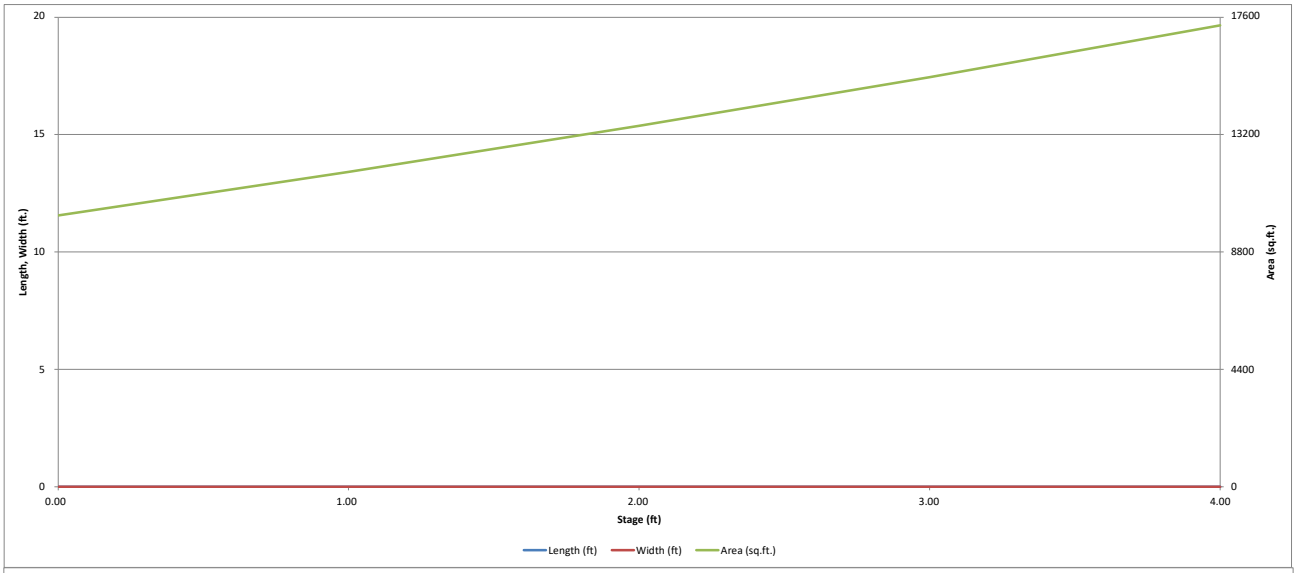
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

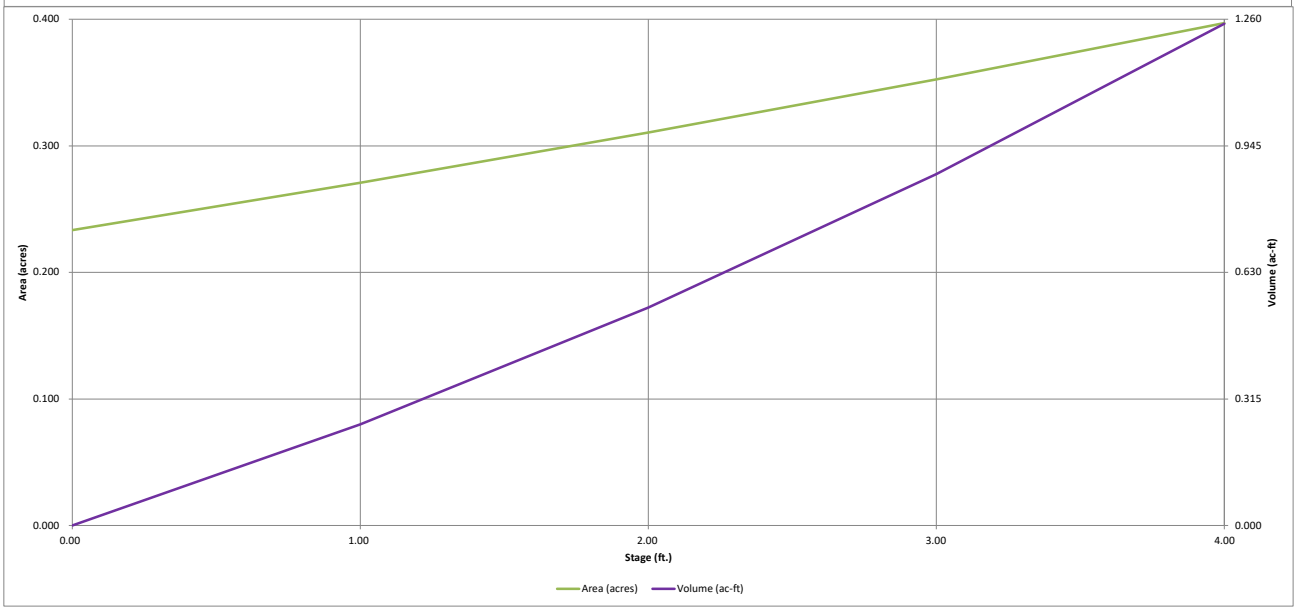
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10,172	0.234		
	--	1.00	--	--	--	11,801	0.271	10,986	0.252
	--	2.00	--	--	--	13,529	0.311	23,651	0.543
	--	3.00	--	--	--	15,357	0.353	38,094	0.875
	--	4.00	--	--	--	17,293	0.397	54,419	1.249

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



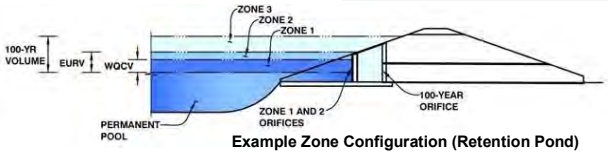


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-B1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.08	0.018	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.018	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.875E-03	ft²
Depth at top of Zone using Orifice Plate =	0.08	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.99	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.99	0.99	0.99	0.99	0.99			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.20	feet
Spillway Crest Length =	21.00	feet	Stage at Top of Freeboard =	4.20	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.40	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.25	acre-ft

Calculated Parameters for Spillway

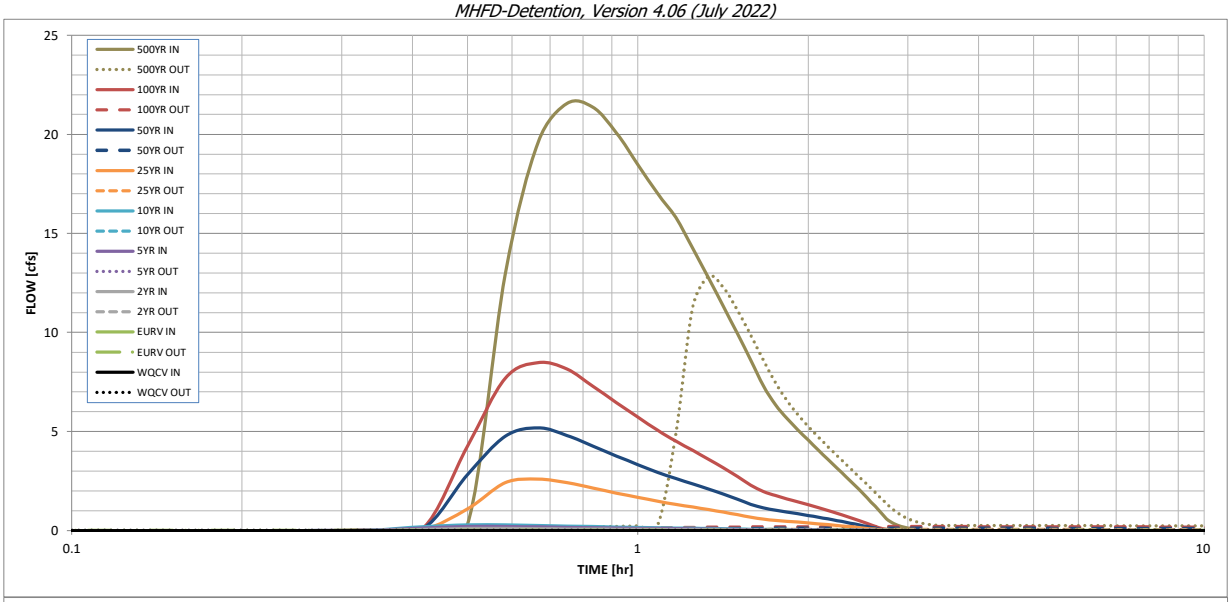
Routed Hydrograph Results

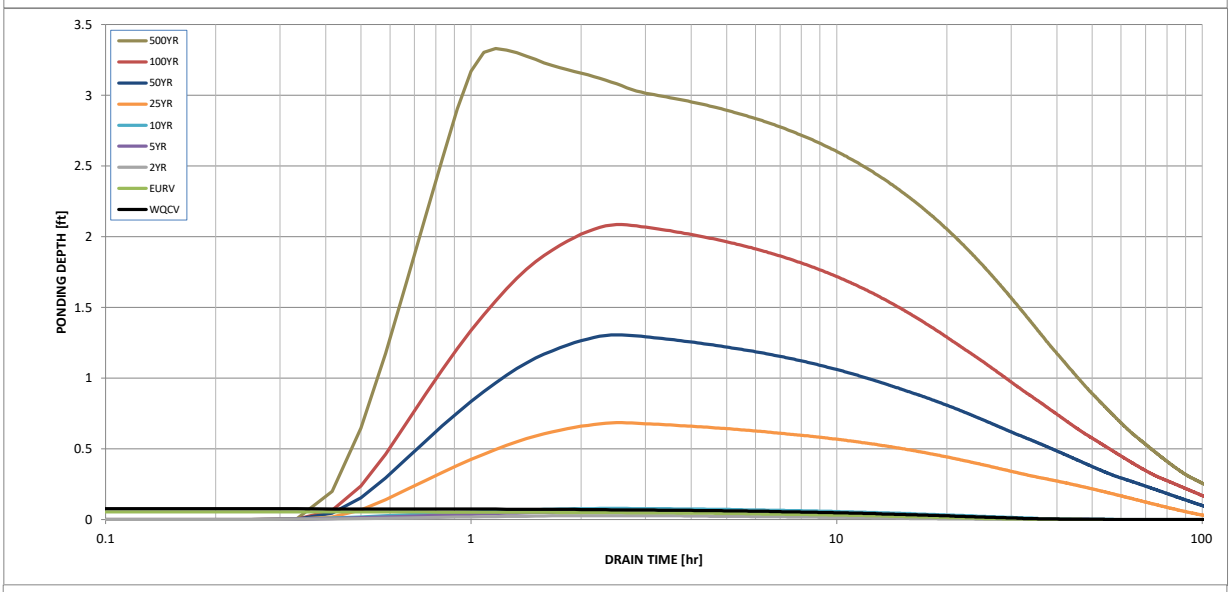
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

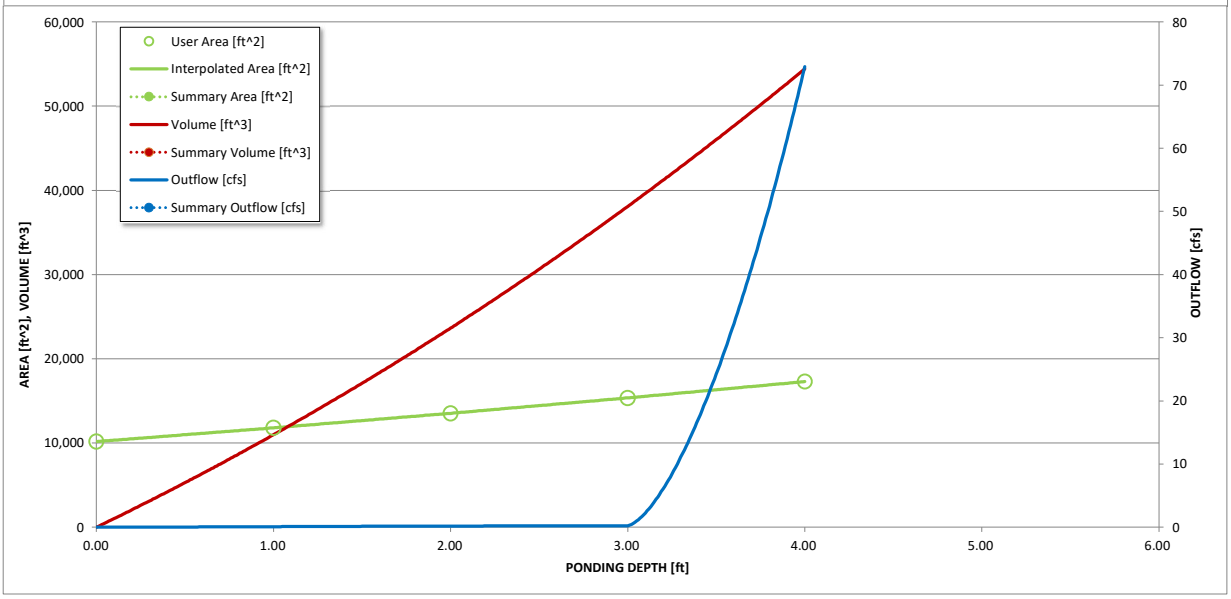
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.018	0.013	0.007	0.014	0.020	0.176	0.354	0.598	1.753
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.007	0.014	0.020	0.176	0.354	0.598	1.753
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.6	5.2	8.5	21.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.18	0.37	0.60	1.54
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.6	5.2	8.5	21.6
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	12.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	43	39	34	40	45	105	118	>120	106
Time to Drain 99% of Inflow Volume (hours) =	**52**	48	44	50	55	116	>120	>120	>120
Maximum Ponding Depth (ft) =	0.08	0.06	0.03	0.05	0.08	0.68	1.31	2.09	3.33
Area at Maximum Ponding Depth (acres) =	0.24	0.24	0.23	0.24	0.24	0.26	0.28	0.31	0.37
Maximum Volume Stored (acre-ft) =	0.019	0.014	0.005	0.012	0.016	0.167	0.335	0.568	0.993

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.05	0.13	0.19	0.03	0.07	0.10	0.32
	0:30:00	0.00	0.00	0.10	0.20	0.28	1.09	2.82	4.25	12.95
	0:35:00	0.00	0.00	0.10	0.20	0.28	2.42	4.75	7.69	19.61
	0:40:00	0.00	0.00	0.09	0.18	0.25	2.59	5.18	8.47	21.57
	0:45:00	0.00	0.00	0.08	0.16	0.22	2.41	4.79	8.15	21.36
	0:50:00	0.00	0.00	0.07	0.14	0.20	2.15	4.26	7.28	20.08
	0:55:00	0.00	0.00	0.07	0.12	0.17	1.89	3.76	6.46	18.47
	1:00:00	0.00	0.00	0.06	0.11	0.15	1.67	3.33	5.72	17.01
	1:05:00	0.00	0.00	0.05	0.10	0.14	1.48	2.94	5.06	15.80
	1:10:00	0.00	0.00	0.05	0.09	0.13	1.31	2.62	4.52	14.24
	1:15:00	0.00	0.00	0.04	0.08	0.12	1.18	2.35	4.05	12.75
	1:20:00	0.00	0.00	0.04	0.07	0.10	1.05	2.09	3.60	11.31
	1:25:00	0.00	0.00	0.03	0.06	0.09	0.92	1.83	3.16	9.93
	1:30:00	0.00	0.00	0.03	0.05	0.08	0.80	1.58	2.72	8.60
	1:35:00	0.00	0.00	0.02	0.05	0.07	0.67	1.32	2.29	7.29
	1:40:00	0.00	0.00	0.02	0.04	0.06	0.57	1.14	1.97	6.35
	1:45:00	0.00	0.00	0.02	0.04	0.06	0.51	1.02	1.76	5.67
	1:50:00	0.00	0.00	0.02	0.03	0.05	0.47	0.93	1.60	5.08
	1:55:00	0.00	0.00	0.02	0.03	0.05	0.43	0.85	1.45	4.56
	2:00:00	0.00	0.00	0.02	0.03	0.04	0.38	0.76	1.30	4.07
	2:05:00	0.00	0.00	0.01	0.02	0.04	0.34	0.67	1.15	3.59
	2:10:00	0.00	0.00	0.01	0.02	0.03	0.30	0.59	1.01	3.14
	2:15:00	0.00	0.00	0.01	0.02	0.02	0.25	0.50	0.86	2.71
	2:20:00	0.00	0.00	0.01	0.01	0.02	0.21	0.41	0.72	2.29
	2:25:00	0.00	0.00	0.01	0.01	0.01	0.17	0.33	0.57	1.86
	2:30:00	0.00	0.00	0.00	0.01	0.01	0.13	0.24	0.43	1.44
	2:35:00	0.00	0.00	0.00	0.00	0.01	0.08	0.16	0.28	1.02
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.14	0.60
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.34
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.21
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

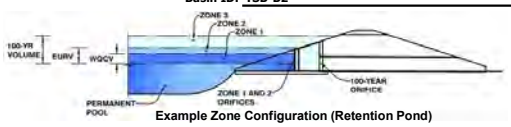
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-B2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	14.48	acres
Watershed Length =	1,305	ft
Watershed Length to Centroid =	653	ft
Watershed Slope =	0.028	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.018	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.014	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.007	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.014	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.021	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.182	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.365	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.617	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.809	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.008	acre-feet		
Approximate 5-yr Detention Volume =	0.011	acre-feet		
Approximate 10-yr Detention Volume =	0.015	acre-feet		
Approximate 25-yr Detention Volume =	0.023	acre-feet		
Approximate 50-yr Detention Volume =	0.057	acre-feet		
Approximate 100-yr Detention Volume =	0.156	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.018	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.018	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

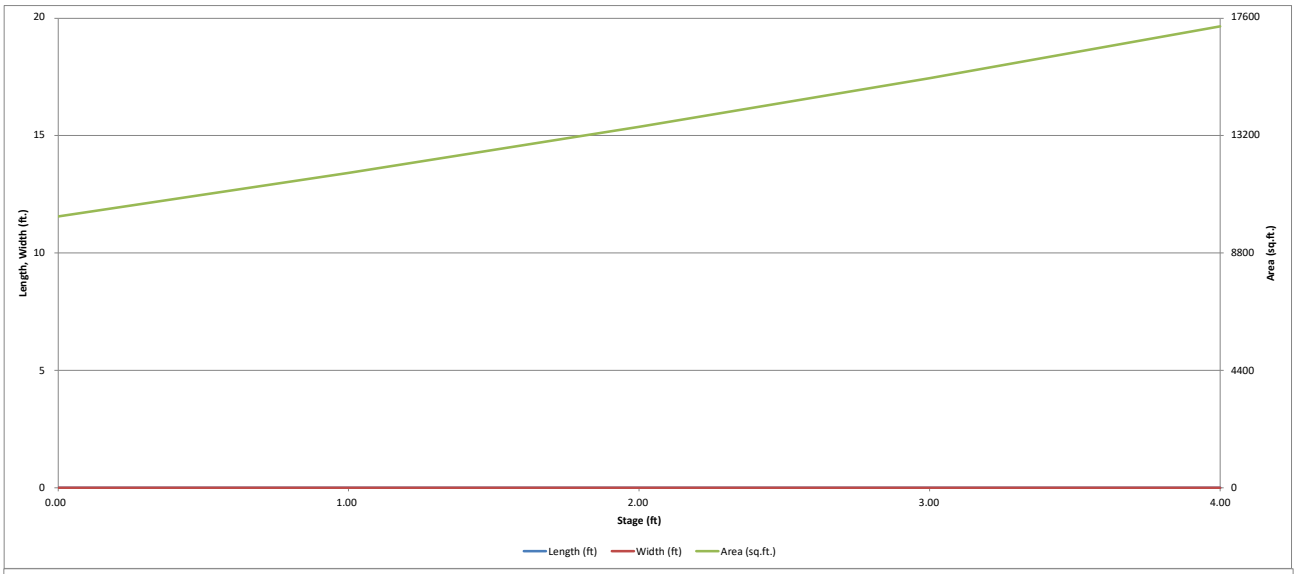
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

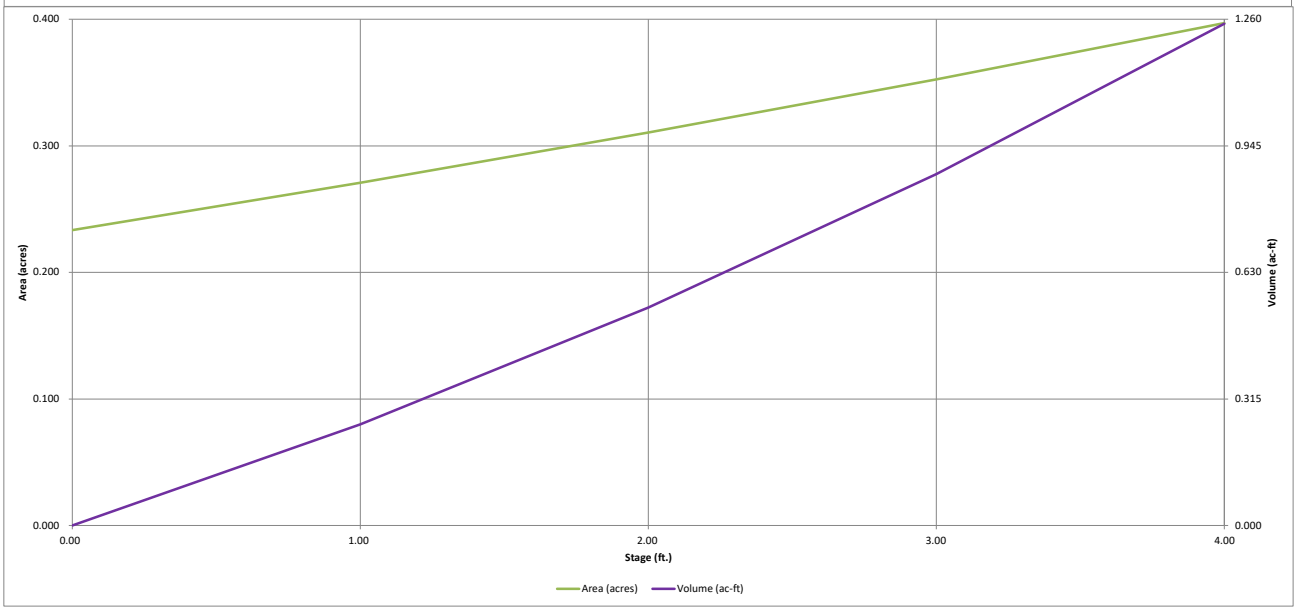
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10,172	0.234		
	--	1.00	--	--	--	11,801	0.271	10,986	0.252
	--	2.00	--	--	--	13,529	0.311	23,651	0.543
	--	3.00	--	--	--	15,357	0.353	38,094	0.875
	--	4.00	--	--	--	17,293	0.397	54,419	1.249

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



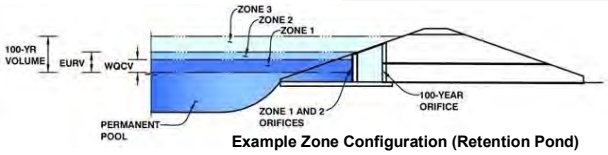


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-B2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.08	0.018	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.018	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.875E-03	ft²
Depth at top of Zone using Orifice Plate =	0.08	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.99	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.99	0.99	0.99	0.99	0.99			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.18	feet
Spillway Crest Length =	8.00	feet	Stage at Top of Freeboard =	4.18	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.40	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.25	acre-ft

Calculated Parameters for Spillway

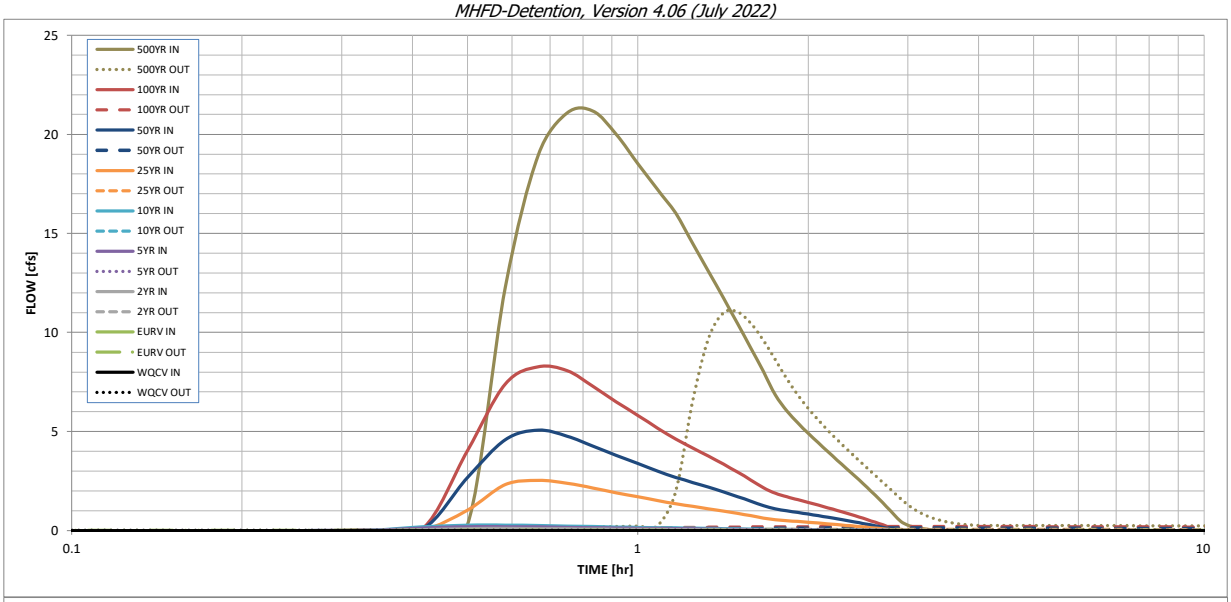
Routed Hydrograph Results

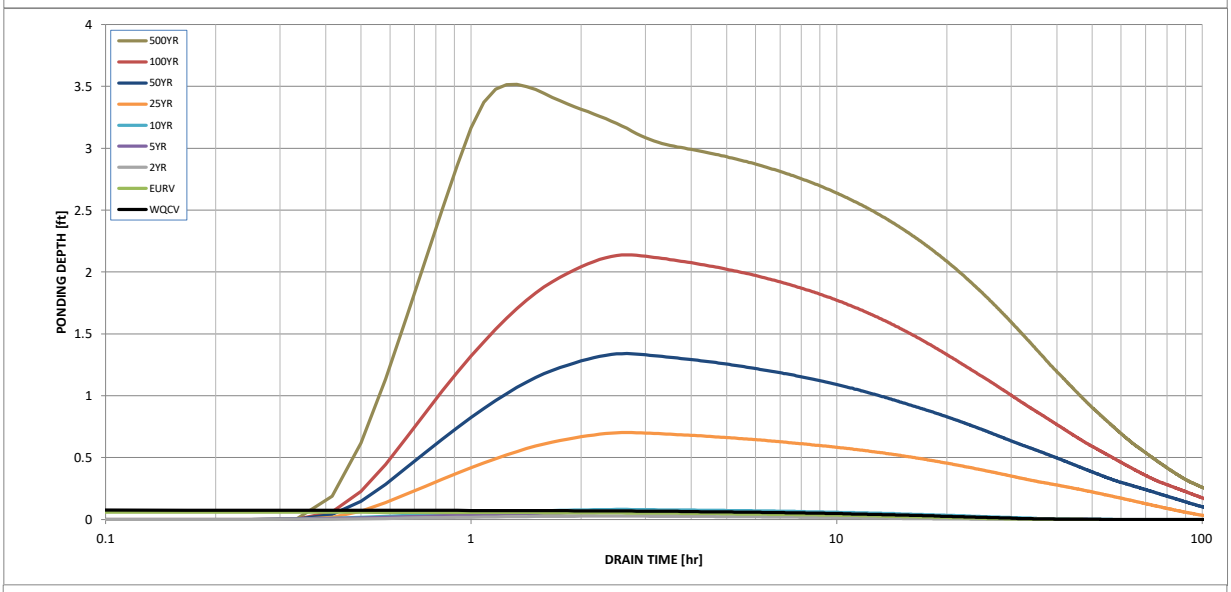
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

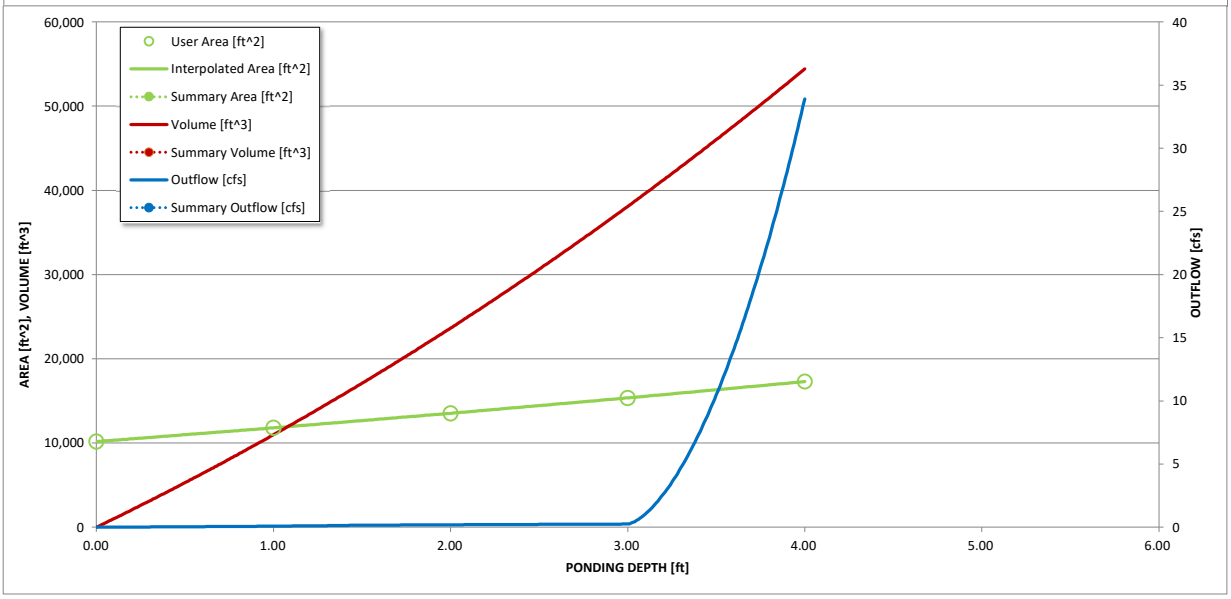
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.018	0.014	0.007	0.014	0.021	0.182	0.365	0.617	1.809
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.007	0.014	0.021	0.182	0.365	0.617	1.809
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.5	5.1	8.3	21.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.17	0.35	0.57	1.46
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.5	5.1	8.3	21.2
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	11.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	43	40	34	41	46	106	118	>120	106
Time to Drain 99% of Inflow Volume (hours) =	**52**	49	44	50	55	117	>120	>120	>120
Maximum Ponding Depth (ft) =	0.08	0.06	0.03	0.06	0.08	0.70	1.34	2.14	3.52
Area at Maximum Ponding Depth (acres) =	0.24	0.24	0.23	0.24	0.24	0.26	0.28	0.32	0.38
Maximum Volume Stored (acre-ft) =	0.019	0.014	0.005	0.012	0.019	0.173	0.347	0.584	1.060

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.05	0.12	0.18	0.03	0.07	0.09	0.30
	0:30:00	0.00	0.00	0.10	0.20	0.27	1.03	2.67	4.03	12.27
	0:35:00	0.00	0.00	0.10	0.20	0.27	2.32	4.58	7.40	18.94
	0:40:00	0.00	0.00	0.09	0.18	0.25	2.53	5.06	8.27	21.08
	0:45:00	0.00	0.00	0.08	0.16	0.22	2.39	4.76	8.07	21.18
	0:50:00	0.00	0.00	0.07	0.14	0.20	2.15	4.26	7.27	19.99
	0:55:00	0.00	0.00	0.07	0.13	0.18	1.90	3.79	6.49	18.52
	1:00:00	0.00	0.00	0.06	0.11	0.16	1.70	3.38	5.81	17.21
	1:05:00	0.00	0.00	0.05	0.10	0.14	1.51	3.00	5.17	16.01
	1:10:00	0.00	0.00	0.05	0.09	0.13	1.35	2.68	4.62	14.48
	1:15:00	0.00	0.00	0.04	0.08	0.12	1.22	2.42	4.17	13.08
	1:20:00	0.00	0.00	0.04	0.08	0.11	1.10	2.18	3.75	11.73
	1:25:00	0.00	0.00	0.04	0.07	0.10	0.98	1.95	3.35	10.45
	1:30:00	0.00	0.00	0.03	0.06	0.08	0.86	1.71	2.95	9.22
	1:35:00	0.00	0.00	0.03	0.05	0.07	0.75	1.48	2.55	8.02
	1:40:00	0.00	0.00	0.02	0.04	0.06	0.63	1.25	2.16	6.84
	1:45:00	0.00	0.00	0.02	0.04	0.06	0.55	1.09	1.88	6.04
	1:50:00	0.00	0.00	0.02	0.04	0.05	0.50	0.99	1.70	5.43
	1:55:00	0.00	0.00	0.02	0.03	0.05	0.46	0.91	1.55	4.91
	2:00:00	0.00	0.00	0.02	0.03	0.05	0.42	0.83	1.42	4.43
	2:05:00	0.00	0.00	0.02	0.03	0.04	0.38	0.75	1.28	3.98
	2:10:00	0.00	0.00	0.01	0.02	0.04	0.34	0.67	1.15	3.56
	2:15:00	0.00	0.00	0.01	0.02	0.03	0.30	0.59	1.01	3.14
	2:20:00	0.00	0.00	0.01	0.02	0.03	0.26	0.51	0.88	2.76
	2:25:00	0.00	0.00	0.01	0.01	0.02	0.22	0.43	0.75	2.37
	2:30:00	0.00	0.00	0.01	0.01	0.02	0.18	0.36	0.62	1.98
	2:35:00	0.00	0.00	0.00	0.01	0.01	0.14	0.28	0.49	1.59
	2:40:00	0.00	0.00	0.00	0.01	0.01	0.10	0.20	0.35	1.21
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.06	0.12	0.22	0.82
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.10	0.45
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.27
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.17
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.10
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

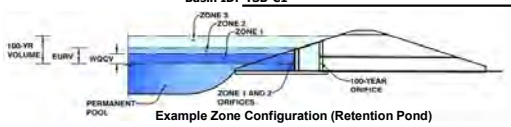
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-C1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	11.26	acres
Watershed Length =	1,405	ft
Watershed Length to Centroid =	703	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.014	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.011	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.006	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.011	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.016	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.141	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.284	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.480	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.408	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.006	acre-feet		
Approximate 5-yr Detention Volume =	0.008	acre-feet		
Approximate 10-yr Detention Volume =	0.012	acre-feet		
Approximate 25-yr Detention Volume =	0.018	acre-feet		
Approximate 50-yr Detention Volume =	0.044	acre-feet		
Approximate 100-yr Detention Volume =	0.122	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.014	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.014	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

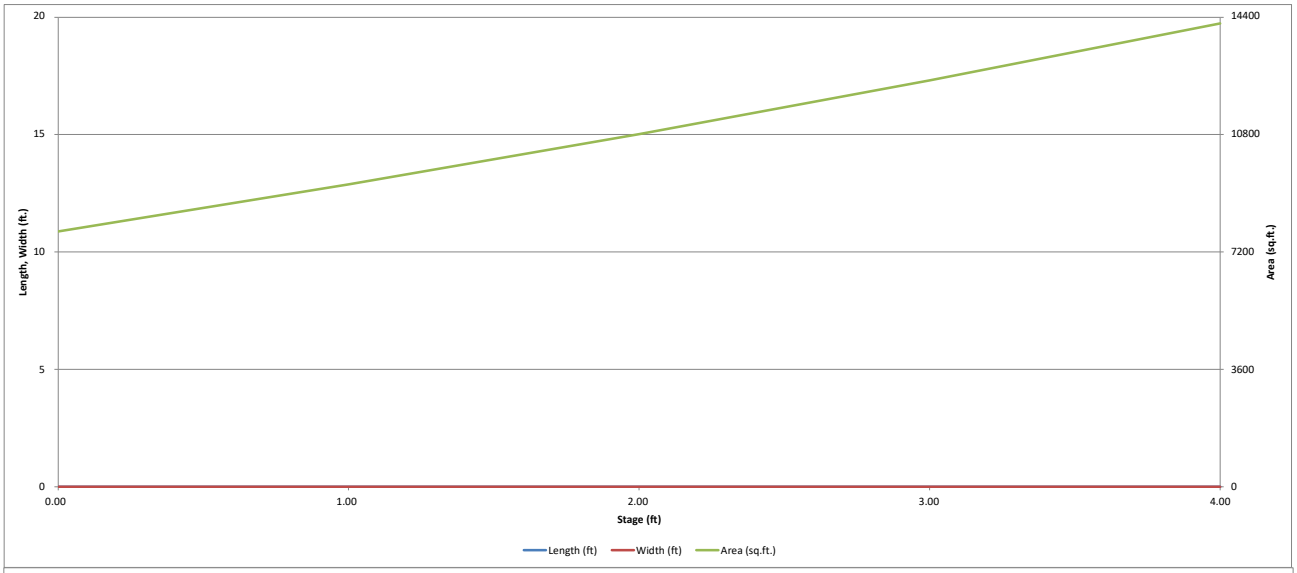
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

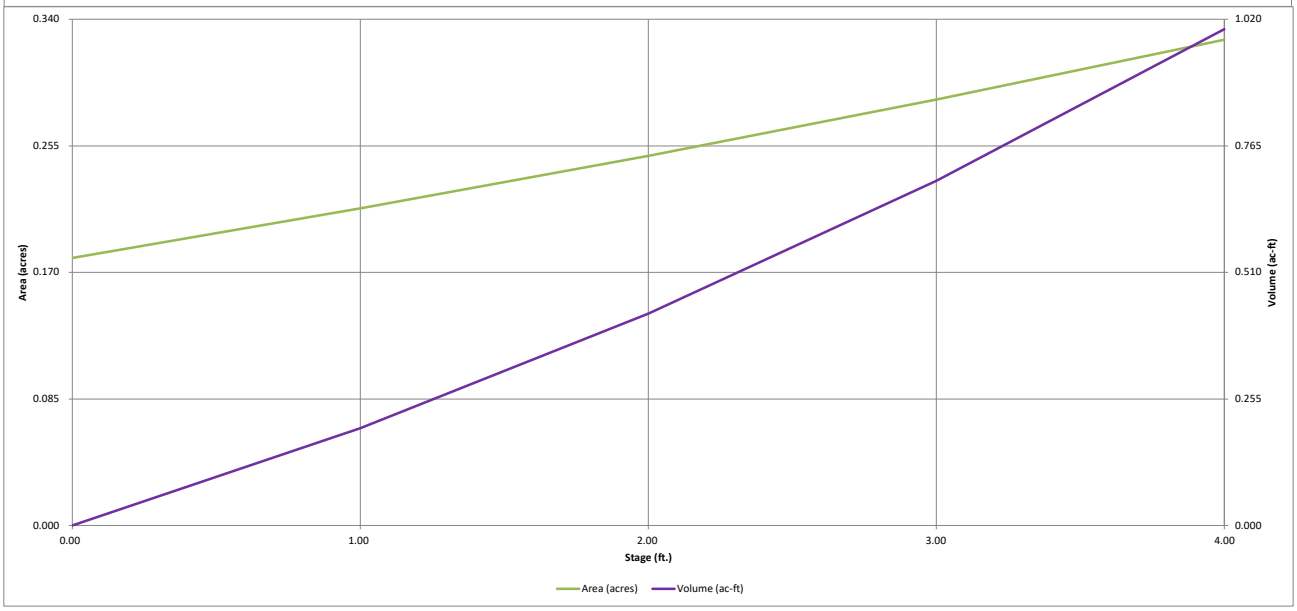
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	7,834	0.180		
	--	1.00	--	--	--	9,277	0.213	8,555	0.196
	--	2.00	--	--	--	10,819	0.248	18,603	0.427
	--	3.00	--	--	--	12,467	0.286	30,246	0.694
	--	4.00	--	--	--	14,216	0.326	43,588	1.001

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



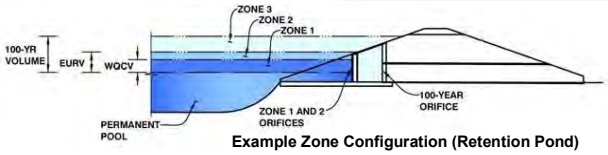


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-C1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.08	0.014	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.014	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.727E-03	ft²
Depth at top of Zone using Orifice Plate =	0.08	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.97	sq. inches (diameter = 1-1/16 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.97	0.97	0.97	0.97	0.97			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.17	feet
Spillway Crest Length =	11.00	feet	Stage at Top of Freeboard =	4.17	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.33	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.00	acre-ft

Calculated Parameters for Spillway

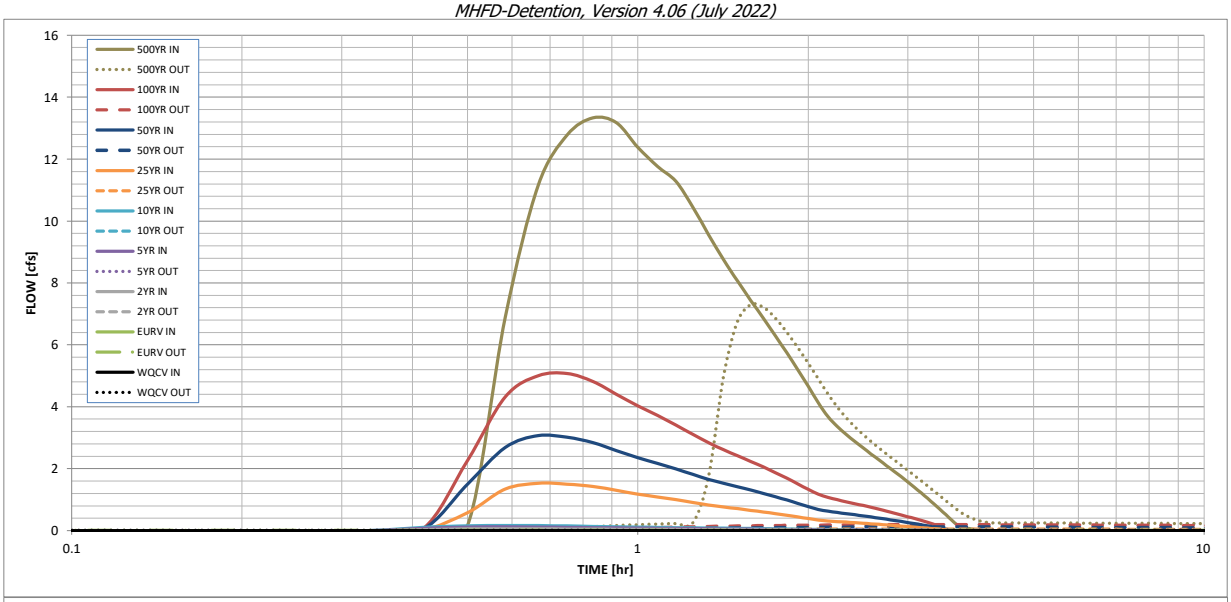
Routed Hydrograph Results

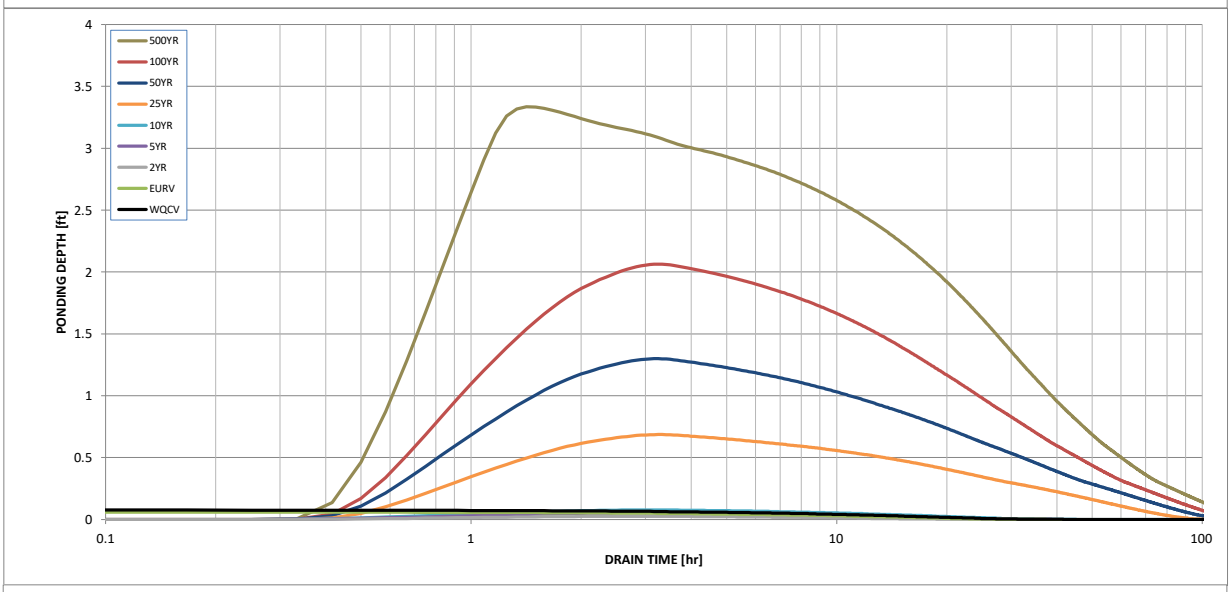
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

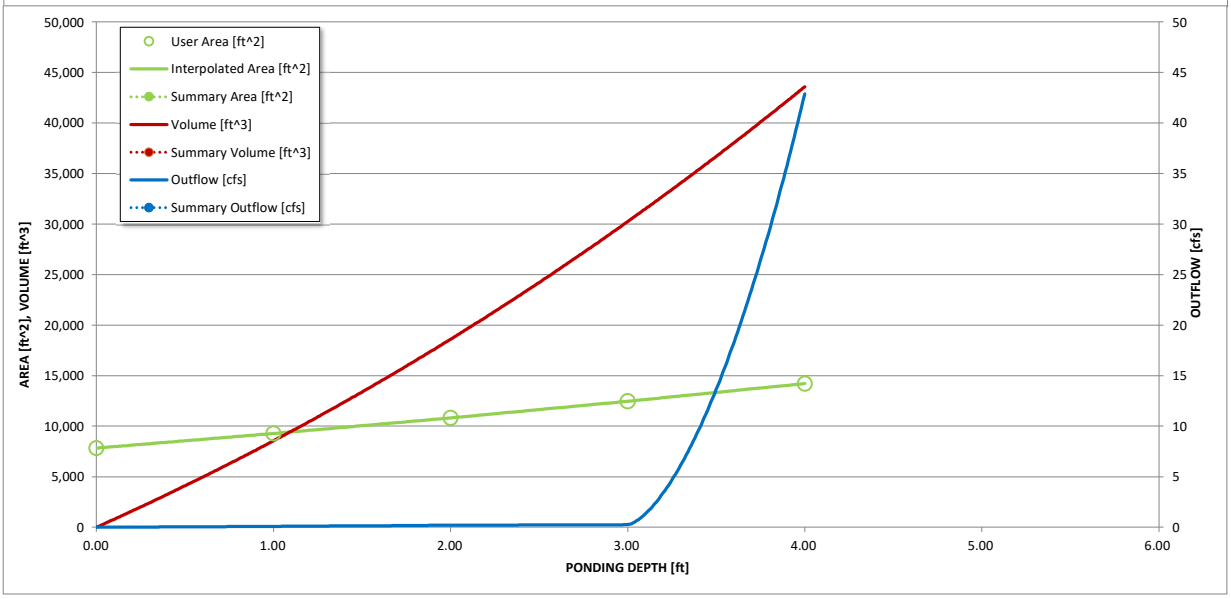
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.014	0.011	0.006	0.011	0.016	0.141	0.284	0.480	1.408
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.006	0.011	0.016	0.141	0.284	0.480	1.408
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.5	3.1	5.1	13.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.01	0.14	0.27	0.45	1.18
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.5	3.1	5.1	13.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	7.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.0	0.0	0.0	0.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	34	31	27	32	37	84	94	99	86
Time to Drain 99% of Inflow Volume (hours) =	**41**	39	35	40	44	93	106	115	113
Maximum Ponding Depth (ft) =	0.08	0.07	0.03	0.05	0.08	0.69	1.30	2.06	3.34
Area at Maximum Ponding Depth (acres) =	0.18	0.18	0.18	0.18	0.18	0.20	0.22	0.25	0.30
Maximum Volume Stored (acre-ft) =	0.014	0.013	0.004	0.009	0.013	0.130	0.260	0.442	0.791

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.03	0.07	0.10	0.02	0.04	0.05	0.17
	0:30:00	0.00	0.00	0.06	0.12	0.16	0.58	1.50	2.26	6.89
	0:35:00	0.00	0.00	0.06	0.12	0.17	1.34	2.68	4.32	11.15
	0:40:00	0.00	0.00	0.06	0.11	0.16	1.53	3.07	5.00	12.78
	0:45:00	0.00	0.00	0.06	0.11	0.15	1.50	3.01	5.08	13.33
	0:50:00	0.00	0.00	0.05	0.10	0.14	1.42	2.84	4.82	13.17
	0:55:00	0.00	0.00	0.05	0.09	0.12	1.30	2.58	4.40	12.38
	1:00:00	0.00	0.00	0.04	0.08	0.12	1.18	2.36	4.03	11.76
	1:05:00	0.00	0.00	0.04	0.08	0.11	1.09	2.17	3.72	11.29
	1:10:00	0.00	0.00	0.04	0.07	0.10	1.00	1.99	3.41	10.45
	1:15:00	0.00	0.00	0.03	0.06	0.09	0.91	1.82	3.11	9.56
	1:20:00	0.00	0.00	0.03	0.06	0.09	0.83	1.66	2.84	8.75
	1:25:00	0.00	0.00	0.03	0.06	0.08	0.76	1.53	2.61	8.06
	1:30:00	0.00	0.00	0.03	0.05	0.07	0.71	1.42	2.42	7.43
	1:35:00	0.00	0.00	0.02	0.05	0.07	0.66	1.31	2.24	6.85
	1:40:00	0.00	0.00	0.02	0.04	0.06	0.60	1.20	2.05	6.29
	1:45:00	0.00	0.00	0.02	0.04	0.06	0.55	1.09	1.87	5.74
	1:50:00	0.00	0.00	0.02	0.03	0.05	0.50	0.99	1.69	5.20
	1:55:00	0.00	0.00	0.02	0.03	0.04	0.44	0.88	1.51	4.66
	2:00:00	0.00	0.00	0.01	0.03	0.04	0.39	0.77	1.33	4.14
	2:05:00	0.00	0.00	0.01	0.03	0.04	0.34	0.68	1.18	3.68
	2:10:00	0.00	0.00	0.01	0.02	0.03	0.31	0.63	1.07	3.37
	2:15:00	0.00	0.00	0.01	0.02	0.03	0.29	0.59	1.00	3.11
	2:20:00	0.00	0.00	0.01	0.02	0.03	0.27	0.55	0.93	2.88
	2:25:00	0.00	0.00	0.01	0.02	0.03	0.26	0.51	0.87	2.67
	2:30:00	0.00	0.00	0.01	0.02	0.03	0.24	0.48	0.81	2.47
	2:35:00	0.00	0.00	0.01	0.02	0.02	0.22	0.44	0.75	2.28
	2:40:00	0.00	0.00	0.01	0.01	0.02	0.20	0.40	0.69	2.10
	2:45:00	0.00	0.00	0.01	0.01	0.02	0.19	0.37	0.63	1.92
	2:50:00	0.00	0.00	0.01	0.01	0.02	0.17	0.33	0.57	1.75
	2:55:00	0.00	0.00	0.01	0.01	0.02	0.15	0.30	0.51	1.57
	3:00:00	0.00	0.00	0.00	0.01	0.01	0.13	0.26	0.45	1.39
	3:05:00	0.00	0.00	0.00	0.01	0.01	0.11	0.23	0.39	1.22
	3:10:00	0.00	0.00	0.00	0.01	0.01	0.10	0.19	0.33	1.04
	3:15:00	0.00	0.00	0.00	0.00	0.01	0.08	0.15	0.27	0.86
	3:20:00	0.00	0.00	0.00	0.00	0.01	0.06	0.12	0.21	0.69
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.15	0.51
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.09	0.34
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.19
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.11
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

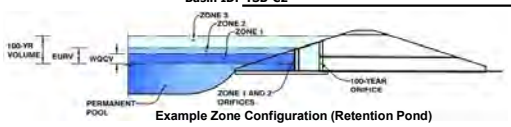
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-C2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	11.92	acres
Watershed Length =	1,201	ft
Watershed Length to Centroid =	601	ft
Watershed Slope =	0.031	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.015	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.011	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.006	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.012	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.017	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.150	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.301	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.508	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.489	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.006	acre-feet		
Approximate 5-yr Detention Volume =	0.009	acre-feet		
Approximate 10-yr Detention Volume =	0.013	acre-feet		
Approximate 25-yr Detention Volume =	0.019	acre-feet		
Approximate 50-yr Detention Volume =	0.047	acre-feet		
Approximate 100-yr Detention Volume =	0.129	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.015	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.015	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

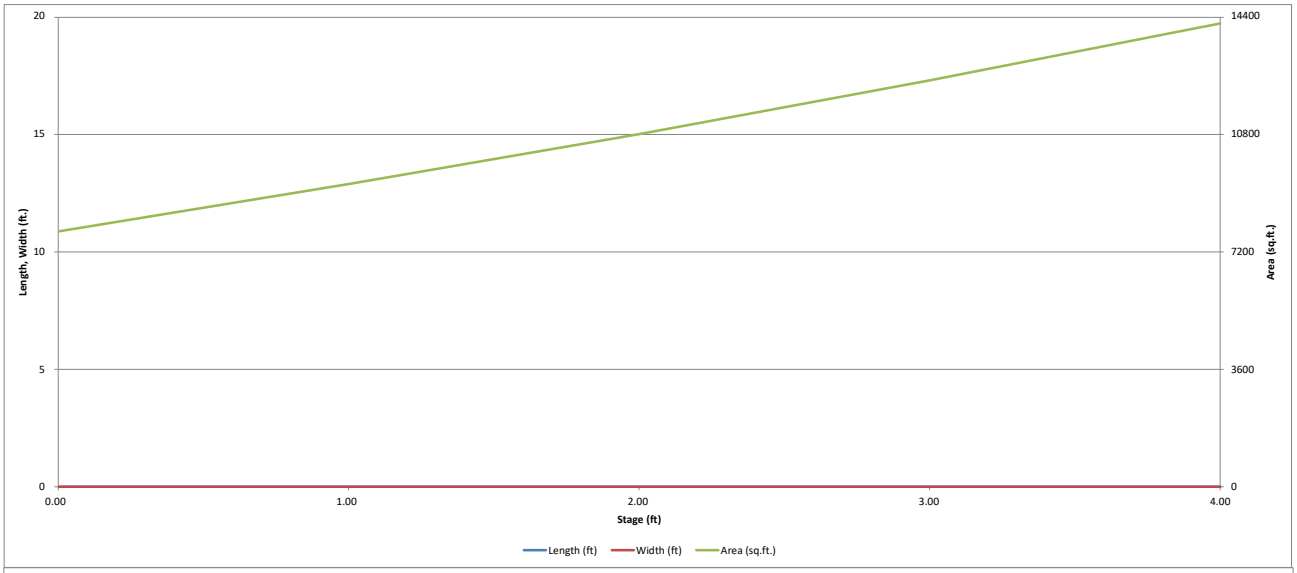
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

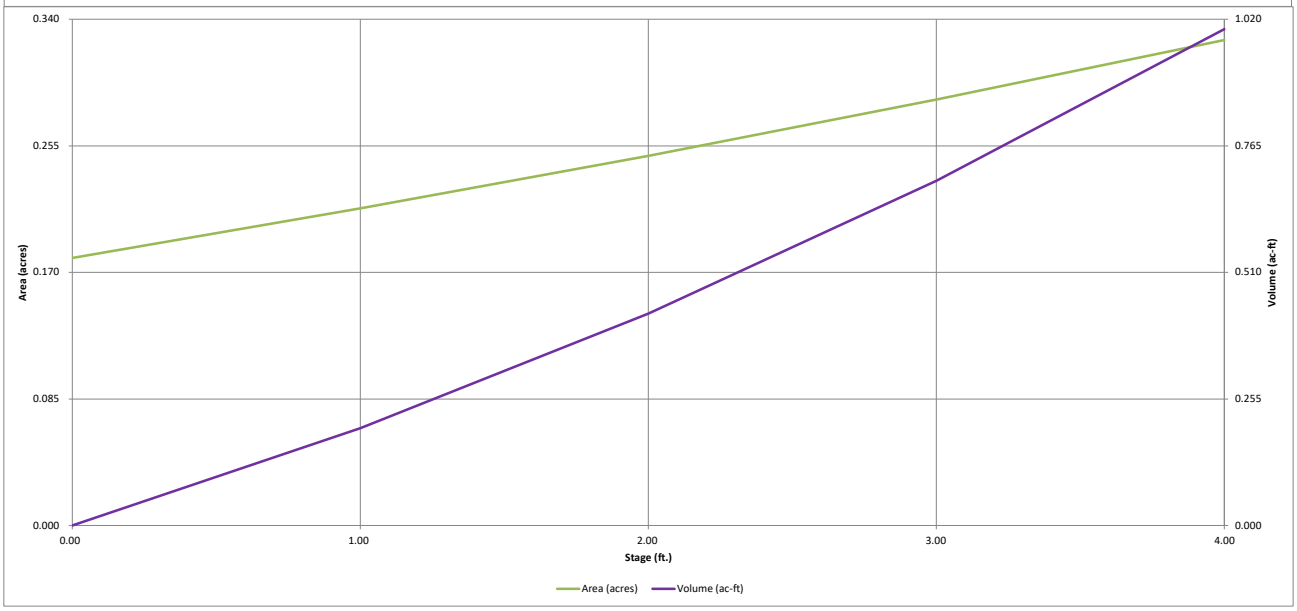
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	7,834	0.180		
	--	1.00	--	--	--	9,282	0.213	8,558	0.196
	--	2.00	--	--	--	10,819	0.248	18,608	0.427
	--	3.00	--	--	--	12,460	0.286	30,248	0.694
	--	4.00	--	--	--	14,209	0.326	43,582	1.001

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



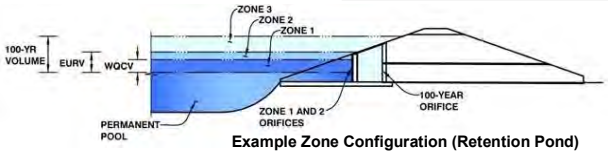


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-C2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.09	0.015	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.015	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	5.486E-03	ft²
Depth at top of Zone using Orifice Plate =	0.11	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.79	sq. inches (diameter = 1 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.79	0.79	0.79	0.79	0.79			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.24	feet
Spillway Crest Length =	24.00	feet	Stage at Top of Freeboard =	4.24	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.33	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.00	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.015	0.011	0.006	0.012	0.017	0.150	0.301	0.508	1.489
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.006	0.012	0.017	0.150	0.301	0.508	1.489
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.1	4.2	6.9	17.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.18	0.35	0.58	1.48
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.1	4.2	6.9	17.6
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	11.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	43	38	34	40	45	104	115	>120	101
Time to Drain 99% of Inflow Volume (hours) =	**52**	48	43	49	54	115	>120	>120	>120
Maximum Ponding Depth (ft) =	0.09	0.07	0.03	0.06	0.09	0.74	1.40	2.22	3.29
Area at Maximum Ponding Depth (acres) =	0.18	0.18	0.18	0.18	0.18	0.20	0.23	0.26	0.30
Maximum Volume Stored (acre-ft) =	0.016	0.013	0.004	0.009	0.014	0.142	0.285	0.483	0.776

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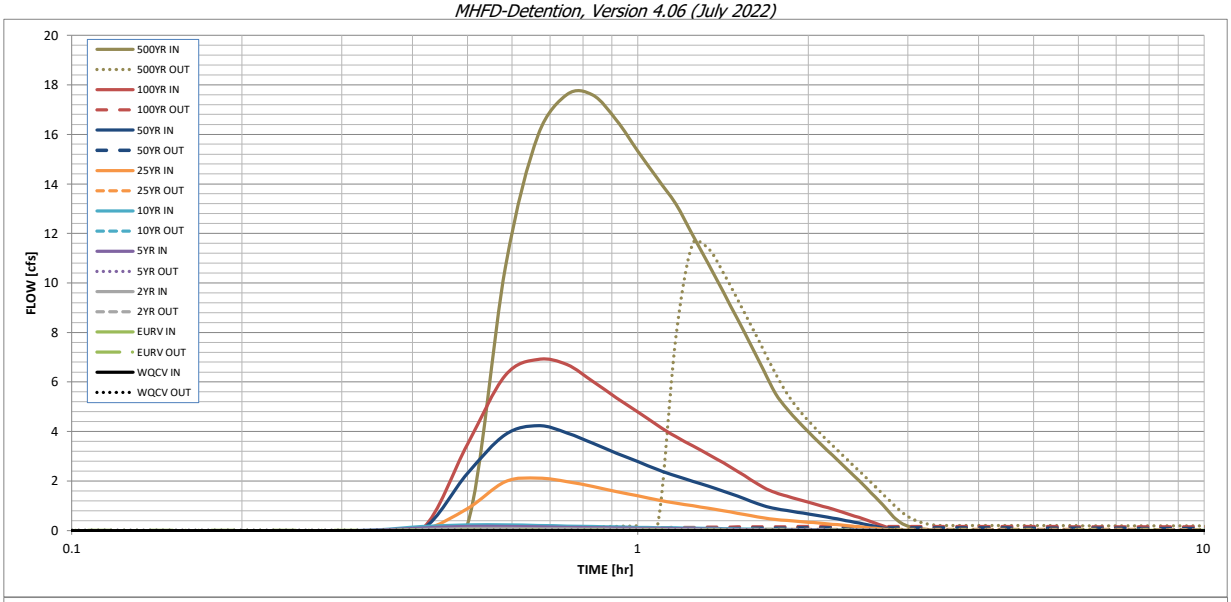

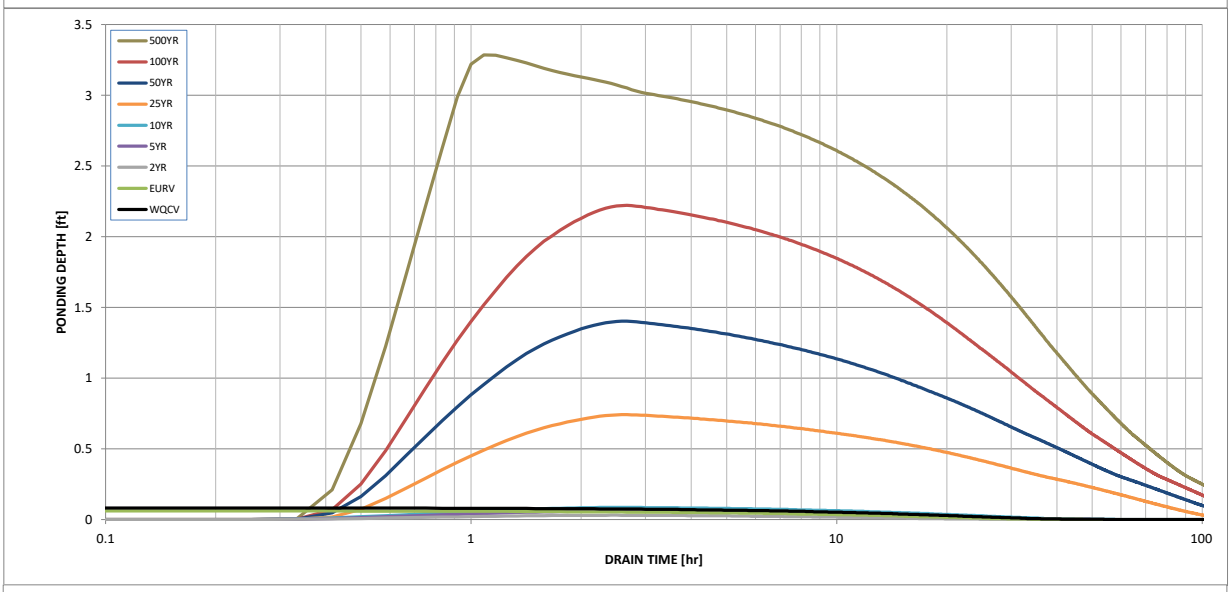

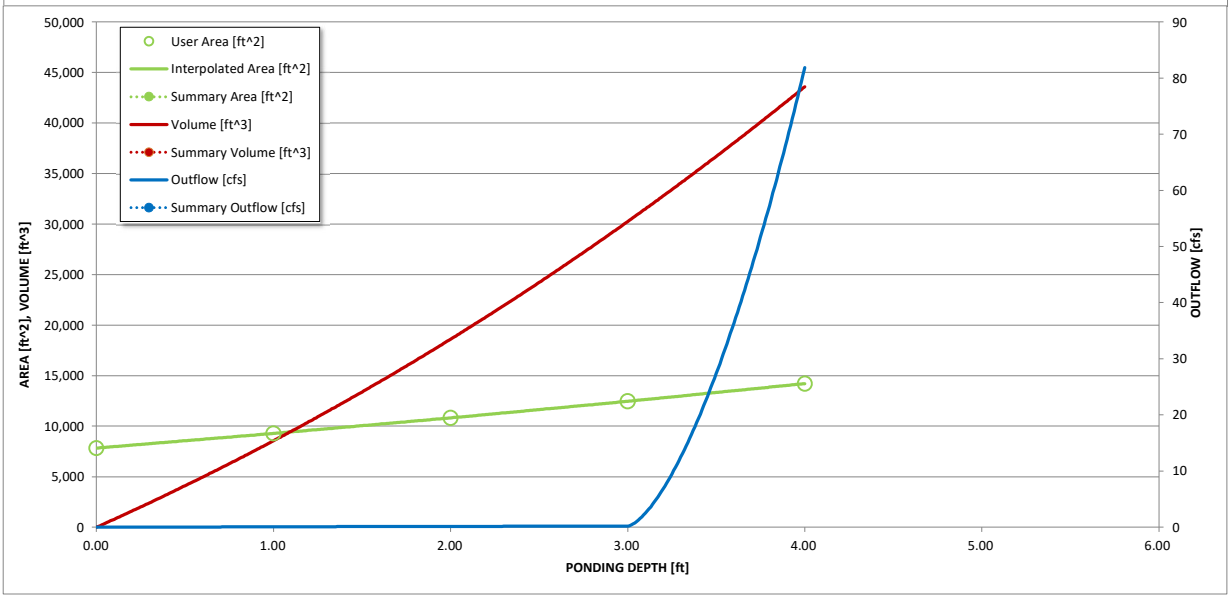

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.04	0.11	0.16	0.03	0.06	0.08	0.26
	0:30:00	0.00	0.00	0.08	0.17	0.23	0.89	2.31	3.48	10.61
	0:35:00	0.00	0.00	0.08	0.16	0.23	1.97	3.87	6.27	15.98
	0:40:00	0.00	0.00	0.08	0.15	0.21	2.11	4.23	6.91	17.61
	0:45:00	0.00	0.00	0.07	0.13	0.18	1.98	3.94	6.70	17.58
	0:50:00	0.00	0.00	0.06	0.12	0.16	1.78	3.52	6.02	16.57
	0:55:00	0.00	0.00	0.05	0.10	0.15	1.57	3.13	5.36	15.32
	1:00:00	0.00	0.00	0.05	0.09	0.13	1.40	2.79	4.79	14.21
	1:05:00	0.00	0.00	0.04	0.08	0.12	1.24	2.46	4.25	13.19
	1:10:00	0.00	0.00	0.04	0.08	0.11	1.10	2.20	3.79	11.92
	1:15:00	0.00	0.00	0.04	0.07	0.10	1.00	1.99	3.42	10.76
	1:20:00	0.00	0.00	0.03	0.06	0.09	0.90	1.79	3.07	9.62
	1:25:00	0.00	0.00	0.03	0.05	0.08	0.80	1.59	2.73	8.54
	1:30:00	0.00	0.00	0.02	0.05	0.07	0.70	1.39	2.39	7.50
	1:35:00	0.00	0.00	0.02	0.04	0.06	0.60	1.19	2.06	6.48
	1:40:00	0.00	0.00	0.02	0.04	0.05	0.51	1.01	1.74	5.55
	1:45:00	0.00	0.00	0.02	0.03	0.05	0.44	0.89	1.53	4.92
	1:50:00	0.00	0.00	0.02	0.03	0.04	0.41	0.81	1.39	4.42
	1:55:00	0.00	0.00	0.02	0.03	0.04	0.37	0.74	1.27	3.99
	2:00:00	0.00	0.00	0.01	0.03	0.04	0.34	0.67	1.15	3.59
	2:05:00	0.00	0.00	0.01	0.02	0.03	0.30	0.60	1.04	3.22
	2:10:00	0.00	0.00	0.01	0.02	0.03	0.27	0.54	0.92	2.86
	2:15:00	0.00	0.00	0.01	0.02	0.02	0.24	0.47	0.81	2.52
	2:20:00	0.00	0.00	0.01	0.01	0.02	0.20	0.40	0.70	2.19
	2:25:00	0.00	0.00	0.01	0.01	0.02	0.17	0.34	0.58	1.86
	2:30:00	0.00	0.00	0.00	0.01	0.01	0.14	0.27	0.47	1.53
	2:35:00	0.00	0.00	0.00	0.01	0.01	0.11	0.20	0.36	1.20
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.25	0.87
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.14	0.54
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.31
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.18
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.11
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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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'.

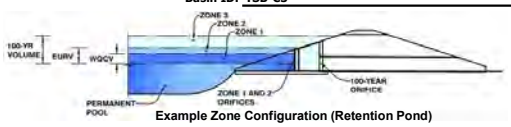
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-C3**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	15.29	acres
Watershed Length =	1,926	ft
Watershed Length to Centroid =	963	ft
Watershed Slope =	0.026	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.019	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.014	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.008	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.015	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.022	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.192	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.386	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.653	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.913	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.008	acre-feet		
Approximate 5-yr Detention Volume =	0.011	acre-feet		
Approximate 10-yr Detention Volume =	0.016	acre-feet		
Approximate 25-yr Detention Volume =	0.024	acre-feet		
Approximate 50-yr Detention Volume =	0.060	acre-feet		
Approximate 100-yr Detention Volume =	0.165	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.019	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.019	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

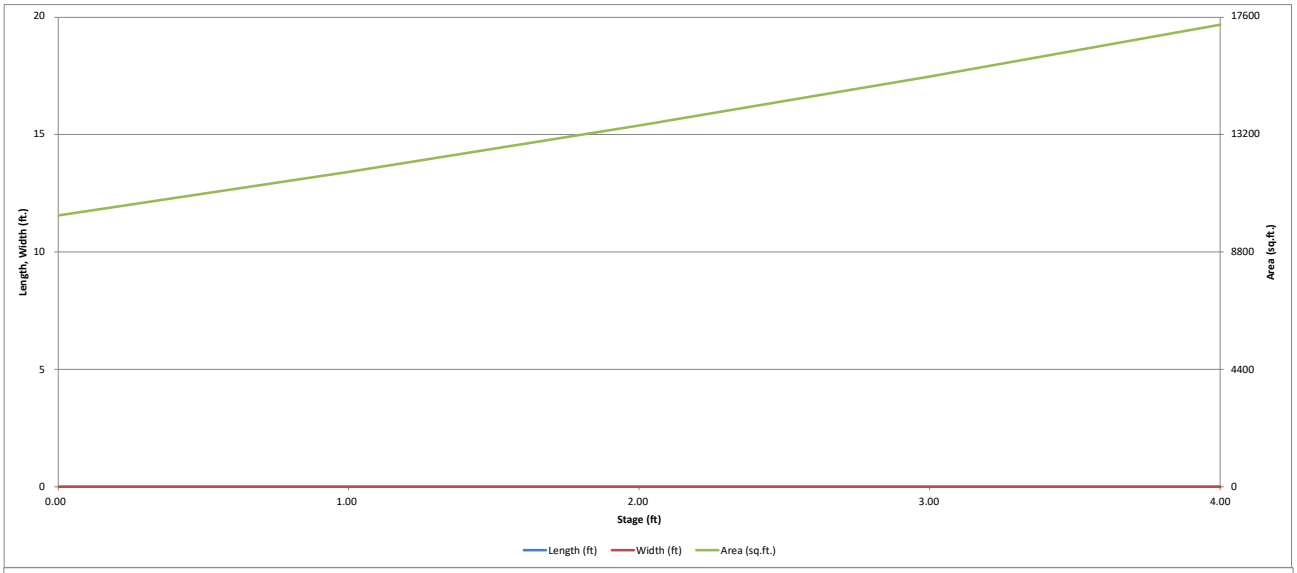
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

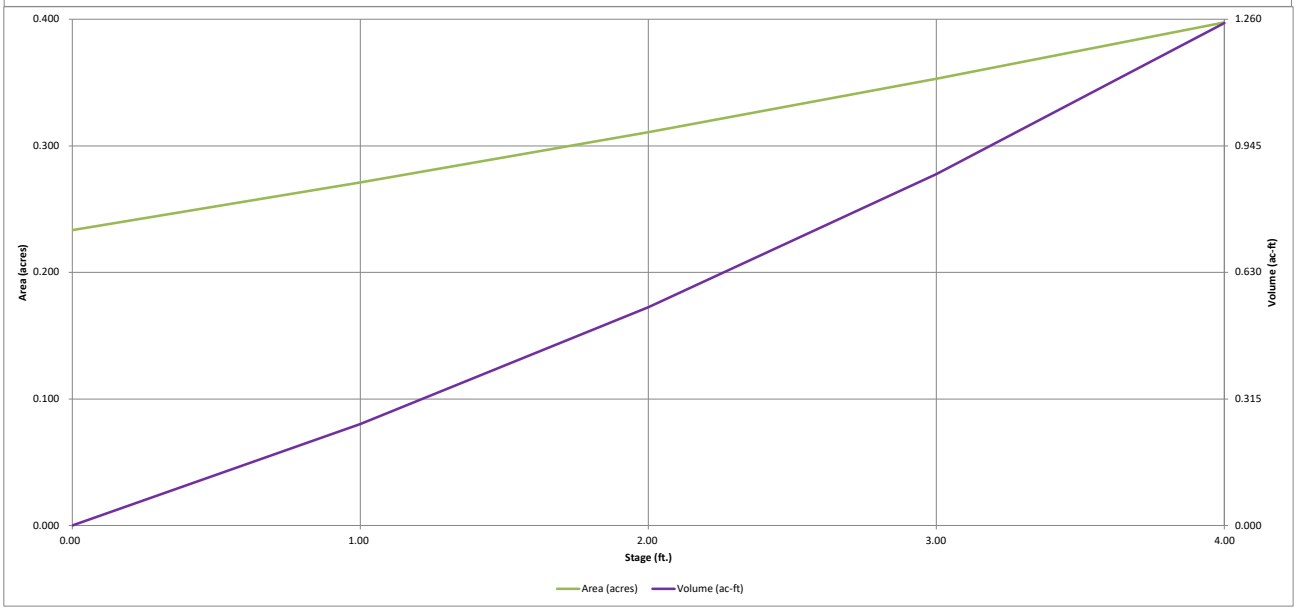
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10,172	0.234		
	--	1.00	--	--	--	11,807	0.271	10,989	0.252
	--	2.00	--	--	--	13,543	0.311	23,664	0.543
	--	3.00	--	--	--	15,380	0.353	38,126	0.875
	--	4.00	--	--	--	17,319	0.398	54,475	1.251

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



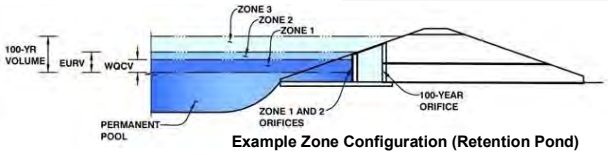


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-C3**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.09	0.019	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.019	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	7.708E-03	ft²
Depth at top of Zone using Orifice Plate =	0.09	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.11	sq. inches (diameter = 1-3/16 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	1.11	1.11	1.11	1.11	1.11			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.22	feet
Spillway Crest Length =	26.00	feet	Stage at Top of Freeboard =	4.22	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.40	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.25	acre-ft

Calculated Parameters for Spillway

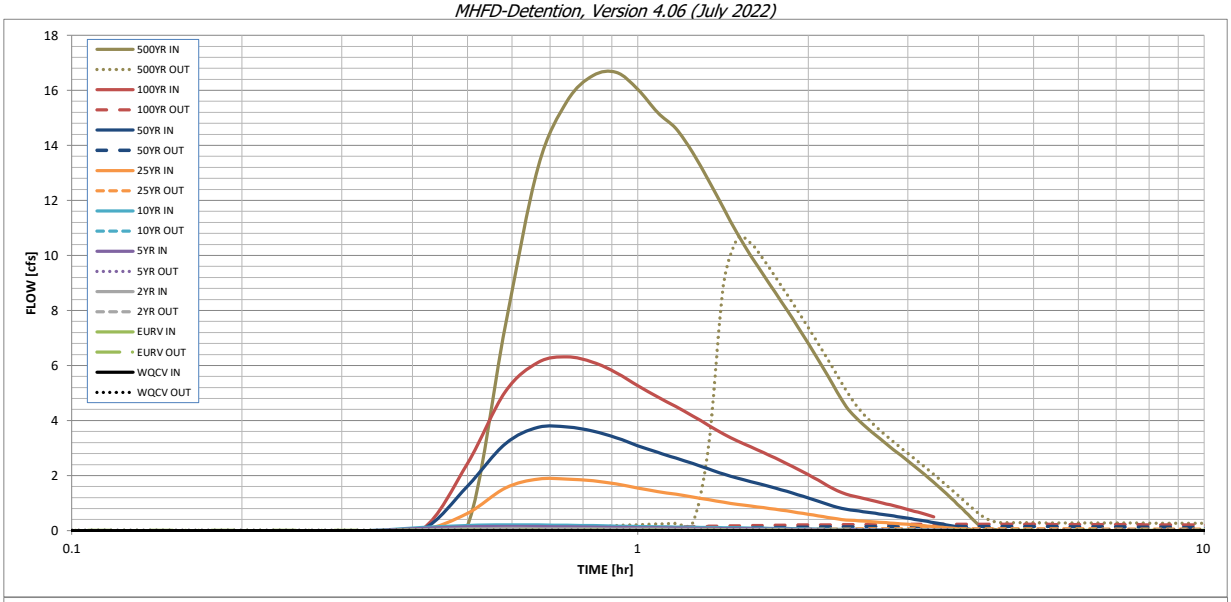
Routed Hydrograph Results

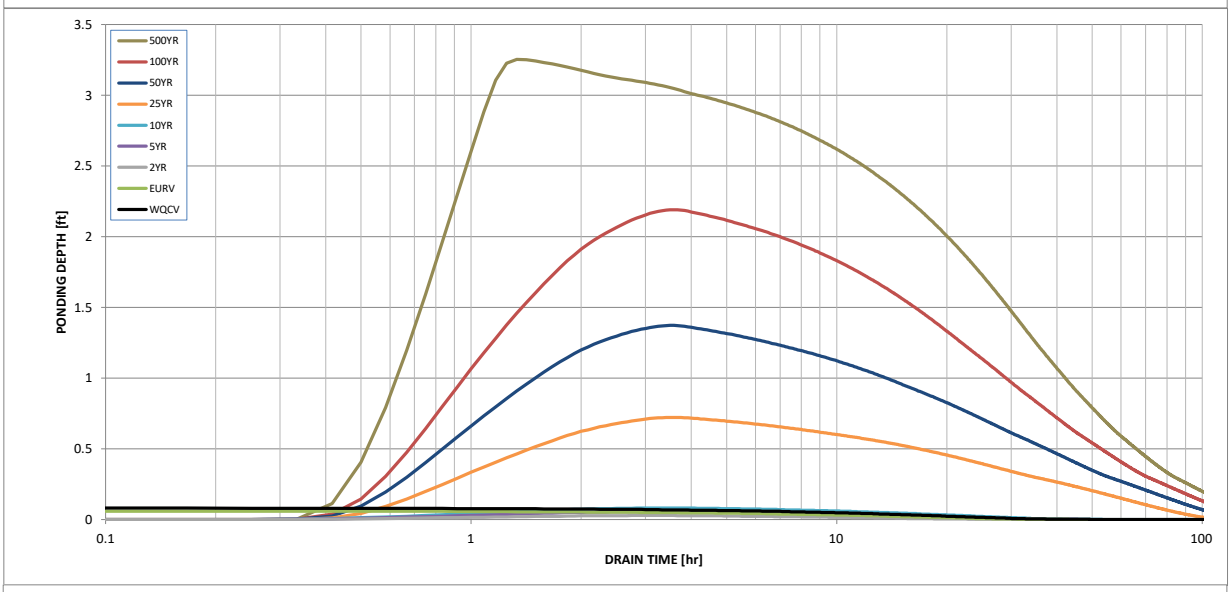
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

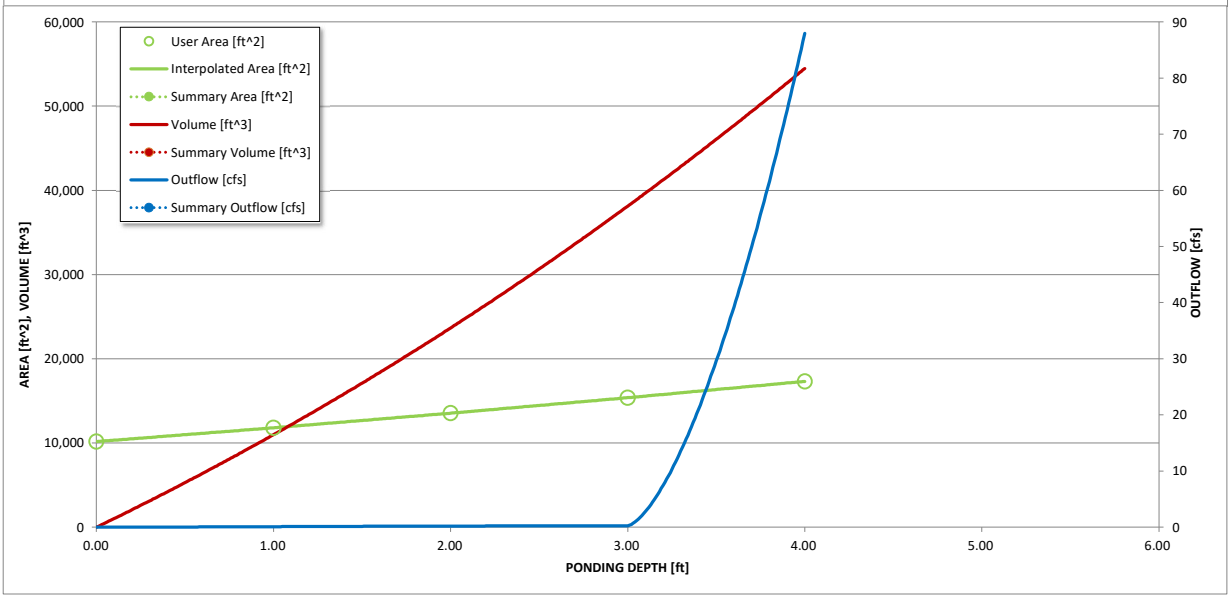
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.019	0.014	0.008	0.015	0.022	0.192	0.386	0.653	1.913
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.008	0.015	0.022	0.192	0.386	0.653	1.913
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.9	3.8	6.3	16.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.12	0.25	0.41	1.09
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.9	3.8	6.3	16.7
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.2	10.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.0	0.0	0.0	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	35	31	37	42	96	106	112	93
Time to Drain 99% of Inflow Volume (hours) =	**48**	44	40	46	50	106	>120	>120	>120
Maximum Ponding Depth (ft) =	0.09	0.06	0.03	0.06	0.08	0.72	1.37	2.19	3.25
Area at Maximum Ponding Depth (acres) =	0.24	0.24	0.23	0.24	0.24	0.26	0.29	0.32	0.36
Maximum Volume Stored (acre-ft) =	0.021	0.014	0.005	0.012	0.019	0.178	0.355	0.603	0.965

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.03	0.07	0.11	0.02	0.04	0.06	0.18
	0:30:00	0.00	0.00	0.07	0.14	0.19	0.62	1.62	2.44	7.43
	0:35:00	0.00	0.00	0.08	0.15	0.21	1.55	3.15	5.05	13.22
	0:40:00	0.00	0.00	0.07	0.14	0.20	1.87	3.75	6.11	15.60
	0:45:00	0.00	0.00	0.07	0.14	0.19	1.87	3.77	6.31	16.54
	0:50:00	0.00	0.00	0.07	0.13	0.18	1.81	3.62	6.12	16.65
	0:55:00	0.00	0.00	0.06	0.12	0.16	1.69	3.37	5.74	16.04
	1:00:00	0.00	0.00	0.06	0.11	0.15	1.55	3.08	5.27	15.20
	1:05:00	0.00	0.00	0.05	0.10	0.14	1.42	2.84	4.86	14.62
	1:10:00	0.00	0.00	0.05	0.09	0.13	1.32	2.63	4.51	13.73
	1:15:00	0.00	0.00	0.04	0.09	0.12	1.22	2.44	4.16	12.73
	1:20:00	0.00	0.00	0.04	0.08	0.11	1.12	2.24	3.83	11.72
	1:25:00	0.00	0.00	0.04	0.07	0.11	1.03	2.05	3.51	10.78
	1:30:00	0.00	0.00	0.04	0.07	0.10	0.95	1.91	3.26	9.99
	1:35:00	0.00	0.00	0.03	0.07	0.09	0.89	1.78	3.04	9.29
	1:40:00	0.00	0.00	0.03	0.06	0.09	0.83	1.66	2.83	8.65
	1:45:00	0.00	0.00	0.03	0.06	0.08	0.77	1.54	2.63	8.02
	1:50:00	0.00	0.00	0.03	0.05	0.07	0.71	1.42	2.43	7.41
	1:55:00	0.00	0.00	0.03	0.05	0.07	0.66	1.31	2.23	6.81
	2:00:00	0.00	0.00	0.02	0.04	0.06	0.60	1.19	2.03	6.21
	2:05:00	0.00	0.00	0.02	0.04	0.05	0.54	1.07	1.83	5.62
	2:10:00	0.00	0.00	0.02	0.03	0.05	0.48	0.95	1.63	5.04
	2:15:00	0.00	0.00	0.02	0.03	0.05	0.43	0.84	1.45	4.51
	2:20:00	0.00	0.00	0.02	0.03	0.04	0.39	0.78	1.33	4.15
	2:25:00	0.00	0.00	0.01	0.03	0.04	0.37	0.73	1.25	3.86
	2:30:00	0.00	0.00	0.01	0.03	0.04	0.34	0.69	1.17	3.60
	2:35:00	0.00	0.00	0.01	0.02	0.04	0.32	0.65	1.10	3.37
	2:40:00	0.00	0.00	0.01	0.02	0.03	0.30	0.61	1.04	3.15
	2:45:00	0.00	0.00	0.01	0.02	0.03	0.29	0.57	0.97	2.93
	2:50:00	0.00	0.00	0.01	0.02	0.03	0.27	0.53	0.90	2.73
	2:55:00	0.00	0.00	0.01	0.02	0.03	0.25	0.49	0.84	2.53
	3:00:00	0.00	0.00	0.01	0.02	0.02	0.23	0.45	0.77	2.34
	3:05:00	0.00	0.00	0.01	0.01	0.02	0.21	0.41	0.70	2.14
	3:10:00	0.00	0.00	0.01	0.01	0.02	0.19	0.37	0.63	1.95
	3:15:00	0.00	0.00	0.01	0.01	0.02	0.17	0.33	0.57	1.75
	3:20:00	0.00	0.00	0.01	0.01	0.01	0.15	0.29	0.50	1.55
	3:25:00	0.00	0.00	0.00	0.01	0.01	0.13	0.25	0.43	1.36
	3:30:00	0.00	0.00	0.00	0.01	0.01	0.11	0.21	0.37	1.16
	3:35:00	0.00	0.00	0.00	0.01	0.01	0.09	0.17	0.30	0.97
	3:40:00	0.00	0.00	0.00	0.00	0.01	0.07	0.13	0.23	0.77
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.05	0.09	0.17	0.58
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.10	0.38
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.21
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.13
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

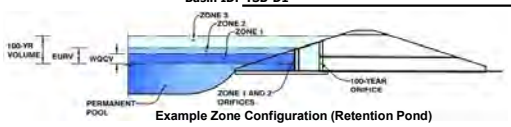
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-D1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	10.09	acres
Watershed Length =	1,605	ft
Watershed Length to Centroid =	803	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.013	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.009	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.005	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.010	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.014	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.127	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.255	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.431	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.262	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.005	acre-feet		
Approximate 5-yr Detention Volume =	0.008	acre-feet		
Approximate 10-yr Detention Volume =	0.011	acre-feet		
Approximate 25-yr Detention Volume =	0.016	acre-feet		
Approximate 50-yr Detention Volume =	0.040	acre-feet		
Approximate 100-yr Detention Volume =	0.109	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.013	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.013	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

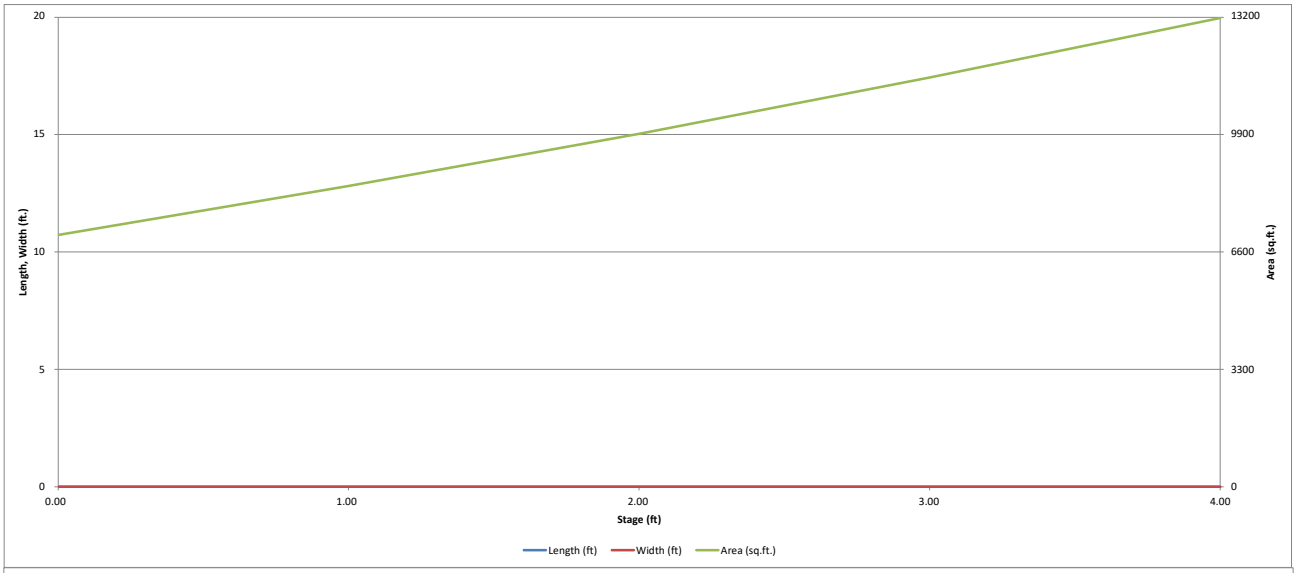
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

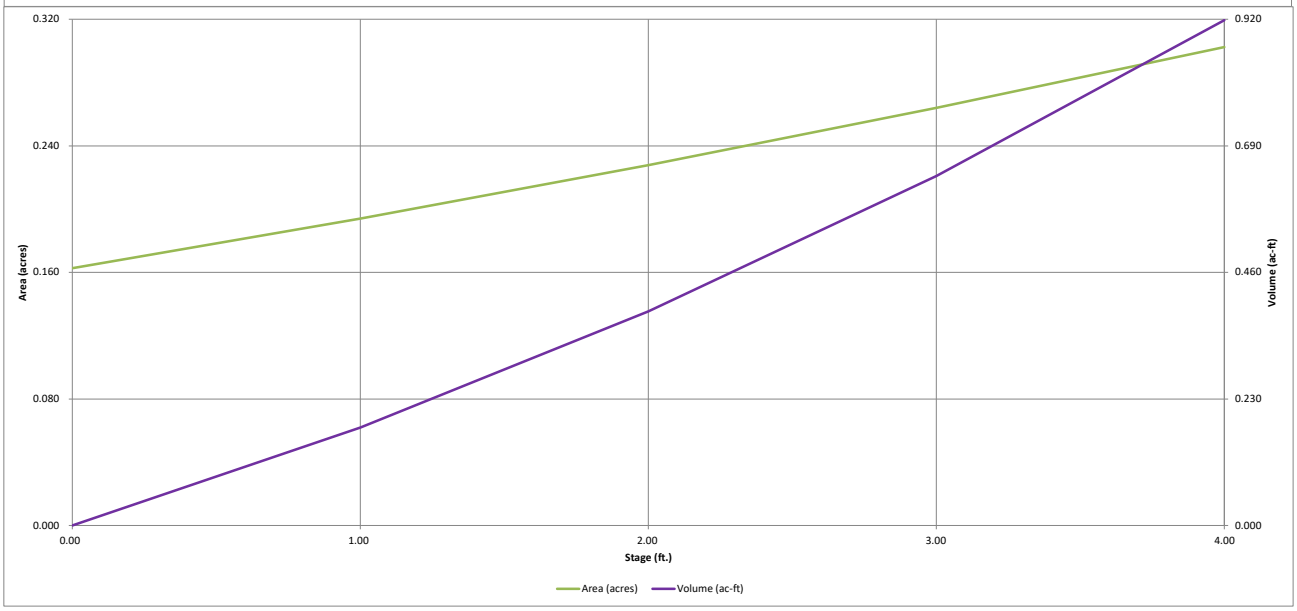
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	7,084	0.163		
	--	1.00	--	--	--	8,455	0.194	7,769	0.178
	--	2.00	--	--	--	9,924	0.228	16,959	0.389
	--	3.00	--	--	--	11,501	0.264	27,671	0.635
	--	4.00	--	--	--	13,178	0.303	40,011	0.919

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



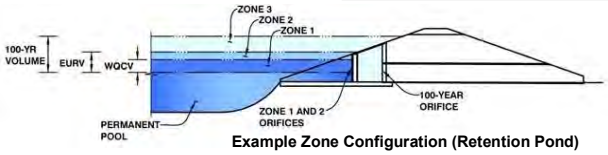


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-D1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.08	0.013	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.013	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.792E-03	ft²
Depth at top of Zone using Orifice Plate =	0.08	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.69	sq. inches (diameter = 15/16 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.69	0.69	0.69	0.69	0.69			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.17	feet
Spillway Crest Length =	16.00	feet	Stage at Top of Freeboard =	4.17	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.30	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.92	acre-ft

Calculated Parameters for Spillway

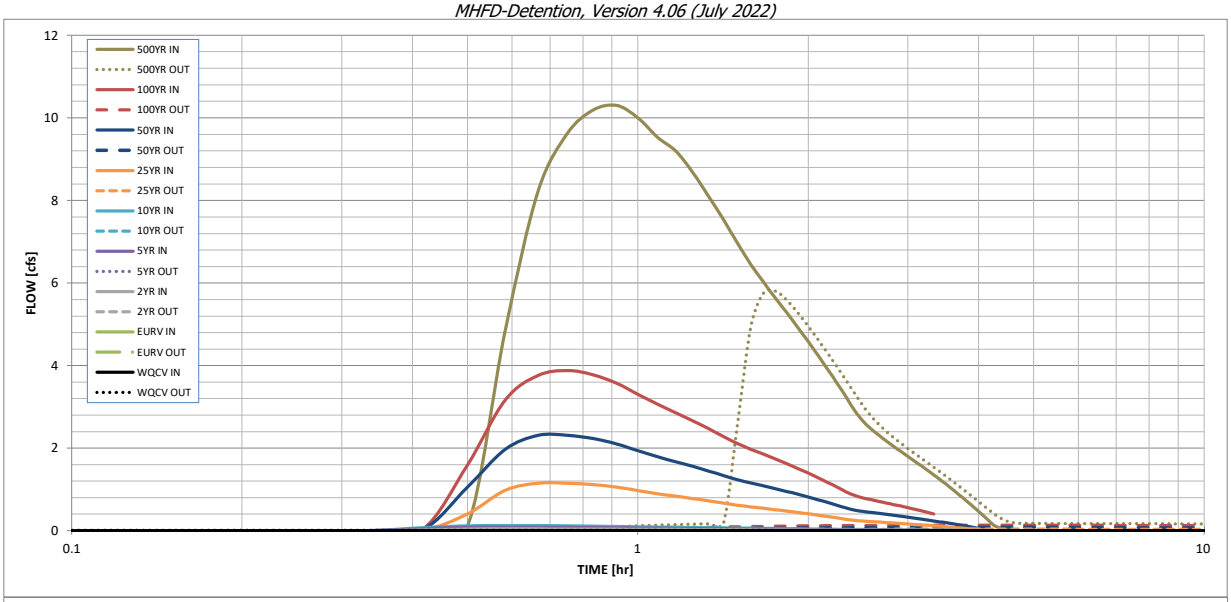
Routed Hydrograph Results

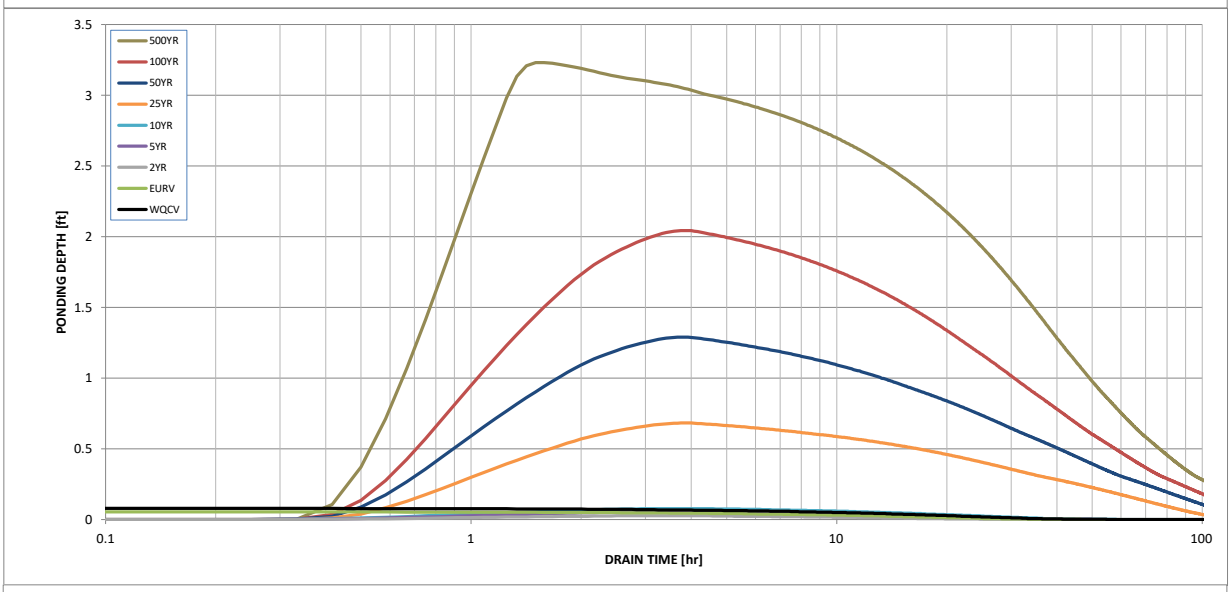
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

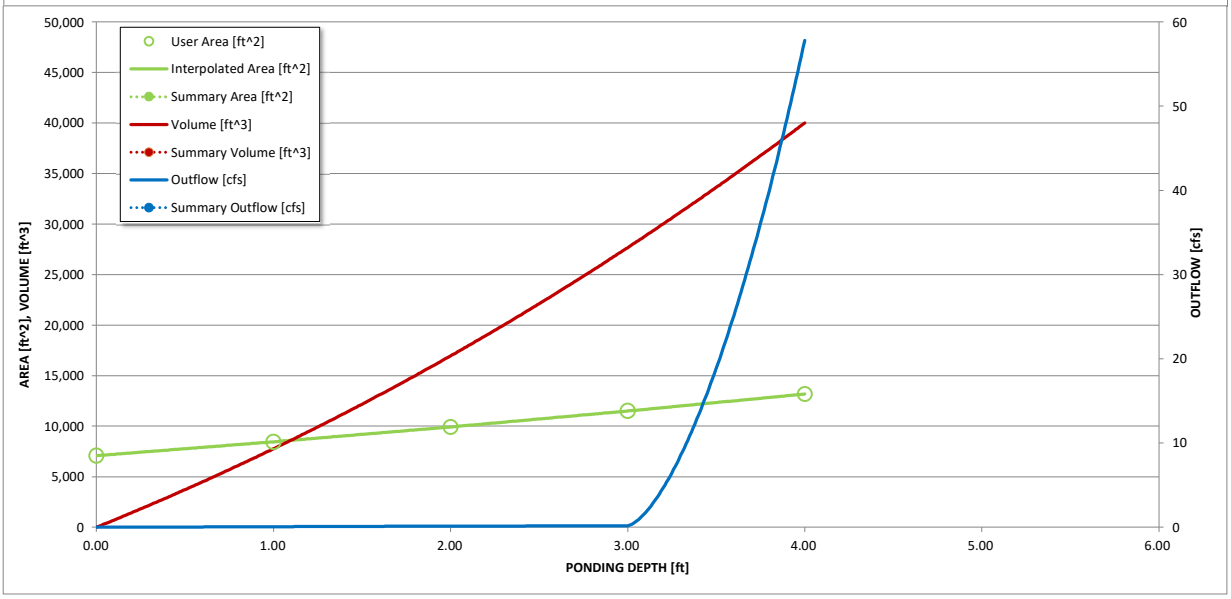
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.013	0.009	0.005	0.010	0.014	0.127	0.255	0.431	1.262
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.005	0.010	0.014	0.127	0.255	0.431	1.262
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.1	1.2	2.3	3.9	10.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.11	0.23	0.38	1.02
Peak Inflow Q (cfs) =	N/A	N/A	0.0	0.1	0.1	1.2	2.3	3.9	10.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	5.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.0	0.0	0.0	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	44	39	35	41	46	106	119	>120	109
Time to Drain 99% of Inflow Volume (hours) =	**53**	48	44	50	56	118	>120	>120	>120
Maximum Ponding Depth (ft) =	0.08	0.06	0.03	0.05	0.08	0.68	1.29	2.04	3.23
Area at Maximum Ponding Depth (acres) =	0.17	0.16	0.16	0.16	0.16	0.18	0.20	0.23	0.27
Maximum Volume Stored (acre-ft) =	0.013	0.010	0.003	0.008	0.011	0.118	0.234	0.398	0.697

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.02	0.05	0.07	0.01	0.03	0.04	0.12
	0:30:00	0.00	0.00	0.04	0.08	0.12	0.41	1.06	1.59	4.86
	0:35:00	0.00	0.00	0.05	0.09	0.13	0.98	1.97	3.17	8.23
	0:40:00	0.00	0.00	0.05	0.09	0.12	1.15	2.31	3.76	9.61
	0:45:00	0.00	0.00	0.04	0.08	0.12	1.15	2.31	3.88	10.19
	0:50:00	0.00	0.00	0.04	0.08	0.11	1.12	2.23	3.78	10.30
	0:55:00	0.00	0.00	0.04	0.07	0.10	1.05	2.11	3.57	10.00
	1:00:00	0.00	0.00	0.04	0.07	0.10	0.97	1.94	3.31	9.53
	1:05:00	0.00	0.00	0.03	0.06	0.09	0.90	1.79	3.07	9.20
	1:10:00	0.00	0.00	0.03	0.06	0.08	0.84	1.67	2.86	8.68
	1:15:00	0.00	0.00	0.03	0.06	0.08	0.78	1.56	2.66	8.10
	1:20:00	0.00	0.00	0.03	0.05	0.07	0.72	1.45	2.47	7.53
	1:25:00	0.00	0.00	0.03	0.05	0.07	0.67	1.34	2.28	6.97
	1:30:00	0.00	0.00	0.02	0.05	0.07	0.62	1.24	2.11	6.45
	1:35:00	0.00	0.00	0.02	0.04	0.06	0.58	1.16	1.97	6.02
	1:40:00	0.00	0.00	0.02	0.04	0.06	0.54	1.09	1.85	5.64
	1:45:00	0.00	0.00	0.02	0.04	0.05	0.51	1.02	1.74	5.28
	1:50:00	0.00	0.00	0.02	0.04	0.05	0.48	0.95	1.62	4.93
	1:55:00	0.00	0.00	0.02	0.03	0.05	0.44	0.88	1.51	4.58
	2:00:00	0.00	0.00	0.02	0.03	0.04	0.41	0.82	1.40	4.24
	2:05:00	0.00	0.00	0.01	0.03	0.04	0.38	0.75	1.28	3.90
	2:10:00	0.00	0.00	0.01	0.02	0.04	0.34	0.68	1.17	3.57
	2:15:00	0.00	0.00	0.01	0.02	0.03	0.31	0.62	1.06	3.24
	2:20:00	0.00	0.00	0.01	0.02	0.03	0.28	0.55	0.94	2.91
	2:25:00	0.00	0.00	0.01	0.02	0.03	0.25	0.50	0.85	2.65
	2:30:00	0.00	0.00	0.01	0.02	0.03	0.23	0.47	0.80	2.46
	2:35:00	0.00	0.00	0.01	0.02	0.02	0.22	0.44	0.75	2.31
	2:40:00	0.00	0.00	0.01	0.02	0.02	0.21	0.42	0.71	2.17
	2:45:00	0.00	0.00	0.01	0.02	0.02	0.20	0.40	0.67	2.04
	2:50:00	0.00	0.00	0.01	0.01	0.02	0.19	0.37	0.63	1.92
	2:55:00	0.00	0.00	0.01	0.01	0.02	0.18	0.35	0.60	1.80
	3:00:00	0.00	0.00	0.01	0.01	0.02	0.16	0.33	0.56	1.68
	3:05:00	0.00	0.00	0.01	0.01	0.02	0.15	0.31	0.52	1.57
	3:10:00	0.00	0.00	0.01	0.01	0.01	0.14	0.28	0.48	1.46
	3:15:00	0.00	0.00	0.01	0.01	0.01	0.13	0.26	0.44	1.35
	3:20:00	0.00	0.00	0.00	0.01	0.01	0.12	0.24	0.41	1.24
	3:25:00	0.00	0.00	0.00	0.01	0.01	0.11	0.22	0.37	1.13
	3:30:00	0.00	0.00	0.00	0.01	0.01	0.10	0.19	0.33	1.02
	3:35:00	0.00	0.00	0.00	0.01	0.01	0.09	0.17	0.29	0.91
	3:40:00	0.00	0.00	0.00	0.01	0.01	0.08	0.15	0.26	0.80
	3:45:00	0.00	0.00	0.00	0.00	0.01	0.06	0.13	0.22	0.69
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.18	0.58
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.14	0.47
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.03	0.06	0.10	0.36
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.07	0.25
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.14
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

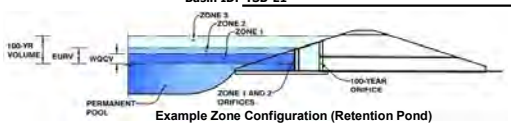
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-E1



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	8.21	acres
Watershed Length =	992	ft
Watershed Length to Centroid =	496	ft
Watershed Slope =	0.041	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.010	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.008	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.004	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.008	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.012	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.103	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.207	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.349	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.023	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.004	acre-feet		
Approximate 5-yr Detention Volume =	0.006	acre-feet		
Approximate 10-yr Detention Volume =	0.009	acre-feet		
Approximate 25-yr Detention Volume =	0.013	acre-feet		
Approximate 50-yr Detention Volume =	0.032	acre-feet		
Approximate 100-yr Detention Volume =	0.089	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.010	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.010	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

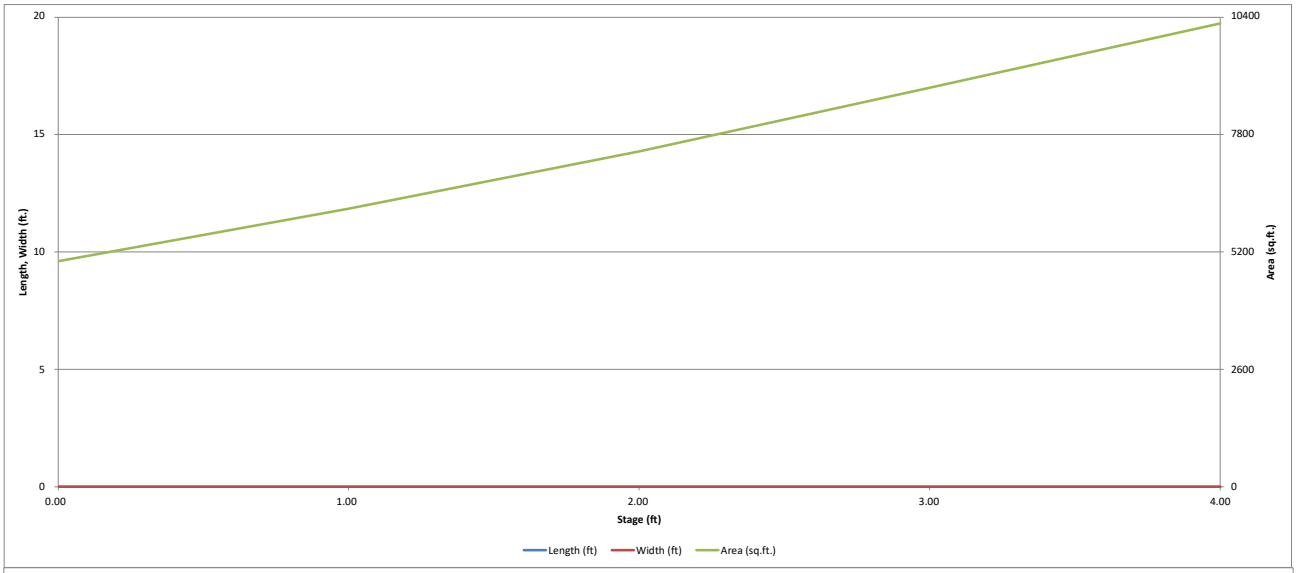
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

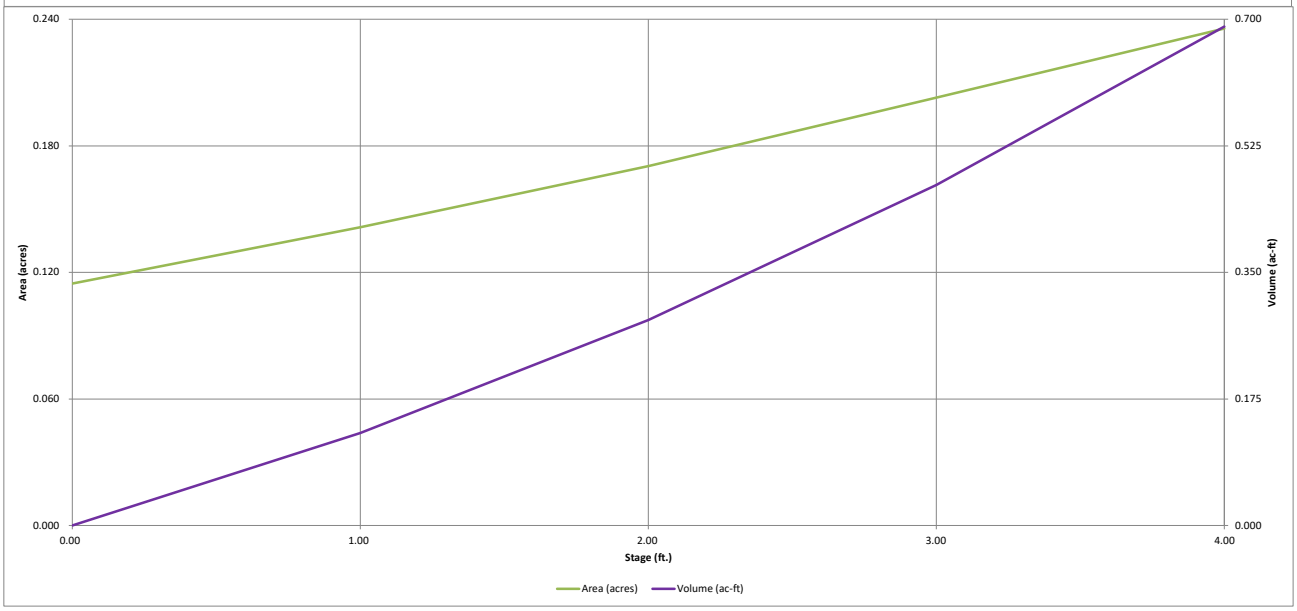
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	4,997	0.115		
	--	1.00	--	--	--	6,162	0.141	5,579	0.128
	--	2.00	--	--	--	7,425	0.170	12,373	0.284
	--	3.00	--	--	--	8,839	0.203	20,505	0.471
	--	4.00	--	--	--	10,267	0.236	30,058	0.690

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



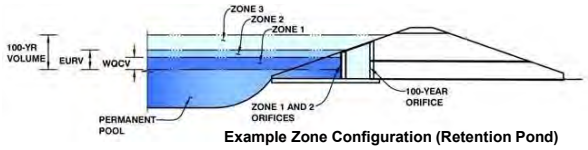


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-E1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.09	0.010	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.010	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	3.889E-03	ft²
Depth at top of Zone using Orifice Plate =	0.12	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.56	sq. inches (diameter = 13/16 inch)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.56	0.56	0.56	0.56	0.56			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.21	feet
Spillway Crest Length =	28.00	feet	Stage at Top of Freeboard =	4.21	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.24	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	0.69	acre-ft

Calculated Parameters for Spillway

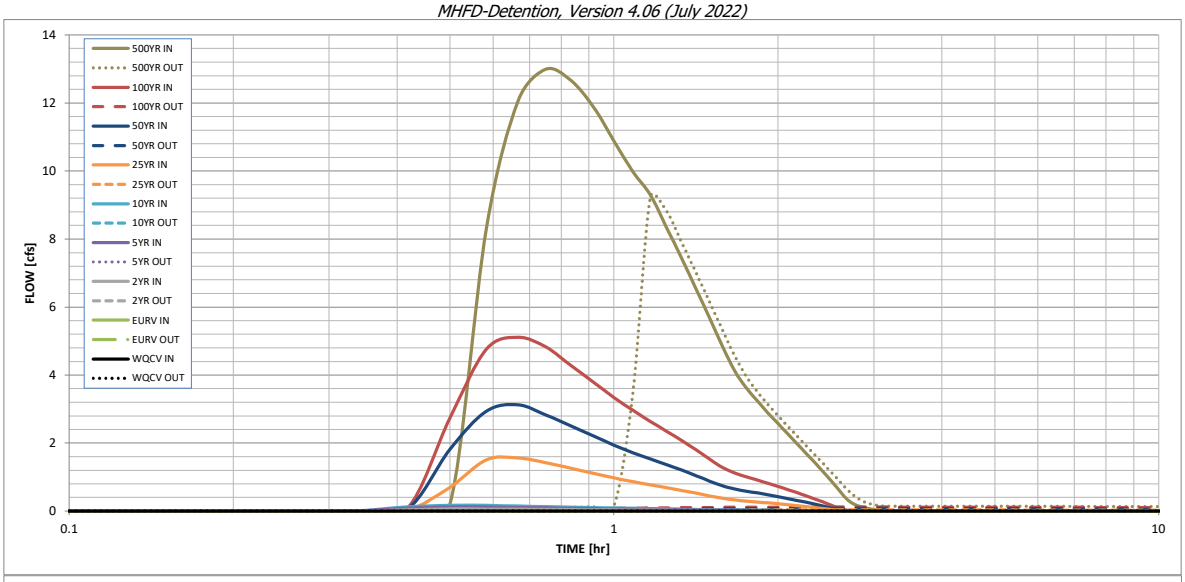
Routed Hydrograph Results

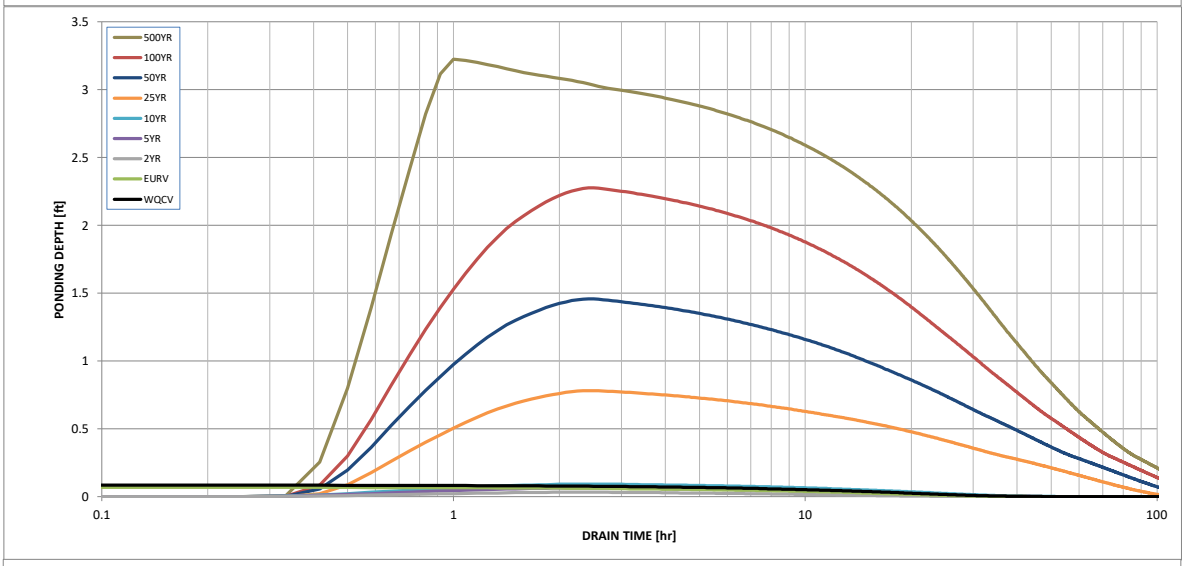
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

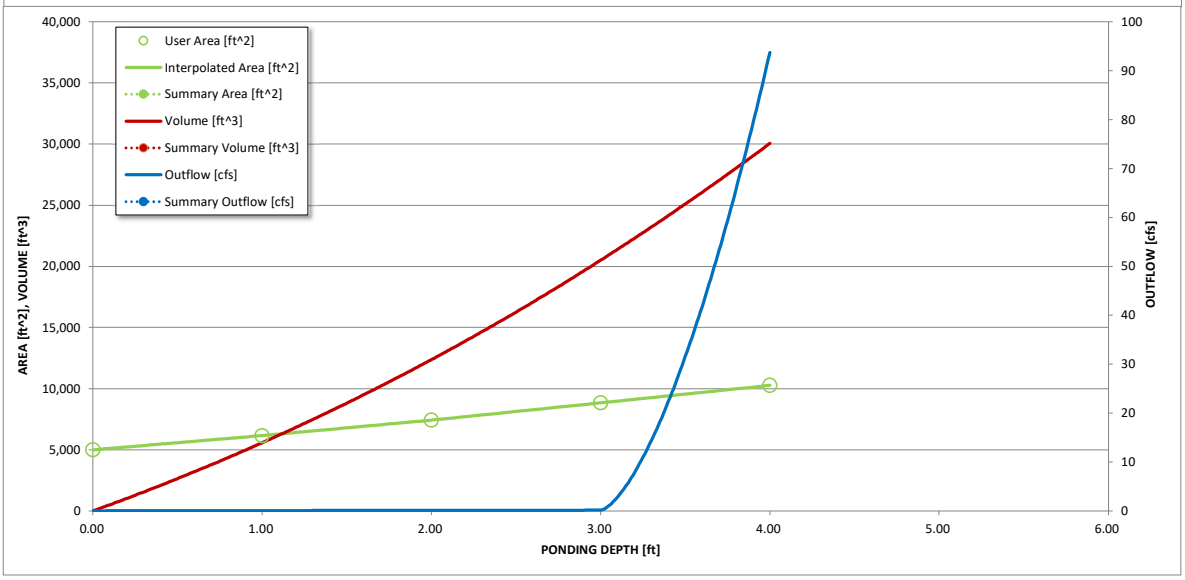
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.010	0.008	0.004	0.008	0.012	0.103	0.207	0.349	1.023
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.004	0.008	0.012	0.103	0.207	0.349	1.023
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.6	3.1	5.1	13.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.19	0.38	0.62	1.58
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.6	3.1	5.1	13.0
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	9.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	36	31	37	42	95	106	112	92
Time to Drain 99% of Inflow Volume (hours) =	**47**	44	39	45	50	106	>120	>120	>120
Maximum Ponding Depth (ft) =	0.09	0.07	0.03	0.06	0.09	0.78	1.46	2.28	3.22
Area at Maximum Ponding Depth (acres) =	0.12	0.12	0.12	0.12	0.12	0.14	0.15	0.18	0.21
Maximum Volume Stored (acre-ft) =	0.010	0.008	0.003	0.007	0.010	0.098	0.195	0.331	0.516

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.03	0.08	0.12	0.02	0.05	0.06	0.20
	0:30:00	0.00	0.00	0.06	0.12	0.17	0.70	1.81	2.74	8.32
	0:35:00	0.00	0.00	0.06	0.12	0.17	1.51	2.94	4.76	12.06
	0:40:00	0.00	0.00	0.06	0.11	0.15	1.56	3.12	5.11	12.99
	0:45:00	0.00	0.00	0.05	0.09	0.13	1.42	2.83	4.82	12.67
	0:50:00	0.00	0.00	0.04	0.08	0.12	1.26	2.50	4.28	11.89
	0:55:00	0.00	0.00	0.04	0.07	0.10	1.11	2.21	3.79	10.88
	1:00:00	0.00	0.00	0.03	0.06	0.09	0.98	1.94	3.34	9.97
	1:05:00	0.00	0.00	0.03	0.06	0.08	0.86	1.72	2.96	9.30
	1:10:00	0.00	0.00	0.03	0.05	0.07	0.77	1.53	2.64	8.33
	1:15:00	0.00	0.00	0.02	0.05	0.07	0.69	1.36	2.35	7.41
	1:20:00	0.00	0.00	0.02	0.04	0.06	0.60	1.20	2.07	6.52
	1:25:00	0.00	0.00	0.02	0.03	0.05	0.52	1.04	1.79	5.66
	1:30:00	0.00	0.00	0.02	0.03	0.04	0.44	0.88	1.52	4.83
	1:35:00	0.00	0.00	0.01	0.03	0.04	0.37	0.74	1.28	4.12
	1:40:00	0.00	0.00	0.01	0.02	0.03	0.33	0.65	1.12	3.63
	1:45:00	0.00	0.00	0.01	0.02	0.03	0.30	0.59	1.01	3.24
	1:50:00	0.00	0.00	0.01	0.02	0.03	0.27	0.53	0.91	2.89
	1:55:00	0.00	0.00	0.01	0.02	0.03	0.24	0.48	0.82	2.57
	2:00:00	0.00	0.00	0.01	0.02	0.02	0.21	0.42	0.73	2.27
	2:05:00	0.00	0.00	0.01	0.01	0.02	0.19	0.37	0.63	1.98
	2:10:00	0.00	0.00	0.01	0.01	0.02	0.16	0.31	0.54	1.71
	2:15:00	0.00	0.00	0.00	0.01	0.01	0.13	0.26	0.45	1.44
	2:20:00	0.00	0.00	0.00	0.01	0.01	0.11	0.21	0.36	1.17
	2:25:00	0.00	0.00	0.00	0.00	0.01	0.08	0.15	0.27	0.90
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.18	0.64
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.09	0.37
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.21
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

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

Stage - Storage Description	Stage [ft]	Area [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

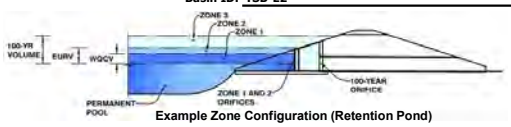
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Grandview - Interim

Basin ID: TSB-E2



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	13.57	acres
Watershed Length =	1,289	ft
Watershed Length to Centroid =	645	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	2.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.017	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.013	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.007	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.013	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.019	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.170	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.343	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.579	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.696	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.007	acre-feet		
Approximate 5-yr Detention Volume =	0.010	acre-feet		
Approximate 10-yr Detention Volume =	0.014	acre-feet		
Approximate 25-yr Detention Volume =	0.022	acre-feet		
Approximate 50-yr Detention Volume =	0.053	acre-feet		
Approximate 100-yr Detention Volume =	0.147	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.017	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.017	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Total detention volume is less than 100-year volume.

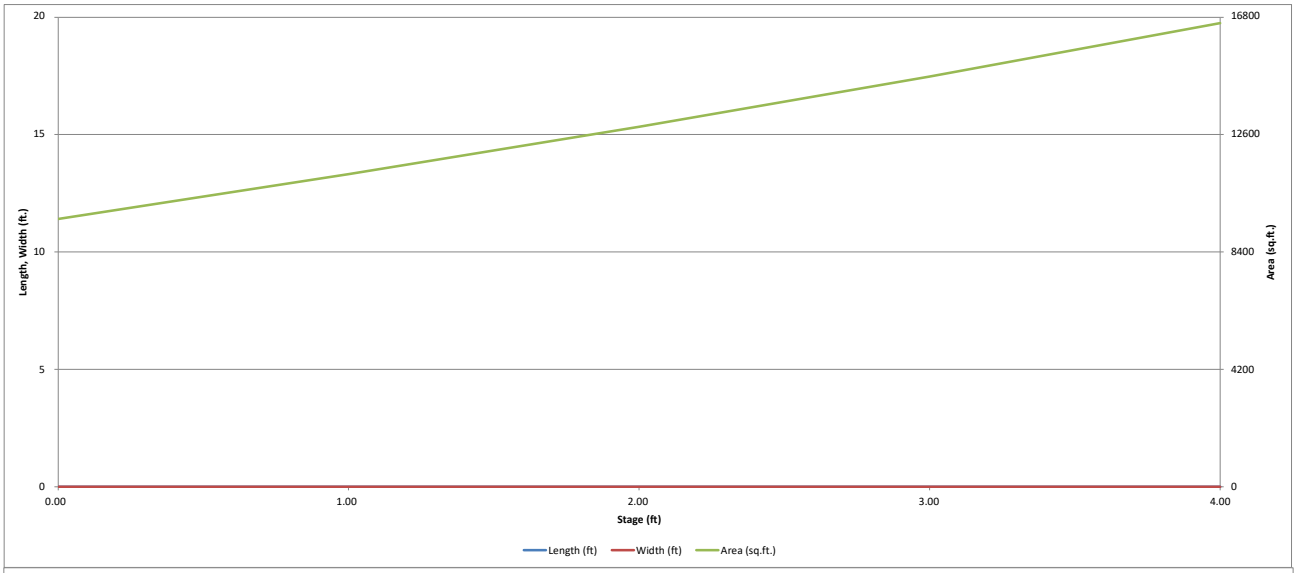
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

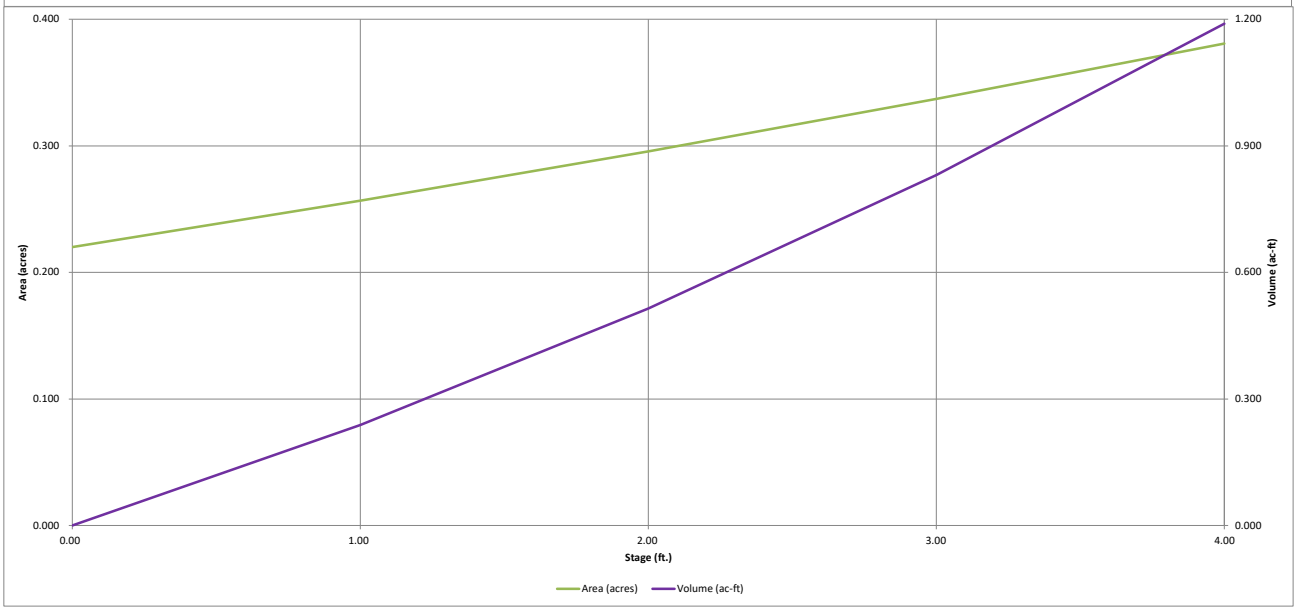
Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	9,583	0.220		
	--	1.00	--	--	--	11,181	0.257	10,382	0.238
	--	2.00	--	--	--	12,879	0.296	22,412	0.515
	--	3.00	--	--	--	14,684	0.337	36,193	0.831
	--	4.00	--	--	--	16,589	0.381	51,830	1.190

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



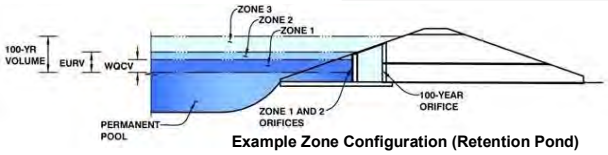


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Grandview - Interim**

Basin ID: **TSB-E2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.08	0.017	Orifice Plate
Zone 2			
Zone 3			
Total (all zones)		0.017	

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

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

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.875E-03	ft²
Depth at top of Zone using Orifice Plate =	0.12	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	4.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.99	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.30	0.60	0.90	1.20			
Orifice Area (sq. inches)	0.99	0.99	0.99	0.99	0.99			

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Overflow Weir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grate Open Area / 100-yr Orifice Area =			
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft²
Overflow Grate Type =				Overflow Grate Open Area w/ Debris =			ft²
Debris Clogging % =			%				

Calculated Parameters for Overflow Weir

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

	Not Selected	Not Selected			Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft²
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.21	feet
Spillway Crest Length =	28.00	feet	Stage at Top of Freeboard =	4.21	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.38	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.19	acre-ft

Calculated Parameters for Spillway

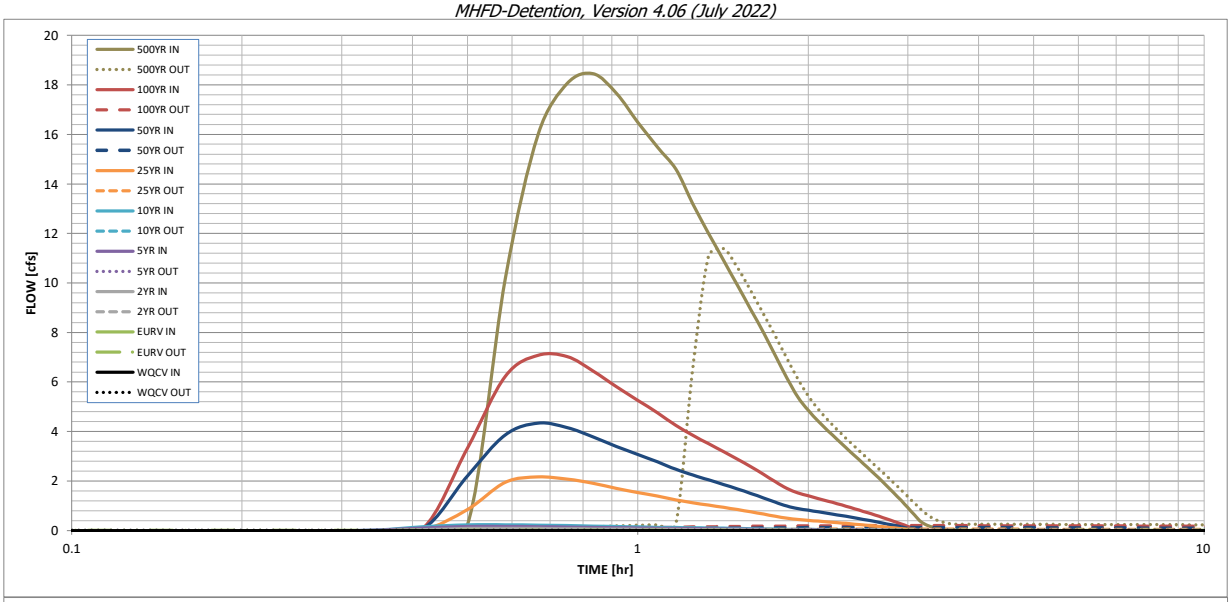
Routed Hydrograph Results

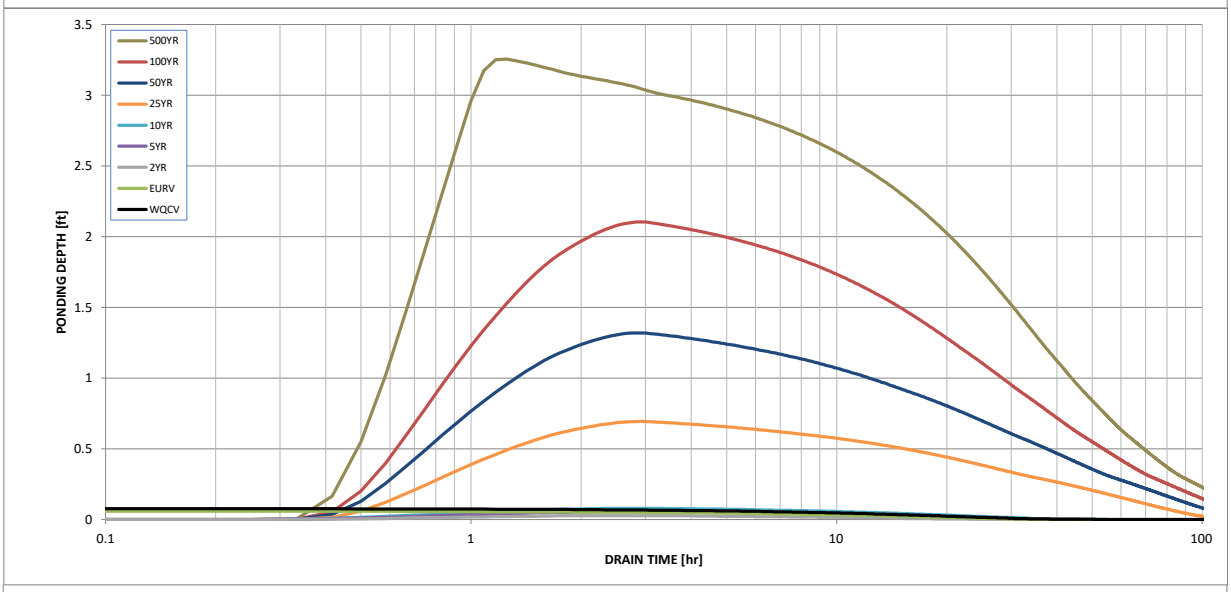
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

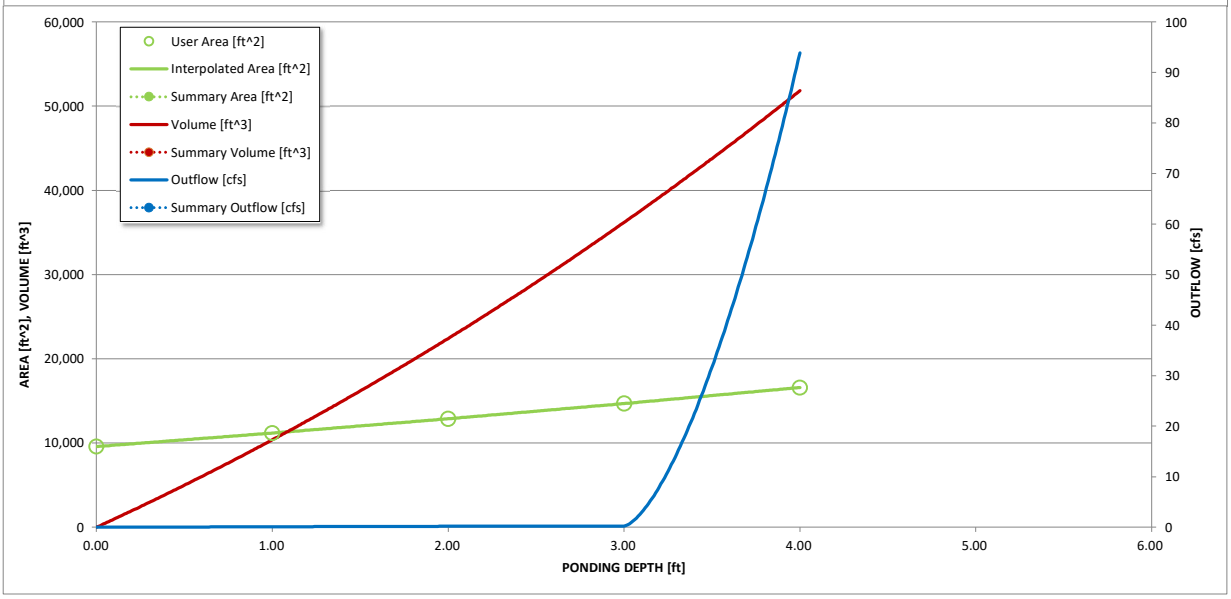
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.017	0.013	0.007	0.013	0.019	0.170	0.343	0.579	1.696
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.007	0.013	0.019	0.170	0.343	0.579	1.696
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.2	4.3	7.1	18.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.16	0.32	0.52	1.36
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.2	4.3	7.1	18.4
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	11.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.0	0.0	0.0	0.0	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	37	33	38	43	100	111	117	100
Time to Drain 99% of Inflow Volume (hours) =	**49**	46	41	47	52	110	>120	>120	>120
Maximum Ponding Depth (ft) =	0.08	0.06	0.03	0.05	0.08	0.69	1.32	2.10	3.25
Area at Maximum Ponding Depth (acres) =	0.22	0.22	0.22	0.22	0.22	0.25	0.27	0.30	0.35
Maximum Volume Stored (acre-ft) =	0.018	0.013	0.004	0.011	0.015	0.161	0.322	0.544	0.917

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.04	0.10	0.15	0.03	0.06	0.08	0.25
	0:30:00	0.00	0.00	0.08	0.17	0.23	0.85	2.21	3.34	10.16
	0:35:00	0.00	0.00	0.09	0.17	0.24	1.95	3.86	6.23	16.01
	0:40:00	0.00	0.00	0.08	0.16	0.22	2.16	4.34	7.08	18.05
	0:45:00	0.00	0.00	0.07	0.14	0.20	2.08	4.16	7.03	18.45
	0:50:00	0.00	0.00	0.07	0.13	0.18	1.91	3.78	6.45	17.66
	0:55:00	0.00	0.00	0.06	0.12	0.16	1.70	3.40	5.81	16.48
	1:00:00	0.00	0.00	0.05	0.10	0.15	1.54	3.07	5.26	15.48
	1:05:00	0.00	0.00	0.05	0.09	0.13	1.39	2.77	4.76	14.60
	1:10:00	0.00	0.00	0.04	0.09	0.12	1.24	2.47	4.25	13.20
	1:15:00	0.00	0.00	0.04	0.08	0.11	1.12	2.24	3.84	12.00
	1:20:00	0.00	0.00	0.04	0.07	0.10	1.03	2.05	3.51	10.92
	1:25:00	0.00	0.00	0.03	0.07	0.10	0.94	1.86	3.19	9.90
	1:30:00	0.00	0.00	0.03	0.06	0.09	0.85	1.68	2.88	8.93
	1:35:00	0.00	0.00	0.03	0.05	0.08	0.76	1.50	2.58	7.99
	1:40:00	0.00	0.00	0.02	0.04	0.07	0.67	1.32	2.27	7.07
	1:45:00	0.00	0.00	0.02	0.04	0.06	0.58	1.14	1.97	6.16
	1:50:00	0.00	0.00	0.02	0.04	0.05	0.50	0.99	1.70	5.39
	1:55:00	0.00	0.00	0.02	0.03	0.05	0.44	0.89	1.53	4.85
	2:00:00	0.00	0.00	0.02	0.03	0.05	0.41	0.82	1.40	4.42
	2:05:00	0.00	0.00	0.02	0.03	0.04	0.38	0.76	1.29	4.03
	2:10:00	0.00	0.00	0.01	0.03	0.04	0.35	0.70	1.19	3.68
	2:15:00	0.00	0.00	0.01	0.02	0.03	0.32	0.63	1.08	3.34
	2:20:00	0.00	0.00	0.01	0.02	0.03	0.29	0.57	0.98	3.02
	2:25:00	0.00	0.00	0.01	0.02	0.03	0.26	0.51	0.88	2.71
	2:30:00	0.00	0.00	0.01	0.02	0.02	0.23	0.45	0.78	2.41
	2:35:00	0.00	0.00	0.01	0.01	0.02	0.20	0.39	0.68	2.11
	2:40:00	0.00	0.00	0.01	0.01	0.02	0.17	0.33	0.58	1.82
	2:45:00	0.00	0.00	0.00	0.01	0.01	0.14	0.27	0.47	1.52
	2:50:00	0.00	0.00	0.00	0.01	0.01	0.11	0.21	0.37	1.22
	2:55:00	0.00	0.00	0.00	0.00	0.01	0.08	0.15	0.27	0.92
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.05	0.09	0.17	0.63
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.07	0.35
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.20
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [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).

APPENDIX E

Grandview Reserve CLOMR Report

HRGreen

HRGREEN.COM

Grandview Reserve
CLOMR REPORT

July 2022

Revised: March 22, 2023

HR Green Project No: 201662.03

PCD File No. CDR228

Prepared By:

HR Green Development, LLC

Contact: Greg Panza, PE

gpanza@hrgreen.com

720-602-4999

Table of Contents

Grandview Reserve CLOMR Report

Project Narrative

This report was prepared by HR Green to support the submission of MT-2 forms and documents in a request for a Conditional Letter of Map Revision (CLOMR) for channel improvements along Geick Ranch Tributary 1 and Geick Ranch Tributary 2. This request impacts the current delineation of the 100-year boundary on Flood Insurance Rate Maps (FIRMs) 08041C0552G and 08041C0556G.

Grandview Reserve is located in Falcon, Colorado within El Paso County and contains approximately 776 acres within the south half of section 21 and 22 and the north half of section 27 and 28, Township 12 South, and Range 66 West of the Sixth Principal Meridian in Ela Paso County, Colorado.

Grandview Reserve (GVR) falls within the Gieck Ranch Drainage Basin which covers approximately 22 square miles. This drainage basin is tributary to Black Squirrel Creek and joins said creek just to the south of Elicott, CO about 18 miles to the south. Black Squirrel Creek eventually drains to the Arkansas River in Pueblo Colorado. Much of the Gieck Ranch Drainage basin is undeveloped consisting of rural farmland. The Gieck Ranch Drainage basin lies north of the Haegler Ranch drainage basin. The channels through the Grandview property can all be described as gently sloping drainages that roll through the site towards the creeks, they are tributary too.

Per the NRCS web soil survey, the site is made up entirely of Type A and B soils. The majority of which are Type A soils. The predominate soils are Blakeland loamy sand, Columbine gravelly sandy loam, and Stapleton sandy loam. The first two soils are Type A soil and cover approximately 55.1% of the site and the later soil is a Type B soil and covers the remaining 44.9% of the site.

The vegetation found within Grandview Reserve consists of wetland communities in the floodplain with a transitional area to shortgrass prairie communities that dominate the site. The primary species found in the shortgrass prairie regions include little bluestem, blue grama, and buffalograss. The transitional area between the wetlands and shortgrass prairie includes patches of snowberry, and wood's rose. There are a few plains cottonwoods along the main channels. The area has historically been heavily grazed and there are weeds throughout the site. Weeds found onsite include Canada thistle, Russian thistle, common mullein and yellow toadflax spp.

Observations of the existing channels suggest that they are at equilibrium with their watershed flows; evidence including relatively stable bankfull channels, adequate floodplain (above bankfull channel elevations) and in-tact plant communities that would be expected in this type of reach support the notion that the reach is in equilibrium.

At present, the preliminary analysis and design of Geick Ranch Tributary 1 (GRT1) and Geick Ranch Tributary 2 (GRT2) has been completed. Geick Ranch Tributary 1 is to be left in its current state with the exception of the reach surrounding the existing breached stock pond berm. This berm is to be removed and the surrounding region is to be regraded and stabilized to match the existing channel conditions.

Proposed improvements for Geick Ranch Tributary 2 include the realignment of the channel, generally shifting the channel towards the west to accommodate the proposed land plan. There is to be a dedicated 100' wide corridor in which the valley will meander. The valley is the area needed to fully contain the 100-year event plus freeboard requirements. Preliminary analysis indicates the valley will have an average width of approximately 63'; initial sizing approximates the bankfull width to be 8.8' – 13.8'. The valley and channel thalweg will generally follow the same profile, with some deviation as the bankfull channel meanders through the valley in turn decreasing the low flow channels average slope. The average valley profile is to be approximately 1% with a series of grade control

structures to both decrease elevation and dissipate energy to meet natural channel criteria as outlined in El Paso County criteria.

Hydrology

Proposed flows were used for the existing and proposed HEC-RAS models for GR1 and GR2.

Offsite flows entering the site were assumed to remain the same as presented in the locally approved and accepted basin study referred to as the Meridian Ranch Master Development Drainage Plan (MDDP). This report was published by Tech Contractors in July of 2021. Flows were pulled from the most current version of the HEC-HMS model for the Meridian Ranch MDDP for Gieck Ranch Tributary 1 (GRT1) at design point G06 and for Gieck Ranch Tributary 2 (GRT2) at design point G16. The location of these drainage basins and design points can be visualized in the Grandview Proposed Drainage Map exhibit in Appendix J. The proposed HEC- HMS model did not have a 100-year peak discharges for design point G18, basin OS10, basin OS10, and basin FG38. These values were calculated, and the existing model was updated to assess flows entering Geick Ranch Tributary 2 at Eastonville Road. Calculations can be found in Appendix J.

Per the proposed Meridian Ranch HEC-HMS model, the 100-year flow entering GRT2 on the north boundary of the site at design point G18 is 365.2 CFS (station 70+29.02 along the existing channel alignment). As the channel works through the existing site, the 100-year flow increases to 528.6 cfs at station 35+75 along the existing channel where design point G16 (112.1 CFS) is expected to enter the channel. The 100-year flow entering GRT1 on the west boundary of the site via design point G06 is 491 CFS.

Onsite flows will remain the same as historic or runoff due to development will be controlled by the various ponds that are to be constructed near the channel. Proposed onsite flows were calculated via CUHP and preliminary pond sizing/peak discharge rates can be found in Appendix K. Peak discharges were used in the HEC-RAS model for a more conservative approach. The locations of the proposed ponds can be found on the Grandview Proposed Drainage Map exhibit in Appendix J.

See Table 1 and Table 2 for summaries of proposed flows for the existing GRT1 and GRT2 respectively.

Table 1 – PROPOSED FLOWS FOR THE EXISTING GEICK RANCH TRIBUTARY 1

STATION	CUMULATIVE 100-YR STORM (CFS)	INPUT DESCRIPTION AND FLOW (CFS)
37+12.84	491.0	Design Point G06 (491.0 cfs)
34+24+50	521.0	Tributary 1 Flows (30.0 cfs)
23+03.17	541.4	Pond B (14.7 cfs) and Pond D (5.7 cfs)
12+97.03	551.9	Pond E (10.5 cfs)

Table 2 – PROPOSED FLOWS FOR THE EXISTING GEICK RANCH TRIBUTARY 2

STATION	CUMULATIVE 100-YR STORM (CFS)	INPUT DESCRIPTION AND FLOW (CFS)
70+29.02	365.2	Design Point G18 (365.2 cfs)
53+21.63	477.3	Tributary 2 flows + OS-11 (14.0 cfs)
35+75.47	528.6	Design Point G16 (112.1 cfs)
29+55.21	544	Pond A (15.4 cfs)
25+59.12	591.9	Pond F (18.6 cfs)
8+02.78	614.4	Pond G (69.2 cfs)
4+60.25	702.5	Pond C (22.5 cfs)

Table 3 and Table 4 summarize the proposed flows for GRT1 and the realigned portion of GRT2 respectively.

Table 3 - FUTURE FLOWS FOR PROPOSED GEICK RANCH TRIBUTARY 1

STATION	CUMULATIVE 100-YR STORM (CFS)	INPUT DESCRIPTION AND FLOW (CFS)
37+12.84	491.0	Design Point G06 (491.0 cfs)
34+24+50	521.0	Tributary 1 Flows (30.0 cfs)
24+78.84	541.4	Pond B (14.7 cfs) and Pond D (5.7 cfs)
12+97.03	551.9	Pond E (10.5 cfs)

Table 4- FUTURE FLOWS FOR PROPOSED GEICK RANCH TRIBUTARY 2

STATION	CUMULATIVE 100-YR STORM (CFS)	INPUT DESCRIPTION AND FLOW (CFS)
70+29.02	365.2	Design Point G18 (365.2 cfs)
56+42	477.3	Tributary 2 flows + OS-11 (14.0 cfs)
38+80	528.6	Design Point G16 (112.1 cfs)
30+40	544	Pond A (15.4 cfs)
27+15	591.9	Pond A (18.6 cfs)
10+50	614.4	Pond B (69.2 cfs)
7+45	702.5	Pond C (22.5 cfs)

Hydraulics

Design criteria were developed to guide a preliminary layout of channel dimension, planform, and profile for the realigned segment of GRT2. Published criteria from the Urban Stormwater Drainage Criteria Manual, Volume 1 (USDCM; Urban Drainage and Flood Control District, 2016), El Paso County DCM and various other reports currently in process for the drainages through GVR and completed for GVR drainages were used for initial design parameter and flow rates. Parameters used and minimum bankfull geometry is summarized in Table 5.

Table 5 - DESIGN PARAMETERS

Design Parameter	Design Value
Roughness values	EPC Table 10-2
Maximum 5-year velocity, main channel (within bankfull channel width) (ft/s)	EPC: 2.5 ft/s MHFD: 5 ft/s*
Maximum 100-year velocity, main channel (within bankfull channel width) (ft/s)	EPC: 2.5 ft/s MHFD: 7 ft/s*
Froude No., 5-year, main channel (within bankfull channel width)	0.7
Froude No., 100-year, main channel (within bankfull channel width)	0.85
Maximum shear stress, 100-year, main channel (within bankfull channel width)	1.2 lb/sf
Minimum bankfull capacity of bankfull channel (based on future development conditions)	2 year, 19 - 33.5 cfs
Minimum bankfull channel geometry[1]	
Design Channel Type	C4
Entrenchment Ratio	2.7-31.65 (x=5.26)
Width to depth ratio	13.5-75.0 (x=29.28)
Sinuosity	1.43-2.80 (x=1.92)

Slope	0.0001-0.0184 (x=0.0045)
D_{50}	12-14mm (~0.5 in)
d_{84}	32-48mm (~1.6in)
Meander Length[2]	34-92 (x=56)
Belt Width[2]	18-55 (x=32)
Radius of Curvature[2]	7-28 (x=11)
Minimum Floodplain Terrace	6 ft
Maximum overbank side slope	4(H):1(V)
Maximum bankfull side slope	2.5(H):1(V)
Maximum bankfull side slope	2.5(H):1(V)
Minimum bottom width[3]	4.8 ft
Freeboard	1.5 ft

[1] These values were derived from empirical data and will be used as guidelines for design and will be used in conjunction with hydraulic regime equations as outlined in "Spreadsheet Tools for River Evaluation, Assessment, and Monitoring: The STREAM Diagnostic Modules"
[2]These values are derived from "Spreadsheet Tools for River Evaluation, Assessment, and Monitoring: The STREAM Diagnostic Modules"
[3]Minimum bottom width shown is for the low flow channel only. The main channel will be ~41 ft wide

The 2-year frequency was selected for the design of the bankfull channel to approximate the flow most likely to govern a stable geometry. Prior reports estimated future 2-year flow as ~15-cfs and assumes no culvert effects; i.e., open channel flow un-affected by a culvert. The future 2-year flow (19-33.5 cfs) was used to size the low flow channel. This resulted in a channel with a minimum bottom width varying from 4.8 feet - 9.8 feet, 0.8 feet deep with 2.5:1 side slopes for a bankfull width varying from 8.8 feet to 13.8 feet, assuming a mean channel longitudinal slope of 0.9%. Equations as shown in the spreadsheet should produce low shear values within the channel section however further analysis using HEC-RAS was completed to determine the final geometry of said channel. The effective discharge channel is highly correlated to the “bankfull” channel (Leopold 1994) As several channel geometrics are derived from bankfull channel width, depth, cross sectional area and sinuosity, and that USDCM and the OSP report design criteria parameters relate to bankfull width, we have chosen bankfull width to serve as the foundation of design.

To determine an appropriate bankfull width, Leopold’s generalized width estimate was first calculated (1994, as presented in USDCM Vol 1):

$W = aQ^{0.5}$

Where:

w = bankfull width of channel (top width when conveying bankfull discharge)

Q = bankfull discharge (10.5 cfs)

a = 2.7 (wide bankfull channel)
2.1 (average bankfull channel width)
1.5 (narrow bankfull channel)

Assuming an average bankfull width, the equation would estimate a 6.8-ft bankfull width. It is important to note that the Leopold equation lumps all channel types of varying width-to-depth rations. To perform a check on this estimation, worksheet alternative iterations of channel width from 4-12 feet were performed to find the depth associated with the 2-year flow. Chanel slope was set to 0.09 to best fit the average valley slope, side slopes were assumed to be 2.5:1 and manning’s “n” was assumed to be 0.035. The resulting channel depth was divided into each iteration’s width to identify the iteration with a width-to-depth ratio most closely associated with a Type-C

channel. Given the valley type of the proposed project (Unconfined Alluvial Valley), we can expect Type-C and Type-E channels to represent stable channel geomorphologies. Given the setting and valley slope, we have chosen a Type-C (riffle-pool morphology) channel. Type-C channels typical have width-to-depth ratios >12, with gravel and sand bottomed systems averaging 29 and 27, respectively (13.5-28.7 for 60% of gravel bed streams 12.6-29.2 for 50% of sand bed streams; Rosgen 1996). Given these ranges, the channel alternative with a OPC 2-yr flow-dependent channel depth that, when divided into its corresponding width, yielded a W/D between 10.7 – 36.7.

The resulting channel, then, has the following general dimensions:

- Bottom width = 4.8 ft – 9.8 ft
- Top Width = 8.8 ft – 13.8 ft
- Average $Depth_{Riffle}$ = 0.8 ft
- Width:Depth (W/D) Ratio = 11.3
- Cross Sectional Area = 5.44 ft^2 - 9.44 ft^2

The resulting channel dimensions listed above were then used to do the initial site grading of GRT2. The channel was then modeled in HEC- RAS and the geometry was further refined to reduce velocities, shear stresses, and the Froude number to fall within acceptable ranges.

GRT1 is to be left in its current state as analysis indicates it will remain in a stable state after development. The only proposed change is to remove the existing stock pond; that segment of the channel is to be graded to match the adjacent existing geometry.

Ultimate project hydraulics were evaluated through HEC-RAS 5.0.5. The following sections delve into the use and evaluation of the duplicate effective model and the development of the proposed conditions model.

a. Duplicate Effective Model

There is no existing effective model.

b. Existing Conditions Model

The existing conditions models were created to serve as a baseline for comparing future conditions to existing conditions. The existing conditions models were created by exporting cross sections from CAD along the existing channel alignments. Manning's roughness "n" values were selected to represent the existing conditions of the channel by following EPC's guidance in table 10-2. Existing flow rates were derived as described in the hydrology section above and are summarized in Table 1 and Table 2. Resulting water surface elevation for the 100-year event can be found in Appendix H.

c. Proposed Conditions Model

The proposed conditions model for GRT1 was developed by copying the geometry for the existing channel and updating the cross sections surrounding the existing stock pond to account for its removal and regrading of that segment of the channel. Manning's roughness "n" values were selected to represent the proposed conditions of the project area and follow EPC's guidance in table 10-2.

In the existing GRT1 model, the steady flow rate data included four changes in flow rate to account for flow contributions from the project site, which correspond to the same sections in the proposed condition model. Flows were modeled in the future condition using flow rates that remained the same as future detention along the channel is to release at historic rates, these flows are summarized in the preceding hydrology section in Table 2

and Table 3. The last three cross sections were used to confirm the water surface elevation remained within tolerance. Cross sections can be referenced in Appendix I.

The proposed conditions model for GRT2 was developed to account for changes to the channel alignment, geometry, and the proposed culverts along the new channel alignment. The proposed conditions model was created by exporting sample lines along the new alignment that sampled the proposed grading. Manning's roughness "n" values were selected to represent the proposed conditions of the project area and follow EPC's guidance in table 10-2.

In the existing GRT2 model, the steady flow rate data included seven changes in flow rate along the channel, these changes are described in the preceding hydrology section in Table 2 and Table 4. Ineffective flow areas were added to cross sections within the project reach upstream and downstream of culverts to account for areas not actively conveying water due to turbulence. The last three cross sections along the modeled channel are identical to the last three cross sections in the existing conditions model and were used to confirm the water surface elevation remained within tolerance and to adequately evaluate the tailwater. Cross sections can be referenced in Appendix I.

Maintenance Considerations

Natural stream design approaches take into consideration short and long term maintenance needs by providing a high functioning low maintenance stream (HFLMS). By spreading more frequent storm events into the floodplain terrace, water is introduced into the uplands species of the riparian corridor to provide irrigation flows. Additionally using naturally armored rundown riffles and pools vs larger grade control structures maintenance is limited to mainly trash removal and noxious weed control. Additionally as outlined above the design takes into consideration various flow regimes in order to analyze proposed stream corridor stresses and apply low maintenance stabilization measures to help stabilize and control sediment degradation and aggradation within the channel.

Conclusion

After evaluating the impacts of the proposed channel improvements to the segment of GRT1 and GRT2 between Eastonville Road to the northwest (upstream) and the south-central project boundary (downstream) it is not anticipated that the BFE will change outside of the project. The reevaluation of the 1% chance of annual occurrence event limits has been delineated and has a footprint for GRT2 that does not fall entirely within the boundary delineated in the FIRM effective 2018; this is largely due to the realignment of the channel, improved topography within the Zone A area and the overall footprint of the 1% chance of annual occurrence is significantly narrower than the previous delineation. BFEs at the location of tie in at the boundary of the site is not shown to rise more than 0.00' in the modeling completed in this assessment. Cross sections for GRT1 and GRT2 can be found in Appendix H and Appendix I to compare the 100year water surface elevation for both the existing and proposed conditions.

Appendix A
MT-2 Forms

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

■ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☐ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
080059	EL PASO COUNTY	CO	08041C0552G	0552G	12/7/2018
080059	EL PASO COUNTY	CO	08041C0556G	0556G	12/7/2018

2. a. Flooding Source: Geick Ranch Tributary 2

b. Types of Flooding: ■ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)
☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: GRANDVIEW RESERVE GEICK RANCH TRIBUTARY 1 AND 2 IMPROVEMENTS

4. FEMA zone designations affected: A (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

a. The basis for this revision request is (check all that apply)

■ Physical Change ■ Improved Methodology/Data ■ Regulatory Floodway Revision ☐ Base Map Changes
☐ Coastal Analysis ■ Hydraulic Analysis ☐ Hydrologic Analysis ☐ Corrections
☐ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
■ New Topographic Data ☐ Other (Attach Description)

Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☒ Channelization ☐ Levee/Floodwall ☒ Bridge/Culvert

☐ Dam ☐ Fill ☐ Other (Attach Description)

6. ☐ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $_____

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: GREG PANZA	Company: HR GREEN	
Mailing Address: 5619 DTC PARKWAY SUITE 1150 GREENWOOD VILLAGE, CO 80111	Daytime Telephone No.: 720-602-4939	Fax No.:
	E-Mail Address: gpanza@hrgreen.com	
Signature of Requester (required):	Date: 7/22/2022	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: KEITH CURTIS, CFM, FLOODPLAIN ADMINISTRATOR	Community Name: EL PASO COUNTY/PPRBD	
Mailing Address: 2880 INTERNATIONAL CIRCLE COLORADO SPRINGS, CO 80910	Daytime Telephone No.: 719-327-2898	Fax No.:
	E-Mail Address: KEITH@PPRBD.ORG	
Community Official's Signature (required):	Date: 7/22/2022	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: GREG PANZA	License No.: 37081	Expiration Date: 10-31-2023	
Company Name: HR GREEN	Telephone No.: 720-602-4939	Fax No.:	
Signature:	Date: 7/22/2022	E-Mail Address: gpanza@hrgreen.com	

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if …
■ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
■ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Geick Ranch Tributary 1

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☐ Not revised (skip to section B) ☐ No existing analysis ■ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
Upstream of project site, west of Eastonville Road	1.04	413	491

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ■ Precipitation/Runoff Model → Specify Model: SCS Curve Number Method/HEC-HMS Model from Meridian Ranch MDDP Approved July 2021 by Tech Contractors
☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ■ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.) Effective	Proposed/Revised
Downstream Limit*	IMMEDIATELY DS OF IMPROVEMENTS	2121.94	6961.58	6961.58
Upstream Limit*	IMMEDIATELY US OF IMPROVEMENTS	3424.5	6987.63	6987.63

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC RAS 5.0.5 (with vertical datum: North American Vertical Datum of 1988 (NAVD88))

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	Natural Run File Name:	Natural Run Plan Name:	Floodway Run File Name:	Floodway Run Plan Name:	Datum
Duplicate Effective Model*		N/A			
Corrected Effective Model*					
Existing or Pre-Project Conditions Model	GRT1.prj	GRT1_EXISTING		N/A	
Revised or Post-Project Conditions Model	GRT1.prj	GRT1_PROPOSED			
Other - (attach description)		N/A			

* For details, refer to the corresponding section of the instructions.

☐ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☐ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: vertical datum: North American Vertical Datum of 1988 (NAVD88)

Source: EDWARD JAMES Date: 7/22/2022

Accuracy: +/- 0.08 ft

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☐ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ■ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ■ No

   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ■ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ■ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program; Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Geick Ranch Tributary 1

Note**:** Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: Tributary 1

   Type (check one): ☒ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: LOCATED EAST OF EASTONVILLE ROAD AND NORTHWEST OF HIGHWAY 24

   Downstream Limit/Cross Section: SECTION 2882.47

   Upstream Limit/Cross Section: SECTION 2592.31

2. Name of Structure: _____

   Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: _____

   Downstream Limit/Cross Section: _____

   Upstream Limit/Cross Section: _____

3. Name of Structure: _____

   Type (check one) ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: _____

   Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: Geick Ranch Tributary 1

Name of Structure: Tributary 1

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the 100 -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ■ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☐ Drop structures ☐ Superelevated sections

■ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ■ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered. THE CHANNEL WAS DESIGNED TO INCLUDE ARMORING AS NEEDED TO PREVENT ADVERSE SEDIMENT TRANSPORT/ SCOURING.

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Geick Ranch Tributary 2

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☐ Not revised (skip to section B) ☐ No existing analysis ■ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
Upstream of project site, west of Eastonville Road	0.5	280	365.2

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ■ Precipitation/Runoff Model → Specify Model: SCS Curve Number Method/HEC-HMS Model from Meridian Ranch MDDP Approved July 2021 by Tech Contractors. Calcs provided.
☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ■ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.) Effective	Proposed/Revised
Downstream Limit*	IMMEDIATELY DS OF PROJECT	-296.57	6909.26	6909.26
Upstream Limit*	EASTONVILLE RD	5964.05	7034.59	7034.59

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC RAS 5.0.5

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	
Corrected Effective Model*	File Name:	Plan Name: N/A	File Name:	Plan Name:	
Existing or Pre-Project Conditions Model	File Name: GRT2.prj	Plan Name: GRT2_EXISTING	File Name:	Plan Name:	
Revised or Post-Project Conditions Model	File Name: GRT2.prj	Plan Name: GRT2_PROPOSED	File Name: N/A	Plan Name:	
Other - (attach description)	File Name:	Plan Name: N/A	File Name:	Plan Name:	

* For details, refer to the corresponding section of the instructions.

■ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☐ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information:

Source: EDWARD JAMES Date: 7/22/2022

Accuracy: +/- 0.08 ft

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

■ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ■ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ■ No

   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ■ Yes ☐ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ■ Yes ☐ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

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PRIVACY ACT STATEMENT

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Geick Ranch Tributary 2

Note**:** Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: Tributary 2

   Type (check one): ☒ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: LOCATED BETWEEN EASTONVILLE ROAD AND NORTHWEST OF HIGHWAY 24

   Downstream Limit/Cross Section: SOUTHERN BOUNDARY OF GRANDVIEW RESERVE, SECTION 70.18

   Upstream Limit/Cross Section: EAST SIDE OF EASTONVILLE ROAD, SECTION 5642

2. Name of Structure: 10' X 4' BOX Culvert at US end of project

   Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: UNDER THE FUTURE REX ROAD

   Downstream Limit/Cross Section: SECTION 5043.56

   Upstream Limit/Cross Section: SECTION 4748.5

3. Name of Structure: 3 - 8' x 4' BOX Culverts MID project

   Type (check one) ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: MID GEICK RANCH TRIB 2, UNDER PROPSOED ROAD THROUGH FUTURE DEVELOPMENT

   Downstream Limit/Cross Section: SECTION 3760 UPSTREAM LIMIT / CROSS SECTION: SECTION 3880

NAME OF STRUCTURE: 3 - 8' x 4' BOX CULVERTSOUTHERN END OF PROJECT
TYPE: BRIDGE CULVERT
LOCATION OF STRUCTURE: MID GEICK RANCH TRIB 2, UNDER PROPSOED ROAD THROUGH FUTURE DEVELOPMENT
DOWNSTREAM LIMIT: 1285
UPSTREAM LIMIT: 1385

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: Geick Ranch Tributary 2

Name of Structure: Tributary 2

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the 100 -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ■ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ■ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ■ Drop structures ☐ Superelevated sections

☐ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ■ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered. THE CHANNEL WAS DESIGNED TO INCLUDE ARMORING AS NEEDED TO PREVENT ADVERSE SEDIMENT TRANSPORT/ SCOURING.

C. BRIDGE/CULVERT

Flooding Source: Geick Ranch Tributary 2

Name of Structure: 10' X 4' BOX Culvert at US end of project

1. This revision reflects (check one):

   ☒ Bridge/culvert not modeled in the FIS There is no existing FIS

   ☐ Modified bridge/culvert previously modeled in the FIS

   ☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

   ☐ Dimensions (height, width, span, radius, length)
   ☐ Shape (culverts only)
   ☐ Material
   ☐ Beveling or Rounding
   ☐ Wing Wall Angle
   ☐ Skew Angle
   ☐ Distances Between Cross Sections
   ☐ Erosion Protection
   ☐ Low Chord Elevations – Upstream and Downstream
   ☐ Top of Road Elevations – Upstream and Downstream
   ☐ Structure Invert Elevations – Upstream and Downstream
   ☐ Stream Invert Elevations – Upstream and Downstream
   ☐ Cross-Section Locations

4. Sediment Transport Considerations

   Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

   If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

THE CULVERT WAS DESIGNED TO INCLUDE ARMORING AS NEEDED TO PREVENT ADVERSE SEDIMENT TRANSPORT/ SCOURING.

C. BRIDGE/CULVERT

Flooding Source: Geick Ranch Tributary 2

Name of Structure: 3 - 8' x 4' BOX Culverts MID project

1. This revision reflects (check one):

   ☒ Bridge/culvert not modeled in the FIS There is no existing FIS

   ☐ Modified bridge/culvert previously modeled in the FIS

   ☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

   ☐ Dimensions (height, width, span, radius, length)
   ☐ Shape (culverts only)
   ☐ Material
   ☐ Beveling or Rounding
   ☐ Wing Wall Angle
   ☐ Skew Angle
   ☐ Distances Between Cross Sections
   ☐ Erosion Protection
   ☐ Low Chord Elevations – Upstream and Downstream
   ☐ Top of Road Elevations – Upstream and Downstream
   ☐ Structure Invert Elevations – Upstream and Downstream
   ☐ Stream Invert Elevations – Upstream and Downstream
   ☐ Cross-Section Locations

4. Sediment Transport Considerations

   Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

   If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

THE CULVERT WAS DESIGNED TO INCLUDE ARMORING AS NEEDED TO PREVENT ADVERSE SEDIMENT TRANSPORT/ SCOURING.

C. BRIDGE/CULVERT

Flooding Source: Geick Ranch Tributary 2

Name of Structure: 3 - 8' x 4' BOX CULVERTS SOUTHERN END OF PROJECT

1. This revision reflects (check one):

   ☒ Bridge/culvert not modeled in the FIS There is no existing FIS

   ☐ Modified bridge/culvert previously modeled in the FIS

   ☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

   ☐ Dimensions (height, width, span, radius, length)
   ☐ Shape (culverts only)
   ☐ Material
   ☐ Beveling or Rounding
   ☐ Wing Wall Angle
   ☐ Skew Angle
   ☐ Distances Between Cross Sections
   ☐ Erosion Protection
   ☐ Low Chord Elevations – Upstream and Downstream
   ☐ Top of Road Elevations – Upstream and Downstream
   ☐ Structure Invert Elevations – Upstream and Downstream
   ☐ Stream Invert Elevations – Upstream and Downstream
   ☐ Cross-Section Locations

4. Sediment Transport Considerations

   Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

   If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

THE CULVERT WAS DESIGNED TO INCLUDE ARMORING AS NEEDED TO PREVENT ADVERSE SEDIMENT TRANSPORT/ SCOURING.

Appendix B
Certified Topo