# FINAL DRAINAGE REPORT
# FOR
# STERLING RANCH EAST FILING NO. 2
# &
# FOURSQUARE AT STERLING RANCH EAST FILING NO. 1

See comments provided with SF2237 - Sterling Ranch East Filing No 2

**December 2022**

Prepared for:
**CLASSIC SRJ LAND, LLC**
2138 Flying Horse Club Dr.
COLORADO SPRINGS CO 80921
(719) 592-9333

Prepared by:
**CLASSIC CONSULTING ENGINEERS & SURVEYORS**
619 N. CASCADE AVENUE, SUITE 200
COLORADO SPRINGS CO 80903
(719) 785-0790

Job no. 2183.23
PCD File # SF SF2236 & SF2237

**FINAL DRAINAGE REPORT FOR STERLING RANCH EAST FILING NO. 2 &**
**FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

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

David L Gibson, Colorado P.E. #46477 Date

**DEVELOPER'S STATEMENT:**
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: Classic SRJ Land, LLC

By:

Title:

Address: 2138 Flying Horse Club Dr.

Colorado Springs, CO 80921

**EL PASO COUNTY ONLY:**
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.

For County Engineer / ECM Administrator Date
Conditions:

**TABLE OF CONTENTS:**



**APPENDICES**

## PURPOSE

This document is the Final Drainage Report for Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1. The purpose of this report is to identify onsite and offsite drainage patterns, define areas tributary to the proposed full spectrum detention and water quality facility (Pond 16), and to safely route developed storm water runoff via a proposed storm sewer system. The proposed Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 developments shall be in adherence to the El Paso County approved Master Development Drainage Plan and MDDP Amendment for Sterling Ranch as well as current County Drainage Criteria.

## PROJECT DESCRIPTION

The Sterling Ranch East Filing No. 2 development is 16.841 acres and Foursquare at Sterling Ranch East Filing No. 1 is 36.647 acres of the 321.37 total acres of Sterling Ranch East, a phased master planned community located in northern El Paso County, Colorado. These developments consist of public residential roadways and single-family home lots. The site is located in portion of Section 33 & 34, Township 12 South, Range 65 west of the 6th p.m. in El Paso County, Colorado. The site is located on the east side of Sand Creek. The site is bounded on the north, east and west by proposed and future Sterling Ranch East residential development, west and south by the proposed extension of Briargate Pkwy. The site is in the upper portion of both the Sand Creek and Sand Creek East Fork Drainage Basins.

## PREVIOUS REPORTS

The latest and most applicable previously approved drainage studies are the following:

1. "Sterling Ranch MDDP Amendment No. 2 & Preliminary Drainage Report for Sterling Ranch East Preliminary Plan No. 1," by Classic Consulting Engineers & Surveyors, LLC approval pending.
2. "Master Development Drainage Plan Amendment for Sterling Ranch," by JR Engineering, LLC, dated September 2022.
3. "2018 Sterling Ranch MDDP," by M&S Civil Consultants, Inc. June 2018.
4. "Drainage Letter for Sterling Ranch Road and Briargate Pkwy. Interim Plan," by JR Engineering, LLC dated September 2022.

5. "Final Drainage Report for Sand Creek Restoration," by JR Engineering, LLC, dated September 2022.

**SOILS AND GEOLOGY**

The soils within the Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No .1 site and tributary area are Hydrologic Soil Group A, Blakeland loamy sand and Columbine gravelly sandy loam (See Appendix for Soil Map). Per the El Paso County DCM, Chapter 6, Section 4.3, to recognize that soils within a development project are usually disturbed and covered with top soil, sod or landscaping and irrigated, Type A soils must be represented as Type B soils for post development runoff coefficients. Therefore, Type B soils are used in sizing the proposed storm sewer infrastructure and full spectrum detention/water quality facility (Pond 16).

See my comments on the UD-Detention spreadsheets below.

**DRAINAGE CRITERIA**

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the DCM as revised in May 2014. Full Spectrum Detention and Stormwater quality analysis, Extended Detention Basin (EDB) design, are per the Mile High Flood District Manual and MHFD-Detention version 4.05 and UD-BMP version 3.06 spreadsheet. The Rational Method was used to estimate stormwater runoff from the developed project and tributary to the proposed full spectrum detention/water quality pond. The UDFCD UD-Inlet excel workbook was used to verify street capacities, size sump inlets, and calculate interception and flow-by rates of at-grade inlets. The UD-Sewer computer program was used to calculate the hydraulic grade line (HGL) within the storm sewer system. An overall tributary area exhibit is included to show the various types of pervious and impervious areas established to determine the overall imperviousness of the 220.90 ultimate acres tributary to the proposed full spectrum detention/water quality facility (Pond 16) and 42.51 interim acres are tributary with development of Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 only.

**FLOODPLAIN STATEMENT**

No portions of the Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 are located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041C 0533G, effective date, December 7, 2018.

**EXISTING DRAINAGE CONDITIONS**

The "Sterling Ranch MDDP Amendment No. 2 & Preliminary Drainage Report for Sterling Ranch East Preliminary Plan No. 1," by Classic Consulting Engineers & Surveyors, LLC is currently under review and approval process with El Paso County Development Services and in full detail describes the Existing Conditions of the proposed development area. Please see this report for the full descriptions. The Pre-Developed (Existing) Conditions Maps are included in the Appendix of this Report and include the Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 boundary's.

The proposed site is located within Basins EX-5, EX-7, EX-9 & EX10A of the Preliminary Drainage Report study and drains north to south. The site has been previously disturbed with mass grading operations and vegetation is sparse and of natural grassland consistency (no trees or shrubs). See previous reports for additional details on the Existing Conditions.

The adjacent Briargate Parkway and Sterling Ranch Road drainage and roadway design was completed by JR Engineering, "Drainage Letter for Sterling Ranch Road and Briargate Parkway Interim Plan," May 2022. These roadways and storm system will be constructed prior to and in conjunction with the proposed Filing No. 1 development. Therefore, the storm system described within this JR Engineering Letter and Construction Drawings is shown as 'Existing' with proposed storm sewer extensions into the storm system for Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1.

**PROPOSED DRAINAGE CONDITIONS**

Developed runoff from Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 will be collected in a public-private storm system and piped into the Privately owned and maintained full spectrum detention/water quality facility (Pond 16) that will detain and treat the developed runoff prior to releasing at or below historic rates to the downstream channel (Sand Creek Reach SC-9). As

previously mentioned, the rational method was used to estimate developed runoff values. All storm sewer inlets and pipes collecting runoff within the County right-of-way will be 'Public'. All storm sewer outside of right-of-way, including the pond outfall pipe, is 'Private' as is the proposed full spectrum detention facility. Private facilities will be owned and maintained by the Sterling Ranch Metropolitan District. HGL grade line calculations are included in the Appendix in support of the construction drawings for the proposed Public and Private storm systems.

Per the current El Paso County Drainage Criteria for stormwater capacity within street sections, the following summaries of Figures 7-7 applies: all proposed roads are Residential.

| ***Street Type*** | ***Allowable – Initial Storm (5 yr)*** | ***Allowable–Major Storm (100 yr)*** |
|---|---|---|
| Residential w/Ramp Curb | 1.5% street slope = 10 cfs<br>2% street slope = 12 cfs<br>4% street slope = 16.5 cfs<br>6% street slope = 19.5 cfs<br>8% street slope = 17.8 cfs<br>10% street slope = 16.5 cfs<br>No curb overtopping. | 1.5% street slope = 46 cfs<br>2% street slope = 44 cfs<br>4% street slope = 36 cfs<br>6% street slope = 32 cfs<br>8% street slope = 29 cfs<br>10% street slope = 27.5 cfs<br>12" maximum depth at flowline. |
| Residential w/Vertical Curb<br>(6" Vertical Curb) | 1.5% street slope = 13 cfs<br>2% street slope = 15 cfs<br>4% street slope = 20.5 cfs<br>6% street slope = 18 cfs<br>8% street slope = 16.8 cfs<br>10% street slope = 15.7 cfs<br>No curb overtopping. | 1.5% street slope = 45 cfs<br>2% street slope = 43 cfs<br>4% street slope = 35 cfs<br>6% street slope = 31 cfs<br>8% street slope = 28 cfs<br>10% street slope = 26.5 cfs<br>12" maximum depth at flowline. |

At-grade inlets and sump (low-points) were designed in a way that street capacity is not an issue anywhere within the proposed Filings. Street capacity has also been verified at each design point by using the UD-Inlet Excel workbook (located in Appendix) from Urban Drainage Flood Control District (UDFCD). Inlet sizing is also per the UD-Inlet Excel workbook. Drainage from individual lots are assumed to travel in side-lot swales to the street. One Site-Level Low Impact Development form (IRF form) is

included in the Appendix of this report, for the basins that discharge to the proposed full spectrum detention and water quality Pond 16. A detailed description of the developed flows for Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 is as follows:

**Design Point 1 ($Q_5$ = 6.1 cfs, $Q_{100}$ = 16.1 cfs)** consists of developed flows from Basin B. Basin B is 4.9 acres of proposed residential development with associated streets, landscaping, and homes. Flows travel south in the east curbline of Boise Court and west curbline of Boulder City Place to Design Point 1 where a proposed public 10' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 24" RCP public storm sewer (Pipe 1). The emergency overflow route for this inlet will be south to Design Point 2.

**Design Point 2 ($Q_5$ = 3.5 cfs, $Q_{100}$ = 9.9 cfs)** consists of developed flows from Basin A. Basin A is 3.35 acres of proposed residential development with associated streets, landscaping, and homes. Flows travel south in the west curbline of Boise Court and to the south curbline of Catalina Road to Design Point 2 where a proposed public 5' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 18" RCP public storm sewer (Pipe 2). The emergency overflow route for this inlet will overtop the southeast curb return at the at the intersection of Catalina Road and Boulder City Place and continue south along Boulder City Place.

**Design Point 3 ($Q_5$ = 5.7 cfs, $Q_{100}$ = 14.0 cfs)** consists of developed flows from Basin J. Basin J is 2.60 acres of proposed residential development with associated streets, landscaping, and homes. Flows travel south in the curbline of Salt Lake Drive and to the north curbline of Catalina Road to Design Point 3 where a proposed public 10' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 24" RCP public storm sewer (Pipe 4). The emergency overflow route for this inlet will be south to Design Point 4.

**Design Point 4 ($Q_5$ = 2.2 cfs, $Q_{100}$ = 6.1 cfs)** consists of developed flows from Basin K. Basin K is 1.83 acres of proposed residential development with associated streets, landscaping, and homes. Flows travel south in the south curbline of Catalina Road to Design Point 4 where a proposed public 5' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 18" RCP public storm sewer (Pipe 5). The

emergency overflow route for this inlet will overtop curb behind Design Point 4 to Tract A and then to Briargate Parkway.

**Design Point 5 ($Q_5$ = 2.3 cfs, $Q_{100}$ = 5.8 cfs)** consists of developed flows from Basin F and Basin OS-1. Basin F is 0.49 acres of proposed Idaho Falls Drive. Basin OS-1 is 2.60 acres of future residential development north of Idaho Falls Drive. Flows travel east in the north curbline of Idaho Falls Drive to Design Point 5 where a proposed public 5' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 18" RCP public storm sewer (Pipe 7). The emergency overflow route for this inlet will be south to Design Point 6.

**Design Point 6 ($Q_5$ = 0.7 cfs, $Q_{100}$ = 1.3 cfs)** consists of developed flows from Basin G. Basin G is 0.16 acres of proposed Idaho Falls Drive. Flows travel south in the south curbline of Idaho Falls Drive to Design Point 6 where a proposed public 5' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 18" RCP public storm sewer (Pipe 8). The emergency overflow route for this inlet will overtop the southeast curb return at the at the intersection of Idaho Falls Drive and Pagosa Springs Drive and continue south along Pagosa Springs Drive to Design Point 8.

**Design Point 7 ($Q_5$ = 5.5 cfs, $Q_{100}$ = 14.1 cfs)** consists of developed flows from Basin H. Basin H is 4.01 acres of proposed residential development with associated streets, landscaping, and homes. Flows travel south in the west curbline of Pagosa Springs Drive to Design Point 7 where a proposed public 10' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 24" RCP public storm sewer (Pipe 10). The emergency overflow route for this inlet will overtop the highpoint in Pagosa Springs Drive to Design Point 3.

**Design Point 8 ($Q_5$ = 1.1 cfs, $Q_{100}$ = 4.6 cfs)** consists of developed flows from Basin I. Basin I is 1.68 acres of proposed residential development with associated streets, landscaping, open space and homes. Flows travel south in the east curbline of Pagosa Springs Drive to Design Point 8 where a proposed public 5' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 18" RCP public storm sewer (Pipe 11). The emergency overflow route for this inlet will overtop the crown in the road to Design Point 7.

**Design Point 9 ($Q_5$ = 7.6 cfs, $Q_{100}$ = 21.9 cfs)** consists of developed flows from Basin M and Basin N. Basin M is 4.10 acres and Basin N is 3.00 acres of proposed residential development with associated streets, landscaping, and homes. Developed flows travel east in the north curbline of Catalina Road to a proposed public 15' Type R at-grade inlet at Design Point 9. This at-grade inlet will intercept ($Q_5$= 7.1 cfs, $Q_{100}$= 13.2 cfs) with a flow-by of ($Q_5$= 0.5 cfs, $Q_{100}$= 8.7 cfs) that will travel in the north curb line of Catalina Road to Design Point 10. Intercepted flows will be conveyed by a proposed 24" RCP public storm sewer (Pipe 14).

**Design Point 10 ($Q_5$ = 3.6 cfs, $Q_{100}$ = 15.7 cfs)** consists of developed flows from Basin L and Flow-by Design Point 9. Basin L is 2.20 acres of proposed residential development with associated streets, landscaping, open space and homes. Flows travel south in the south curbline of Catalina Road to Design Point 9 where a proposed public 15' Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 24" RCP public storm sewer (Pipe 16). The emergency overflow route for this inlet will overtop the curb and into Tract A and then to Sterling Ranch Road.

**Design Point 11 ($Q_5$ = 39 cfs, $Q_{100}$ = 117 cfs)** consists of Basin T and Pipe 17 and represents to the total flows into the proposed private Full Spectrum Detention Facility from Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1. Basin T is 11.19 acres of landscape slope and pond. Pipe 17 **($Q_5$ = 35.8 cfs, $Q_{100}$ = 95 cfs)** is a public 42" RCP storm.

**Basin C ($Q_5$ = 0.9 cfs, $Q_{100}$ = 4.8 cfs)** is 1.92 acres of open space tract and residential back yards that will discharge directly Briargate Parkway. Flows will be intercepted by an existing 20' Type R inlet in Briargate Parkway installed with Sterling Ranch East Filing No. 1. This is shown as a portion of Basin P1-A2 in the Sterling Ranch East Filing No. 1 Final Drainage Report.

**Basin E ($Q_5$ = 2.2 cfs, $Q_{100}$ = 16.3 cfs)** is 6.63 acres of open space tract and adjacent Sand Creek (Reach SC-9) channel improvements that are within the boundary of Sterling Ranch East Filing No. 2. No development is located within this basin as its only open space and existing channel work. All channel

work is completed per the "Final Drainage Report for Sand Creek Restoration," by JR Engineering LLC, dated September 2022.

Notate which WQ PBMP each basin is tributary to and/or which WQ exclusion applies. In the case of Basin E, there is excluded stream stabilization areas per ECM Appendix I.7.1.B.8 and land disturbance to undeveloped land that will remain undeveloped per ECM I.7.1.B.7

**Basin Q ($Q_5$ = 0.6 cfs, $Q_{100}$ = 2.0 cfs)** is 0.50 acres of open space tract that will discharge directly Briargate Parkway. Flows will be intercepted by an existing 20' Type R inlet in Briargate Parkway installed with Sterling Ranch East Filing No. 1. This is shown as a portion of Basin P1-A2 in the Sterling Ranch East Filing No. 1 Final Drainage Report.

**Basin O ($Q_5$ = 6.2 cfs, $Q_{100}$ = 12.0 cfs)** is 2.16 acres Sterling Ranch Road that will discharge directly Briargate Parkway. Flows will be intercepted by an existing 20' Type R inlet in Briargate Parkway installed with Sterling Ranch East Filing No. 1. This is shown as a portion of Basin P1-C2 in the Sterling Ranch East Filing No. 1 Final Drainage Report.

**Basin P ($Q_5$ = 0.7 cfs, $Q_{100}$ = 2.4 cfs)** is 0.63 acres of open space tract that will discharge directly Briargate Parkway. Flows will be intercepted by an existing 20' Type R inlet in Briargate Parkway installed with Sterling Ranch East Filing No. 1. This is shown as a portion of Basin P1-A3 in the Sterling Ranch East Filing No. 1 Final Drainage Report.

**STORM WATER QUALITY/DETENTION**

As required, storm water quality measures will be utilized in order to reduce the amount of sediment, debris and pollutants that are allowed to enter Sand Creek. Developed flows from Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 along with future flows from the Sterling Ranch East Preliminary Plan No. 1 will be routed to a private Full Spectrum Detention facility, FSD Pond 16 to be located in Tract H of Foursquare at Sterling Ranch East Filing No. 1. The facilities will release treated developed flows to an existing 48" RCP storm within future Briargate Parkway. Reference the "Drainage Letter for Sterling Ranch Road and Briargate Pkwy. Interim Plan", prepared by JR Engineering, LLC, dated December 2021 and the "Sterling Ranch Road and Briargate Pkwy. Storm Plans", prepared by JR Engineering, LLC, dated September 2022. These referenced design plans provide a 48" RCP outfall pipe at this location with an allowable release rate of ($Q_{100}$ = 156.6 cfs)

Plans show a 42" pipe.

**Private FSD POND-16**

The outlet structure will be designed in an interim condition until future tributary storm systems from developments north of Foursquare at Sterling Ranch East Filing No . 1 are developed. As systems are designed and plans submitted for review Final Drainage Reports will be submitted updated the outlet plate until the ultimate condition is reached. This report will detail the interim condition as well as estimated ultimate conditions based on tributary areas shown in the Preliminary Drainage Report for Foursquare at Sterling Ranch Preliminary Plan/PUD as well as the Sterling Ranch MDDP amendment No. 2.

The UD-BMP spreadsheet along with the UD-Detention spreadsheet were used to calculate the required volume for the EURV and 100-year release. User input 1-hour precipitation values in the UD-Detention spreadsheet were taken from Table 6-2 Volume 1 Colorado Springs El Paso County Drainage Criteria Manual. The UD-BMP IRF spreadsheet (see appendix) was used to calculate the overall total site imperviousness Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 to the EDB (Interim) and these subdivisions including the future tributary area (Ultimate). This total interim area is 42.51 acres. Per the spread sheet a 100 Year Event 42.3% imperviousness will be used in the interim condition. This total ultimate area is estimated at 220.90 acres. Per the spread sheet a 100 Year Event 48.9% imperviousness will be used in the ultimate condition.

Revise if needed per my comments on the CDs (what is shown on CDs does not match UD-Detention spreadsheet)

**Interim Condition (Sterling Ranch East Filing No. 2 & Foursquare at Sterling Ranch East Filing No. 1)**

Per UD-Detention spreadsheet a 0.659 ac-ft. WQVC, 1.320ac-ft. EURV, and a 3.296 ac-ft. 100-year flow volume is provided. The outlet structure will have a 4-hole configuration with 4 individual rectangular holes spaced 30 inches apart each hole with have an area of 3.50, 8.0, 18.0 and 18.0 square inches. The outlet box will be an 20'x4' grated inlet box 10.0' tall with a 48" RCP storm sewer outlet with a plate 26" from invert will connect to the existing 48" RCP storm sewer in Briargate Parkway. A 165' wide 2' deep emergency overflow weir will be installed in the pond berm with Type L rip-rap (see appendix for calculation). Flows will overtop the pond in the provided weir and travel directly to the adjacent Briargate Parkway. Maintenance and ownership of the Private detention/water quality facility and the

entire proposed storm sewer is by the Sterling Ranch East Metropolitan District. An El Paso County Detention Pond Maintenance Agreement will be required indicating these Facilities to be ultimately owned and maintained by the Metro District

Planned release per the UD-Detention spreadsheet from the Full Spectrum EDB will be **$Q_5$= 0.60 cfs, $Q_{100}$= 1.40 cfs**. Allowable release into the existing 48" RCP outfall pipe at this location is anticipated to release rate of ($Q_{100}$ = 156.6 cfs). This facility restricts the release to below pre-development (historic levels) per the MHFD-Detention spreadsheet and is in conformance with the Preliminary Drainage Report and MDDP Amendment.

**Ultimate Condition (Sterling Ranch East Filing No. 2, Foursquare at Sterling Ranch East Filing No. 1 & Future Sterling Ranch East Development)**

Per UD-Detention spreadsheet a 3.742 ac-ft. WQVC, 8.423ac-ft. EURV, and a 19.927 ac-ft. 100-year flow volume is provided. The outlet structure will have a 4-hole configuration with 4 individual rectangular holes spaced 30 inches apart each hole with have an area of 10.0, 14.0, 18.0 and 18.0 square inches. The outlet box will be an 20'x4' grated inlet box 10.0' tall with a 48" RCP storm sewer outlet with a plate 26" from invert will connect to the existing 48" RCP storm sewer in Briargate Parkway. A 165' wide 2' deep emergency overflow weir will be installed in the pond berm with Type L rip-rap (see appendix for calculation). Flows will overtop the pond in the provided weir and travel directly to the adjacent Briargate Parkway. Maintenance and ownership of the Private detention/water quality facility and the entire proposed storm sewer is by the Sterling Ranch East Metropolitan District. An El Paso County Detention Pond Maintenance Agreement will be required indicating these Facilities to be ultimately owned and maintained by the Metro District

Planned release per the UD-Detention spreadsheet from the Full Spectrum EDB will be **$Q_5$= 4.3 cfs, $Q_{100}$= 120.4 cfs**. Allowable release into the existing 48" RCP outfall pipe at this location is anticipated to release rate of ($Q_{100}$ = 156.6 cfs). This facility restricts the release to below pre-development (historic levels) per the MHFD-Detention spreadsheet and is in conformance with the Preliminary Drainage Report and MDDP Amendment.

**STORMWATER QUALITY (FOUR STEP PROCESS)**

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

1. Individual home roof downspouts will be directed onto pervious landscape areas. The additional grass buffer BMP provides the following: 1) Minimize directly connected impervious areas. 2) Provides initial pollutant and sediment removal before entering the storm system. Rear yard flows of those proposed lots adjacent to public streets will be directed over a grass buffer area (both landscaped and native grasses) to provide treatment of these small rear year areas.

For consistency throughout this report and CD's, pick one naming convention for the pond. I think the most common one is "Pond FSD-16"

2. The proposed Pond 16 provides Detention and Stormwater Quality Treatment for the entirety of the proposed development and surrounding arterial and collector roadways. The facility in conjunction with Step 1 implementation above will address all required Water Quality Capture Volume and Slow Release Requirements.

3. The recipient of the drainage flows from the site is Sand Creek (Reach SC-8), with an estimated 100-year storm runoff rate along Filing No. 1 between 1,487 cfs to 1,904 cfs. This portion of the creek contains 100-year FEMA floodplain, but no jurisdictional wetlands or Preble's Jumping Mouse habitat. As such the downstream corridor is very well established and as the detained developed release rate is far less than historic, theoretically no additional erosion will occur. The adjacent Sand Creek Channel Improvements accounted for the restricted runoff from Pond 16.

4. Does not apply to this Residential subdivision as this step is to 'consider the need for Industrial and Commercial BMPs'. Temporary construction BMPs will be installed per the approved grading and erosion control plans.

**DRAINAGE AND BRIDGE FEES**

Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 are within the Sand Creek Drainage Basin and is a total of 16.841 acres and 36.647. Per the year 2022 El Paso County Basin Fees, the Sand Creek Drainage Fee is $21,814 per impervious acre of development and the Bridge Fee is $8,923 per impervious acre. Sterling Ranch East Filing 2 consists of 7.320 acres of typical home lots, 2.453 acres of public right-of-way (roads), and 7.068 acres of open space/undeveloped area. Using Table 6-6 of the DCM, specifically 65% imperviousness for typical home lots, 100% imperviousness for pavement/right-of-way, and 0% imperviousness for open space/undeveloped area; an overall Filing No. 2 impervious area is calculated at 7.211 acres.

**STERLING RANCH EAST FILING No. 2 (7.211 Impervious acres)**

DRAINAGE FEE:

| | |
|---|---|
| $21,814/acre x 7.211 acres | $ 157,300.75 |

BRIDGE FEE:

| | |
|---|---|
| $8,923/acre x 7.211 acres | $ 64,343.75 |

This site lies entirely within the Sand Creek Drainage Basin boundaries.

Foursquare at Sterling Ranch East Filing 1 consists of 13.581 acres of typical home lots, 6.702 acres of public right-of-way (roads), and 16.364 acres of open space/undeveloped area. Using Table 6-6 of the DCM, specifically 65% imperviousness for typical home lots, 100% imperviousness for pavement/right-of-way, and 0% imperviousness for open space/undeveloped area; an overall Filing No. 1 impervious area is calculated at 7.211 acres.

**FOURSQUARE AT STERLING RANCH EAST FILING No. 1 (15.529 Impervious acres)**

DRAINAGE FEE:

| | |
|---|---|
| $21,814/acre x 15.929 acres | $ 347,475.21 |

BRIDGE FEE:

| | |
|---|---|
| $8,923/acre x 15.529 acres | $ 138,565.27 |

This site lies entirely within the Sand Creek Drainage Basin boundaries.

Basin fees will be required to be paid prior to plat recordation.

**CONSTRUCTION COST OPINION**

The following is a construction cost opinion for the public facilities, located within the public right-of-way and accepting runoff from the public roadways, and the private facilities, intercepting the runoff from the adjacent school and park sites, and routing to the downstream natural channel:

**Public Drainage Facilities Non-reimbursable (STERLING RANCH EAST FILING NO. 2)**

| ITEM | DESCRIPTION | QUANTITY | UNIT COST | COST |
|---|---|---|---|---|
| 1. | 10' Type-R Inlet | 2 EACH | $8,447/EA | $ 16,894.00 |
| 2. | 18" RCP Storm Drain | 8 LF | $70/LF | $ 560.00 |
| 3. | 24" RCP Storm Drain | 32 LF | $83/LF | $ 2,656.00 |
| 4. | 30" RCP Storm Drain | 104 LF | $104/LF | $ 10,816.00 |
| 5. | Type II Storm MH | 1 EACH | $7,082/EA | $ 7,082.00 |
| | | | | |
| SUB-TOTAL | | | | $ 38,008.00 |
| 10% ENGINEERING | | | | $ 3,800.80 |
| 5% CONTINGENCIES | | | | $ 1,900.40 |
| **TOTAL** | | | | **$ 43,709.20** |

**Public Drainage Facilities Non-reimbursable (FOURSQUARE AT STERLING RANCH EAST FILING NO. 1)**

| ITEM | DESCRIPTION | QUANTITY | UNIT COST | COST |
|---|---|---|---|---|
| 1. | Riprap (spillway) | 1,075 TONS | $89/TON | $ 95,675.00 |
| 2. | Geotextile (under riprap) | 1,062 SY | $7/SY | $ 7,434.00 |
| 3. | 18" RCP Storm Drain | 586 LF | $70/LF | $ 41,020.00 |
| 4. | 24" RCP Storm Drain | 363 LF | $83/LF | $ 30,129.00 |
| 5. | 30" RCP Storm Drain | 487 LF | $104/LF | $ 50,648.00 |
| 6. | 36" RCP Storm Drain | 647 LF | $128/LF | $ 82,816.00 |
| 7. | 42" RCP Storm Drain | 267 LF | $171/LF | $ 45,657.00 |
| 8. | 5' Type R Inlets | 4 EA | $6,138/EA | $ 24,552.00 |
| 9. | 10' Type R Inlets | 2 EA | $8,447/EA | $ 16,894.00 |

| | | | | |
|---|---|---|---|---|
| 10. | 15’ Type R Inlets | 2 EA | $11,775/EA | $ 23,550.00 |
| 11. | Type II Storm MH | 2 EA | $7,082/EA | $ 14,164.00 |
| 12. | Type I Storm MH | 7 EA | $12,876/EA | $ 90,132.00 |
| 13. | Permanent Pond 16* | 1 EA | $200,000/EA | $ 200,000.00 |
| SUB-TOTAL | | | | $ 722,671.00 |
| 10% ENGINEERING | | | | $ 72,267.10 |
| 5% CONTINGENCIES | | | | $ 36,133.55 |
| **TOTAL** | | | | **$ 831,071.65** |

*Includes cost of impact structures, forebays, trickle channel, road, and outlet box.

**SUMMARY**

Developed runoff from the proposed Sterling Ranch East Filing No. 2 and Foursquare at Sterling Ranch East Filing No. 1 development is proposed to outfall to one proposed private Full Spectrum Detention (EDB) and Storm Water Quality Facility (owned and maintained by the Sterling Ranch East Metropolitan District) prior to discharging to downstream facilities. The proposed Full Spectrum detention & water quality pond was sized using the current and applicable drainage criteria and provides release rates below existing allowable release rates. Therefore, the developed site runoff and proposed storm sewer facilities will not adversely affect the downstream facilities or surrounding developments.

PREPARED BY:

David L Gibson P.E.
Project Manager

dlg/118323/FDR-SRE FILING 1ª FSQ SER FILING 1.docx

**REFERENCES**


1. City of Colorado Springs/County of El Paso Drainage Criteria Manual Volume 1, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

2. "Urban Storm Drainage Criteria Manual Volume 1, 2 & 3," Urban Drainage and Flood Control District, dated January 2016.

3. "Sand Creek Drainage Basin Planning Study," by Kiowa Engineering Corporation, dated March 1996.

4. "2018 Sterling Ranch MDDP," by M&S Consultants, Inc., June 2018.

5. "Final Drainage Report for Retreat at TimberRidge Filing No. 1", Classic Consulting, approved November, 2020.

6. "Final Drainage Report for Retreat at TimberRidge Filing No. 2", Classic Consulting, dated March, 2022

7. "Final Design Report for Sand Creek Restoration", JR Engineering, LLC, dated September 2022

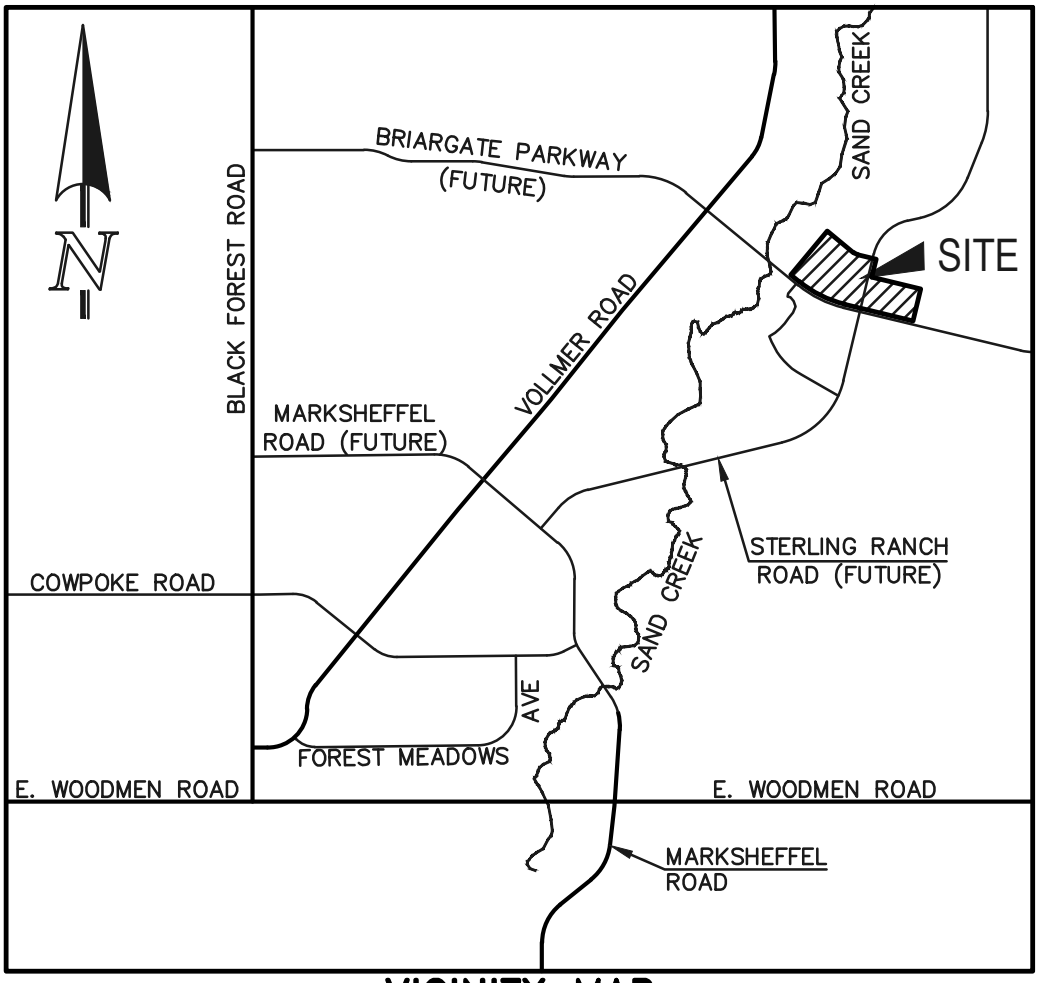
8. "Drainage Letter for Sterling Ranch Road and Briargate Pkwy. Interim Plan", prepared by JR Engineering, LLC, dated September 2022

9. "Master Development Drainage Plan Amendment for Sterling Ranch", prepared by JR Engineering, LLC, dated September 2022

# APPENDIX

# VICINITY MAP

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

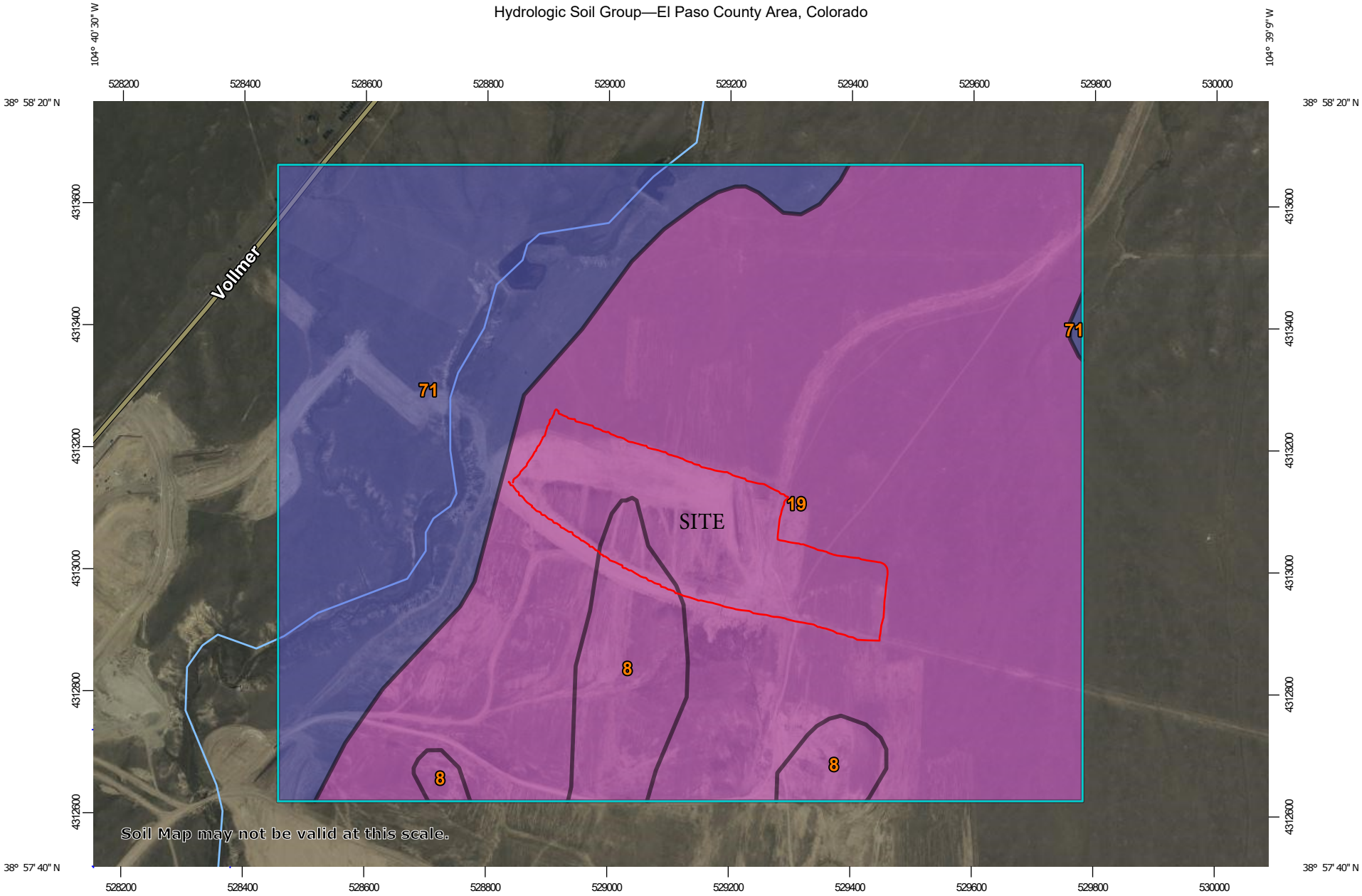



**VICINITY MAP**

NOT TO SCALE

**SOILS MAP (S.C.S. SURVEY)**

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS




Map Scale: 1:8,850 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

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

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

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

**Soil Rating Lines**

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

**Soil Rating Points**

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

**Water Features**

- Streams and Canals

**Transportation**

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

- Aerial Photography

## MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

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

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 8 | Blakeland loamy sand, 1 to 9 percent slopes | A | 23.0 | 6.7% |
| 19 | Columbine gravelly sandy loam, 0 to 3 percent slopes | A | 219.5 | 64.0% |
| 71 | Pring coarse sandy loam, 3 to 8 percent slopes | B | 100.4 | 29.3% |
| **Totals for Area of Interest** | | | **342.9** | **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

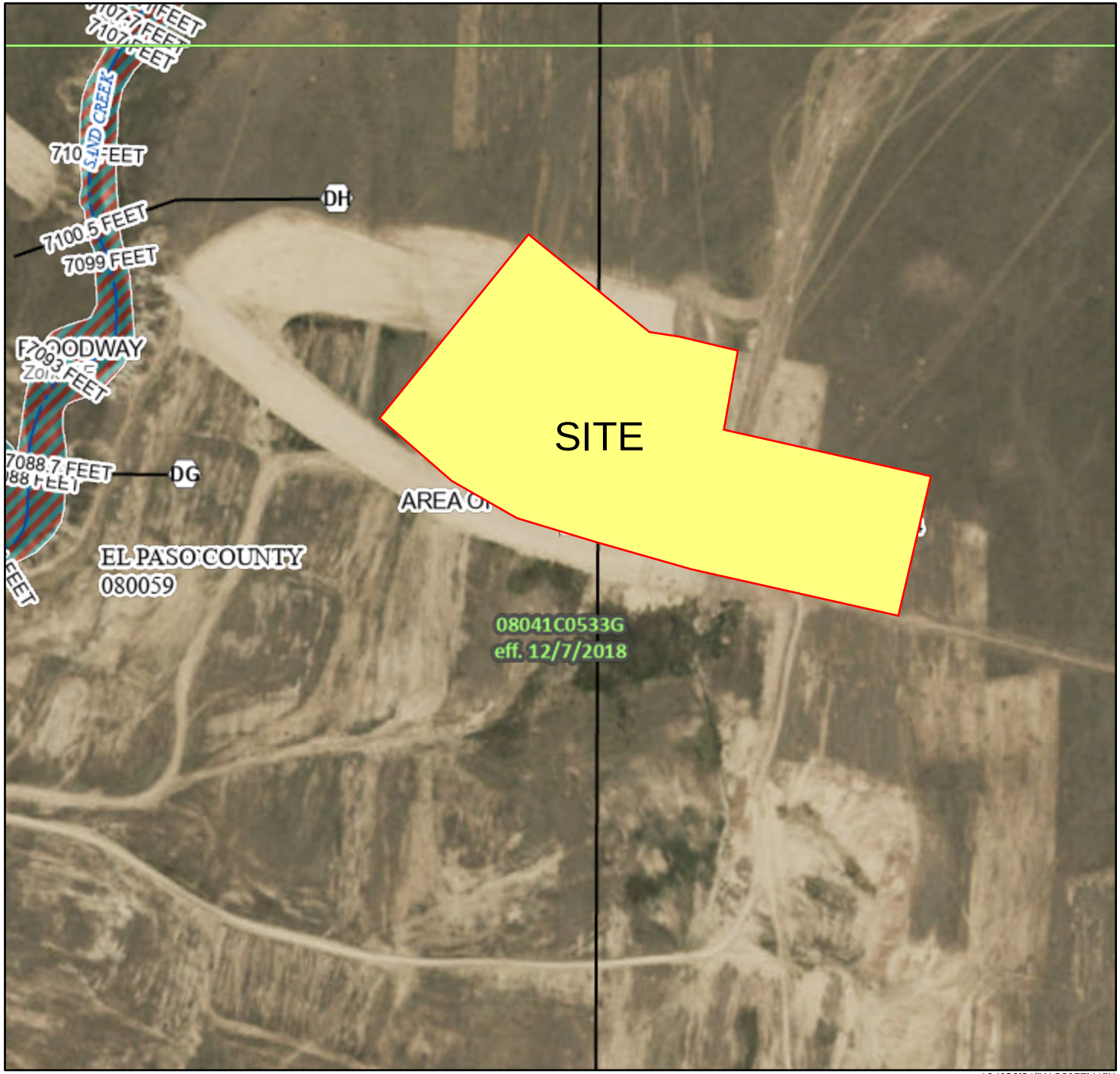
**F.E.M.A. MAP**

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

# National Flood Hazard Layer FIRMette

FEMA

104°40'9"W 38°58'9"N




104°39'31"W 38°57'41"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

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

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

**SPECIAL FLOOD HAZARD AREAS**
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

**OTHER AREAS**
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

**GENERAL STRUCTURES**
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**
- 20.2 — Cross Sections with 1% Annual Chance
- 17.5 — Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/22/2022 at 4:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

# DEVELOPED CONDITIONS CALCULATIONS

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME: *STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1*
JOB NUMBER: *1183.23*
DATE: *12/07/22*
CALCULATED BY: *DLG*

## FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

| | | DEVELOPED AREA/IMPERVIOUS AREA | | | | LANDSCAPE/UNDEVELOPED AREAS | | | | WEIGHTED | | | WEIGHTED CA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BASIN | TOTAL AREA (AC) | AREA (AC) | C(2) | C(5) | C(100) | AREA (AC) | C(2) | C(5) | C(100) | C(2) | C(5) | C(100) | CA(2) | CA(5) | CA(100) |
| A | 3.35 | 0.92 | 0.89 | 0.90 | 0.96 | 2.43 | 0.02 | 0.08 | 0.35 | 0.26 | 0.31 | 0.52 | **0.87** | **1.02** | **1.73** |
| B | 4.99 | 1.66 | 0.89 | 0.90 | 0.96 | 3.33 | 0.02 | 0.08 | 0.35 | 0.31 | 0.35 | 0.55 | **1.54** | **1.76** | **2.76** |
| C | 1.92 | 0.10 | 0.89 | 0.90 | 0.96 | 1.82 | 0.02 | 0.08 | 0.35 | 0.07 | 0.12 | 0.38 | **0.13** | **0.24** | **0.73** |
| D | 0.20 | 0.20 | 0.89 | 0.90 | 0.96 | 0.00 | 0.02 | 0.08 | 0.35 | 0.89 | 0.90 | 0.96 | **0.18** | **0.18** | **0.19** |
| E | 6.63 | 0.00 | 0.89 | 0.90 | 0.96 | 6.63 | 0.02 | 0.08 | 0.35 | 0.02 | 0.08 | 0.35 | **0.13** | **0.53** | **2.32** |
| F | 0.49 | 0.49 | 0.89 | 0.90 | 0.96 | 0.00 | 0.02 | 0.08 | 0.35 | 0.89 | 0.90 | 0.96 | **0.44** | **0.44** | **0.47** |
| G | 0.16 | 0.16 | 0.89 | 0.90 | 0.96 | 0.00 | 0.02 | 0.08 | 0.35 | 0.89 | 0.90 | 0.96 | **0.14** | **0.14** | **0.15** |
| H | 4.01 | 1.44 | 0.89 | 0.90 | 0.96 | 2.57 | 0.02 | 0.08 | 0.35 | 0.33 | 0.37 | 0.57 | **1.33** | **1.50** | **2.28** |
| I | 1.68 | 0.20 | 0.89 | 0.90 | 0.96 | 1.48 | 0.02 | 0.08 | 0.35 | 0.12 | 0.18 | 0.42 | **0.21** | **0.30** | **0.71** |
| J | 3.87 | 1.50 | 0.89 | 0.90 | 0.96 | 2.37 | 0.02 | 0.08 | 0.35 | 0.36 | 0.40 | 0.59 | **1.38** | **1.54** | **2.27** |
| K | 1.83 | 0.56 | 0.89 | 0.90 | 0.96 | 1.27 | 0.02 | 0.08 | 0.35 | 0.29 | 0.33 | 0.54 | **0.52** | **0.61** | **0.98** |
| L | 2.20 | 0.74 | 0.89 | 0.90 | 0.96 | 1.46 | 0.02 | 0.08 | 0.35 | 0.31 | 0.36 | 0.56 | **0.69** | **0.78** | **1.22** |
| M | 4.10 | 1.43 | 0.89 | 0.90 | 0.96 | 2.67 | 0.02 | 0.08 | 0.35 | 0.32 | 0.37 | 0.56 | **1.33** | **1.50** | **2.31** |
| N | 3.00 | 0.50 | 0.89 | 0.90 | 0.96 | 2.50 | 0.02 | 0.08 | 0.35 | 0.17 | 0.22 | 0.45 | **0.50** | **0.65** | **1.36** |
| O | 2.16 | 1.67 | 0.89 | 0.90 | 0.96 | 0.49 | 0.02 | 0.08 | 0.35 | 0.69 | 0.71 | 0.82 | **1.50** | **1.54** | **1.77** |
| P | 0.63 | 0.10 | 0.89 | 0.90 | 0.96 | 0.53 | 0.02 | 0.08 | 0.35 | 0.16 | 0.21 | 0.45 | **0.10** | **0.13** | **0.28** |
| Q | 0.50 | 0.10 | 0.89 | 0.90 | 0.96 | 0.40 | 0.02 | 0.08 | 0.35 | 0.19 | 0.24 | 0.47 | **0.10** | **0.12** | **0.24** |
| R | 0.33 | 0.04 | 0.89 | 0.90 | 0.96 | 0.29 | 0.02 | 0.08 | 0.35 | 0.13 | 0.18 | 0.42 | **0.04** | **0.06** | **0.14** |
| S | 0.54 | 0.10 | 0.89 | 0.90 | 0.96 | 0.44 | 0.02 | 0.08 | 0.35 | 0.18 | 0.23 | 0.46 | **0.10** | **0.13** | **0.25** |
| T | 11.19 | 0.00 | 0.89 | 0.90 | 0.96 | 11.19 | 0.02 | 0.08 | 0.35 | 0.02 | 0.08 | 0.35 | **0.22** | **0.90** | **3.92** |
| OS-1 | 1.18 | 0.15 | 0.89 | 0.90 | 0.96 | 1.03 | 0.02 | 0.08 | 0.35 | 0.13 | 0.18 | 0.43 | **0.15** | **0.22** | **0.50** |

Add a row at the bottom here to sum up the two Area columns.

2.6 ac on drainage map on last page of FDR.

JOB NAME: ***STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1***

JOB NUMBER: ***1183.23***

DATE: ***03/28/03***

CALC'D BY: ***DLG***

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

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5} \qquad \text{Tc=L/V}$$

**Table 6-7. Conveyance Coefficient, $C_v$**

| Type of Land Surface | $C_v$ |
|---|---|
| Heavy meadow | 2.5 |
| Tillage/field | 5 |
| Riprap (not buried)* | 6.5 |
| Short pasture and lawns | 7 |
| Nearly bare ground | 10 |
| Grassed waterway | 15 |
| Paved areas and shallow paved swales | 20 |

$t_c = \frac{L}{180} + 10$

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

## FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED | | | OVERLAND | | | | STREET / CHANNEL FLOW | | | | Tc | INTENSITY | | | TOTAL FLOWS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CA(2) | CA(5) | CA(100) | C(5) | Length (ft) | Height (ft) | Tc (min) | Length (ft) | Slope (%) | Velocity (fps) | Tc (min) | TOTAL (min) | I(2) (in/hr) | I(5) (in/hr) | I(100) (in/hr) | Q(2) (cfs) | Q(5) (cfs) | Q(100) (cfs) |
| A | 0.87 | 1.02 | 1.73 | 0.08 | 100 | 2 | 14.7 | 300 | 2.0% | 2.8 | 1.8 | 16.4 | 2.70 | 3.39 | 5.68 | 2.3 | **3.5** | **9.9** |
| B | 1.54 | 1.76 | 2.76 | 0.08 | 100 | 2.5 | 13.6 | 300 | 2.0% | 2.8 | 1.8 | 15.4 | 2.78 | 3.48 | 5.85 | 4.3 | **6.1** | **16.1** |
| C | 0.13 | 0.24 | 0.73 | 0.08 | 75 | 2 | 11.5 | 0 | 0.0% | 0.0 | 0.0 | 11.5 | 3.12 | 3.91 | 6.57 | 0.4 | **0.9** | **4.8** |
| D | 0.18 | 0.18 | 0.19 | 0.08 | 5 | 0.2 | 2.6 | 300 | 2.0% | 2.8 | 1.8 | 5.0 | 4.12 | 5.17 | 8.68 | 0.7 | **0.9** | **1.7** |
| E | 0.13 | 0.53 | 2.32 | 0.08 | 100 | 7 | 9.7 | 0 | 0.0% | 0.0 | 0.0 | 9.7 | 3.33 | 4.18 | 7.01 | 0.4 | **2.2** | **16.3** |
| F | 0.44 | 0.44 | 0.47 | 0.08 | 5 | 0.2 | 2.6 | 300 | 2.0% | 2.8 | 1.8 | 5.0 | 4.12 | 5.17 | 8.68 | 1.8 | **2.3** | **4.1** |
| G | 0.14 | 0.14 | 0.15 | 0.08 | 5 | 0.2 | 2.6 | 100 | 2.0% | 2.8 | 0.6 | 5.0 | 4.12 | 5.17 | 8.68 | 0.6 | **0.7** | **1.3** |
| H | 1.33 | 1.50 | 2.28 | 0.08 | 100 | 4 | 11.7 | 300 | 2.0% | 2.8 | 1.8 | 13.4 | 2.94 | 3.69 | 6.19 | 3.9 | **5.5** | **14.1** |
| I | 0.21 | 0.30 | 0.71 | 0.08 | 100 | 4 | 11.7 | 100 | 2.0% | 2.8 | 0.6 | 12.2 | 3.05 | 3.83 | 6.42 | 0.6 | **1.1** | **4.6** |
| J | 1.38 | 1.54 | 2.27 | 0.08 | 100 | 4 | 11.7 | 300 | 2.0% | 2.8 | 1.8 | 13.4 | 2.94 | 3.69 | 6.19 | 4.1 | **5.7** | **14.0** |
| K | 0.52 | 0.61 | 0.98 | 0.08 | 100 | 4 | 11.7 | 300 | 2.0% | 2.8 | 1.8 | 13.4 | 2.94 | 3.69 | 6.19 | 1.5 | **2.2** | **6.1** |
| L | 0.69 | 0.78 | 1.22 | 0.08 | 100 | 4 | 11.7 | 300 | 2.0% | 2.8 | 1.8 | 13.4 | 2.94 | 3.69 | 6.19 | 2.0 | **2.9** | **7.6** |
| M | 1.33 | 1.50 | 2.31 | 0.08 | 100 | 4 | 11.7 | 300 | 2.0% | 2.8 | 1.8 | 13.4 | 2.94 | 3.69 | 6.19 | 3.9 | **5.5** | **14.3** |
| N | 0.50 | 0.65 | 1.36 | 0.08 | 100 | 2 | 14.7 | 0 | 0.0% | 0.0 | 0.0 | 14.7 | 2.84 | 3.56 | 5.97 | 1.4 | **2.3** | **8.1** |
| O | 1.50 | 1.54 | 1.77 | 0.08 | 80 | 5 | 9.0 | 300 | 2.0% | 2.8 | 1.8 | 10.8 | 3.21 | 4.02 | 6.75 | 4.8 | **6.2** | **12.0** |
| P | 0.10 | 0.13 | 0.28 | 0.08 | 5 | 0.2 | 2.6 | 0 | 0.0% | 0.0 | 0.0 | 5.0 | 4.12 | 5.17 | 8.68 | 0.4 | **0.7** | **2.4** |

JOB NAME: ***STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1***

JOB NUMBER: ***1183.23***

DATE: ***03/28/03***

CALC'D BY: ***DLG***

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

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5} \qquad \text{Tc=L/V}$$

**Table 6-7. Conveyance Coefficient, $C_v$**

| Type of Land Surface | $C_v$ |
|---|---|
| Heavy meadow | 2.5 |
| Tillage/field | 5 |
| Riprap (not buried)* | 6.5 |
| Short pasture and lawns | 7 |
| Nearly bare ground | 10 |
| Grassed waterway | 15 |
| Paved areas and shallow paved swales | 20 |

$t_c = \frac{L}{180} + 10$

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

## FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

| BASIN | WEIGHTED | | | OVERLAND | | | | STREET / CHANNEL FLOW | | | | Tc | INTENSITY | | | TOTAL FLOWS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CA(2) | CA(5) | CA(100) | C(5) | Length (ft) | Height (ft) | Tc (min) | Length (ft) | Slope (%) | Velocity (fps) | Tc (min) | TOTAL (min) | I(2) (in/hr) | I(5) (in/hr) | I(100) (in/hr) | Q(2) (cfs) | Q(5) (cfs) | Q(100) (cfs) |
| Q | 0.10 | 0.12 | 0.24 | 0.08 | 5 | 0.5 | 1.9 | 0 | 0.0% | 0.0 | 0.0 | 5.0 | 4.12 | 5.17 | 8.68 | 0.4 | **0.6** | **2.0** |
| R | 0.04 | 0.06 | 0.14 | 0.08 | 100 | 4 | 11.7 | 50 | 2.0% | 2.8 | 0.3 | 11.9 | 3.08 | 3.86 | 6.48 | 0.1 | **0.2** | **0.9** |
| S | 0.10 | 0.13 | 0.25 | 0.08 | 100 | 4 | 11.7 | 50 | 2.0% | 2.8 | 0.3 | 11.9 | 3.08 | 3.86 | 6.48 | 0.3 | **0.5** | **1.6** |
| T | 0.22 | 0.90 | 3.92 | 0.08 | 100 | 4 | 11.7 | 0 | 2.0% | 0.0 | 0.0 | 11.7 | 3.11 | 3.90 | 6.55 | 0.7 | **3.5** | **25.6** |
| OS-1 | 0.15 | 0.22 | 0.50 | 0.08 | 100 | 2 | 14.7 | 0 | 0.0% | 0.0 | 0.0 | 14.7 | 2.84 | 3.56 | 5.97 | 0.4 | **0.8** | **3.0** |

JOB NAME: *STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1*
JOB NUMBER: *1183.23*
DATE: *12/07/22*
CALCULATED BY: *DLG*

## FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

| Design Point(s) | Contributing Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | I(5) | I(100) | Q(5) | Q(100) | Inlet Size |
| 1 | BASIN B | 1.76 | 2.76 | 15.4 | 3.48 | 5.85 | 6.1 | 16.1 | 10' TYPE R PUBLIC |
| 2 | BASIN A | 1.02 | 1.73 | 16.4 | 3.39 | 5.68 | 3.5 | 9.9 | 10' TYPE R PUBLIC |
| 3 | BASIN J | 1.54 | 2.27 | 13.4 | 3.69 | 6.19 | 5.7 | 14.0 | 10' TYPE R PUBLIC |
| 4 | BASIN K | 0.61 | 0.98 | 13.4 | 3.69 | 6.19 | 2.2 | 6.1 | 5' TYPE R PUBLIC |
| 5 | BASIN F & BASIN OS-3 | 0.66 | 0.97 | 14.7 | 3.56 | 5.97 | 2.3 | 5.8 | 5' TYPE R PUBLIC |
| 6 | BASIN G | 0.14 | 0.15 | 5.0 | 5.17 | 8.68 | 0.7 | 1.3 | 5' TYPE R PUBLIC |
| 7 | BASIN H | 1.50 | 2.28 | 13.4 | 3.69 | 6.19 | 5.5 | 14.1 | 10' TYPE R PUBLIC |
| 8 | BASIN I | 0.30 | 0.71 | 12.2 | 3.83 | 6.42 | 1.1 | 4.6 | 5' TYPE R PUBLIC |
| 9 | BASIN M & BASIN N | 2.15 | 3.66 | 14.7 | 3.56 | 5.97 | 7.6 | 21.9 | 15' TYPE R PUBLIC |
| 10 | BASIN L & FLOWBY DP 9 | 1.00 | 2.62 | 14.7 | 3.56 | 5.97 | 3.6 | 15.7 | 15' TYPE R PUBLIC |
| 11 | BASIN T & PIPE 17 | 11.48 | 20.64 | 16.4 | 3.39 | 5.68 | 39 | 117 | POND IN |

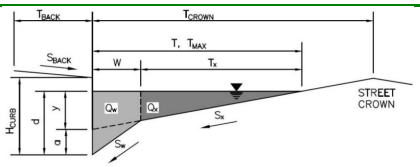
*MHFD-Inlet, Version 5.01 (April 2021)*

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 1**




Gutter Geometry:

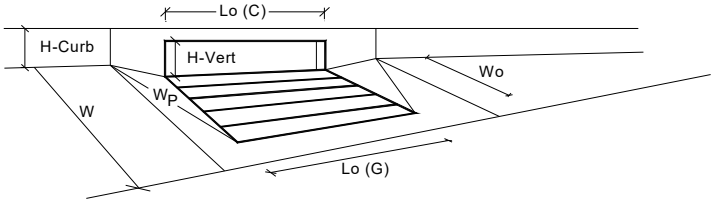
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 7.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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 = | 6.0 | 7.8 | 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) = | 10.00 | 10.00 | 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.57 | 0.74 | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 0.93 | 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) | **$Q_a$ =** | **11.5** | **18.7** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 6.1 | 16.1 | cfs |

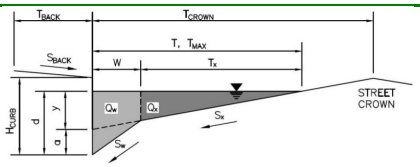
*MHFD-Inlet, Version 5.01 (April 2021)*

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 2**




Gutter Geometry:

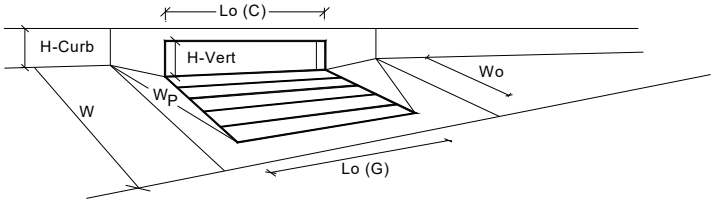
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 7.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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 = | 6.0 | 7.8 | 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) = | 10.00 | 10.00 | 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.57 | 0.74 | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 0.93 | 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) | **$Q_a$ =** | **11.5** | **18.7** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 3.5 | 9.9 | cfs |

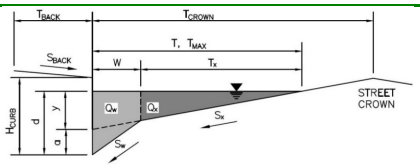
*MHFD-Inlet, Version 5.01 (April 2021)*

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 3**




Gutter Geometry:

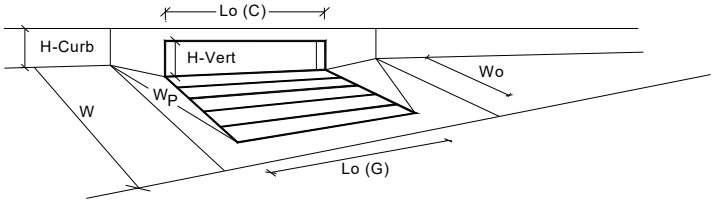
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 7.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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 = | 6.0 | 7.8 | 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) = | 10.00 | 10.00 | 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.57 | 0.74 | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 0.93 | 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) | **$Q_a$ =** | **11.5** | **18.7** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 5.7 | 14.0 | cfs |

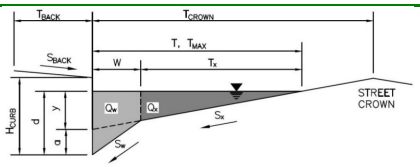
*MHFD-Inlet, Version 5.01 (April 2021)*

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 4**




Gutter Geometry:

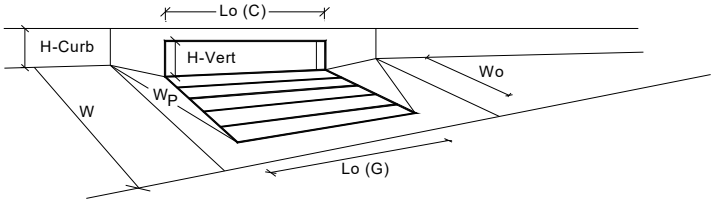
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 7.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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 = | 6.0 | 7.8 | 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 |
| 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.77 | 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) | **$Q_a$ =** | **7.5** | **9.9** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 2.2 | 6.1 | cfs |

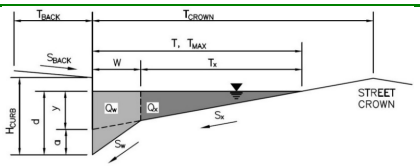
*MHFD-Inlet, Version 5.01 (April 2021)*

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 5**




Gutter Geometry:

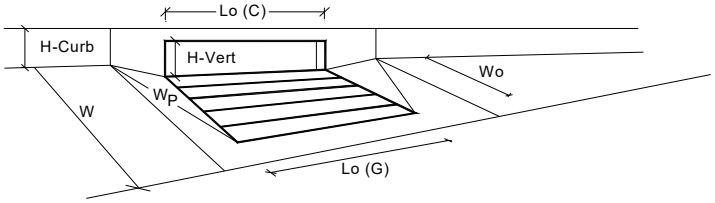
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 6.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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)*



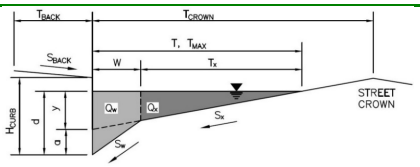

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | Ponding Depth = | 6.0 | 7.8 | 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 |
| 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.77 | 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) | **$Q_a$ =** | **7.5** | **9.9** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 2.3 | 5.8 | cfs |

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 6**




Gutter Geometry:

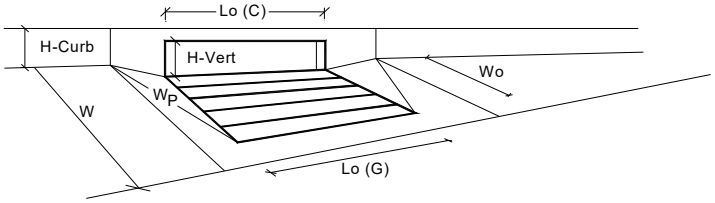
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 7.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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 = | 6.0 | 7.8 | 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 |
| 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.77 | 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) | **$Q_a$ =** | **7.5** | **9.9** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 0.7 | 1.3 | cfs |

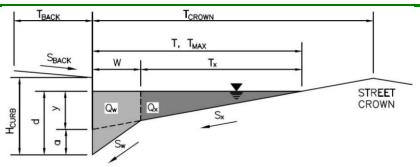
*MHFD-Inlet, Version 5.01 (April 2021)*

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 7**




Gutter Geometry:

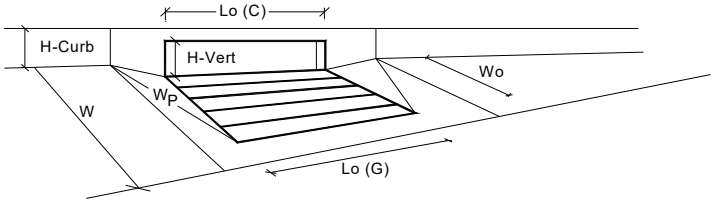
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 7.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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 = | 6.0 | 7.8 | 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) = | 10.00 | 10.00 | 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.57 | 0.74 | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 0.93 | 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) | **$Q_a$ =** | **11.5** | **18.7** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 5.5 | 14.1 | cfs |

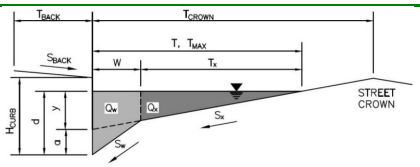
*MHFD-Inlet, Version 5.01 (April 2021)*

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 8**




Gutter Geometry:

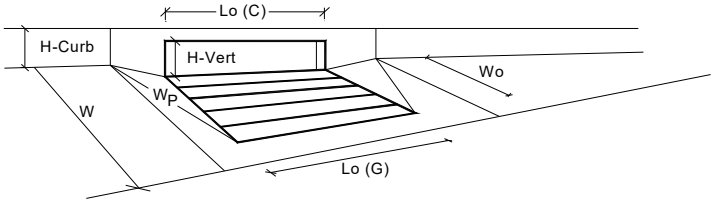
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 7.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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)*



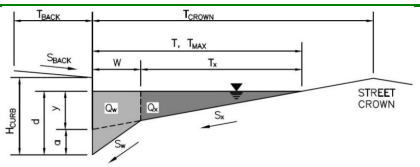

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | Ponding Depth = | 6.0 | 7.8 | 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 |
| 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.77 | 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) | **$Q_a$ =** | **7.5** | **9.9** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 1.1 | 4.6 | cfs |

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **AT GRADE INLET 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) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☑ | |

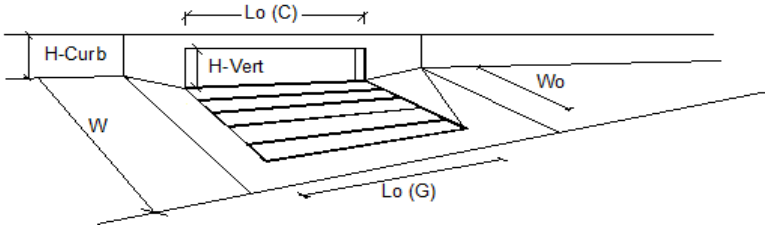
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | $Q_{allow}$ = | **14.4** | **50.4** | **cfs** |

**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) | $L_o$ = | 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 | |
|---|---|---|---|---|
| Total Inlet Interception Capacity | **Q =** | **7.1** | **13.2** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.5** | **8.7** | **cfs** |
| Capture Percentage = $Q_a/Q_o$ = | **C% =** | **93** | **60** | **%** |

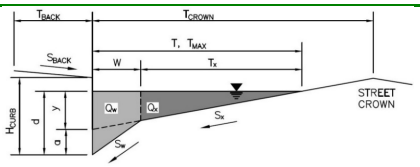
*MHFD-Inlet, Version 5.01 (April 2021)*

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

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

**Project:** **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**

**Inlet ID:** **INLET DP 10**




Gutter Geometry:

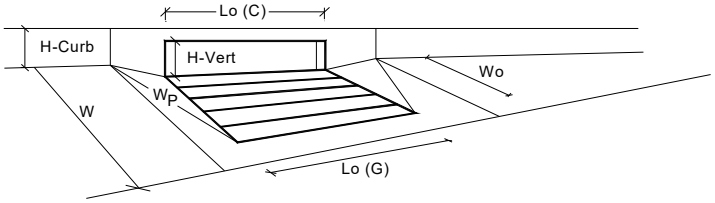
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | 7.5 | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | 0.020 | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.013 | |
| 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) | $S_W$ = | 0.042 | 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 | $T_{MAX}$ = | 17.0 | 17.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 7.8 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | 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 = | 6.0 | 7.8 | 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 | |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.42 | 0.57 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | 0.57 | 0.74 | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 0.79 | 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) | **$Q_a$ =** | **13.5** | **24.1** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 3.6 | 15.7 | cfs |

JOB NAME: ***STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1***
JOB NUMBER: ***1183.23***
DATE: ***12/07/22***
CALCULATED BY: ***DLG***

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

## FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

| Pipe Run | Contributing Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Pipe Size* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| 1 | DP 1 | 1.76 | 2.76 | 15.38 | 3.48 | 5.85 | 6.1 | 16.1 | 24" PUBLIC RCP STORM |
| 2 | DP 2 | 1.02 | 1.73 | 16.42 | 3.39 | 5.68 | 3.5 | 9.9 | 18" PUBLIC RCP STORM |
| 3 | PIPE 1 & PIPE 2 | 2.78 | 4.49 | 16.42 | 3.39 | 5.68 | 9.4 | 25.5 | 30" PUBLIC RCP STORM |
| 4 | DP 3 | 1.54 | 2.27 | 13.4 | 3.69 | 6.19 | 5.7 | 14.0 | 24" PUBLIC RCP STORM |
| 5 | DP 4 | 0.61 | 0.98 | 13.4 | 3.69 | 6.19 | 2.2 | 6.1 | 18" PUBLIC RCP STORM |
| 6 | PIPE 3, PIPE 4 & PIPE 5 | 4.93 | 7.74 | 16.4 | 3.39 | 5.68 | 16.7 | 44.0 | 30" PUBLIC RCP STORM |
| 7 | DP 5 | 0.66 | 0.97 | 14.7 | 3.56 | 5.97 | 2.3 | 5.8 | 18" PUBLIC RCP STORM |
| 8 | DP 6 | 0.14 | 0.15 | 5.0 | 5.17 | 8.68 | 0.7 | 1.3 | 18" PUBLIC RCP STORM |
| 9 | PIPE 7 & PIPE 8 | 0.80 | 1.13 | 14.7 | 3.56 | 5.97 | 2.9 | 6.7 | 18" PUBLIC RCP STORM |
| 10 | DP 7 | 1.50 | 2.28 | 13.4 | 3.69 | 6.19 | 5.5 | 14.1 | 24" PUBLIC RCP STORM |
| 11 | DP 8 | 0.30 | 0.71 | 12.2 | 3.83 | 6.42 | 1.1 | 4.6 | 18" PUBLIC RCP STORM |
| 12 | PIPE 9, PIPE 10, PIPE 11 | 2.60 | 4.12 | 14.7 | 3.56 | 5.97 | 9.3 | 24.6 | 24" PUBLIC RCP STORM |
| 13 | PIPE 6 & PIPE 12 | 7.53 | 11.86 | 16.4 | 3.39 | 5.68 | 25.5 | 67.4 | 36" PUBLIC RCP STORM |
| 14 | DP 9 INTERCEPTED | 2.05 | 2.23 | 14.7 | 3.56 | 5.97 | 7.3 | 13.3 | 24" PUBLIC RCP STORM |

JOB NAME: ***STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1***
JOB NUMBER: ***1183.23***
DATE: ***12/07/22***
CALCULATED BY: ***DLG***

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

## FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

| Pipe Run | Contributing Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity | | Flow | | Pipe Size* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | I(5) | I(100) | Q(5) | Q(100) | |
| 15 | PIPE 13 & PIPE 14 | 9.58 | 14.10 | 16.4 | 3.39 | 5.68 | 32.4 | 80.1 | 42" PUBLIC RCP STORM |
| 16 | DP 10 | 1.00 | 2.62 | 14.7 | 3.56 | 5.97 | 3.6 | 15.7 | 24" PUBLIC RCP STORM |
| 17 | PIPE 15 & PIPE 16 | 10.58 | 16.72 | 16.4 | 3.39 | 5.68 | 35.8 | 95.0 | 42" PUBLIC RCP STORM |

# Worksheet for Pipe Run - 1

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 24.0 in |
| Discharge | 16.10 cfs |

| Results | |
|---|---|
| Normal Depth | 15.0 in |
| Flow Area | 2.1 ft² |
| Wetted Perimeter | 3.6 ft |
| Hydraulic Radius | 6.8 in |
| Top Width | 1.94 ft |
| Critical Depth | 17.4 in |
| Percent Full | 62.3 % |
| Critical Slope | 0.007 ft/ft |
| Velocity | 7.82 ft/s |
| Velocity Head | 0.95 ft |
| Specific Energy | 2.20 ft |
| Froude Number | 1.338 |
| Maximum Discharge | 24.33 cfs |
| Discharge Full | 22.62 cfs |
| Slope Full | 0.005 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 62.3 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 15.0 in |
| Critical Depth | 17.4 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.007 ft/ft |

# Worksheet for Pipe Run - 2

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.010 | ft/ft |
| Diameter | 18.0 | in |
| Discharge | 9.90 | cfs |

| Results | | |
|---|---|---|
| Normal Depth | 13.9 | in |
| Flow Area | 1.5 | $ft^2$ |
| Wetted Perimeter | 3.2 | ft |
| Hydraulic Radius | 5.5 | in |
| Top Width | 1.26 | ft |
| Critical Depth | 14.6 | in |
| Percent Full | 77.2 | % |
| Critical Slope | 0.009 | ft/ft |
| Velocity | 6.76 | ft/s |
| Velocity Head | 0.71 | ft |
| Specific Energy | 1.87 | ft |
| Froude Number | 1.104 | |
| Maximum Discharge | 11.30 | cfs |
| Discharge Full | 10.50 | cfs |
| Slope Full | 0.009 | ft/ft |
| Flow Type | Supercritical | |

| GVF Input Data | | |
|---|---|---|
| Downstream Depth | 0.0 | in |
| Length | 0.0 | ft |
| Number Of Steps | 0 | |

| GVF Output Data | | |
|---|---|---|
| Upstream Depth | 0.0 | in |
| Profile Description | N/A | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.0 | % |
| Normal Depth Over Rise | 77.2 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 13.9 | in |
| Critical Depth | 14.6 | in |
| Channel Slope | 0.010 | ft/ft |
| Critical Slope | 0.009 | ft/ft |

# Worksheet for Pipe Run - 3

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.005 | ft/ft |
| Diameter | 30.0 | in |
| Discharge | 25.50 | cfs |

| Results | | |
|---|---|---|
| Normal Depth | 21.8 | in |
| Flow Area | 3.8 | ft² |
| Wetted Perimeter | 5.1 | ft |
| Hydraulic Radius | 9.0 | in |
| Top Width | 2.23 | ft |
| Critical Depth | 20.7 | in |
| Percent Full | 72.8 | % |
| Critical Slope | 0.006 | ft/ft |
| Velocity | 6.67 | ft/s |
| Velocity Head | 0.69 | ft |
| Specific Energy | 2.51 | ft |
| Froude Number | 0.896 | |
| Maximum Discharge | 31.20 | cfs |
| Discharge Full | 29.00 | cfs |
| Slope Full | 0.004 | ft/ft |
| Flow Type | Subcritical | |

| GVF Input Data | | |
|---|---|---|
| Downstream Depth | 0.0 | in |
| Length | 0.0 | ft |
| Number Of Steps | 0 | |

| GVF Output Data | | |
|---|---|---|
| Upstream Depth | 0.0 | in |
| Profile Description | N/A | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.0 | % |
| Normal Depth Over Rise | 57.1 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 21.8 | in |
| Critical Depth | 20.7 | in |
| Channel Slope | 0.005 | ft/ft |
| Critical Slope | 0.006 | ft/ft |

# Worksheet for Pipe Run - 4

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.005 | ft/ft |
| Diameter | 24.0 | in |
| Discharge | 14.00 | cfs |

| Results | | |
|---|---|---|
| Normal Depth | 17.4 | in |
| Flow Area | 2.4 | $ft^2$ |
| Wetted Perimeter | 4.1 | ft |
| Hydraulic Radius | 7.2 | in |
| Top Width | 1.79 | ft |
| Critical Depth | 16.2 | in |
| Percent Full | 72.5 | % |
| Critical Slope | 0.006 | ft/ft |
| Velocity | 5.74 | ft/s |
| Velocity Head | 0.51 | ft |
| Specific Energy | 1.96 | ft |
| Froude Number | 0.866 | |
| Maximum Discharge | 17.21 | cfs |
| Discharge Full | 16.00 | cfs |
| Slope Full | 0.004 | ft/ft |
| Flow Type | Subcritical | |

| GVF Input Data | | |
|---|---|---|
| Downstream Depth | 0.0 | in |
| Length | 0.0 | ft |
| Number Of Steps | 0 | |

| GVF Output Data | | |
|---|---|---|
| Upstream Depth | 0.0 | in |
| Profile Description | N/A | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.0 | % |
| Normal Depth Over Rise | 49.0 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 17.4 | in |
| Critical Depth | 16.2 | in |
| Channel Slope | 0.005 | ft/ft |
| Critical Slope | 0.006 | ft/ft |

# Worksheet for Pipe Run - 5

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.005 ft/ft |
| Diameter | 18.0 in |
| Discharge | 6.10 cfs |

| Results | |
|---|---|
| Normal Depth | 12.4 in |
| Flow Area | 1.3 ft² |
| Wetted Perimeter | 2.9 ft |
| Hydraulic Radius | 5.3 in |
| Top Width | 1.39 ft |
| Critical Depth | 11.5 in |
| Percent Full | 69.0 % |
| Critical Slope | 0.006 ft/ft |
| Velocity | 4.69 ft/s |
| Velocity Head | 0.34 ft |
| Specific Energy | 1.38 ft |
| Froude Number | 0.854 |
| Maximum Discharge | 7.99 cfs |
| Discharge Full | 7.43 cfs |
| Slope Full | 0.003 ft/ft |
| Flow Type | Subcritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 42.8 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 12.4 in |
| Critical Depth | 11.5 in |
| Channel Slope | 0.005 ft/ft |
| Critical Slope | 0.006 ft/ft |

# Worksheet for Pipe Run - 6

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 30.0 in |
| Discharge | 44.00 cfs |

| Results | |
|---|---|
| Normal Depth | 27.5 in |
| Flow Area | 4.7 ft² |
| Wetted Perimeter | 6.4 ft |
| Hydraulic Radius | 8.8 in |
| Top Width | 1.37 ft |
| Critical Depth | 26.5 in |
| Percent Full | 91.8 % |
| Critical Slope | 0.010 ft/ft |
| Velocity | 9.33 ft/s |
| Velocity Head | 1.35 ft |
| Specific Energy | 3.65 ft |
| Froude Number | 0.886 |
| Maximum Discharge | 44.12 cfs |
| Discharge Full | 41.01 cfs |
| Slope Full | 0.012 ft/ft |
| Flow Type | Subcritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 42.8 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 27.5 in |
| Critical Depth | 26.5 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.010 ft/ft |

# Worksheet for Pipe Run - 7

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 18.0 in |
| Discharge | 5.80 cfs |

| Results | |
|---|---|
| Normal Depth | 9.5 in |
| Flow Area | 1.0 ft² |
| Wetted Perimeter | 2.4 ft |
| Hydraulic Radius | 4.7 in |
| Top Width | 1.50 ft |
| Critical Depth | 11.2 in |
| Percent Full | 53.0 % |
| Critical Slope | 0.006 ft/ft |
| Velocity | 6.09 ft/s |
| Velocity Head | 0.58 ft |
| Specific Energy | 1.37 ft |
| Froude Number | 1.347 |
| Maximum Discharge | 11.30 cfs |
| Discharge Full | 10.50 cfs |
| Slope Full | 0.003 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 53.0 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 9.5 in |
| Critical Depth | 11.2 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.006 ft/ft |

# Worksheet for Pipe Run - 8

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 18.0 in |
| Discharge | 1.30 cfs |

| Results | |
|---|---|
| Normal Depth | 4.3 in |
| Flow Area | 0.3 ft² |
| Wetted Perimeter | 1.5 ft |
| Hydraulic Radius | 2.5 in |
| Top Width | 1.28 ft |
| Critical Depth | 5.1 in |
| Percent Full | 23.8 % |
| Critical Slope | 0.005 ft/ft |
| Velocity | 4.04 ft/s |
| Velocity Head | 0.25 ft |
| Specific Energy | 0.61 ft |
| Froude Number | 1.420 |
| Maximum Discharge | 11.30 cfs |
| Discharge Full | 10.50 cfs |
| Slope Full | 0.000 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 23.8 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 4.3 in |
| Critical Depth | 5.1 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.005 ft/ft |

# Worksheet for Pipe Run - 9

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 18.0 in |
| Discharge | 6.70 cfs |

| Results | |
|---|---|
| Normal Depth | 10.4 in |
| Flow Area | 1.1 ft² |
| Wetted Perimeter | 2.6 ft |
| Hydraulic Radius | 4.9 in |
| Top Width | 1.48 ft |
| Critical Depth | 12.0 in |
| Percent Full | 58.0 % |
| Critical Slope | 0.007 ft/ft |
| Velocity | 6.30 ft/s |
| Velocity Head | 0.62 ft |
| Specific Energy | 1.49 ft |
| Froude Number | 1.311 |
| Maximum Discharge | 11.30 cfs |
| Discharge Full | 10.50 cfs |
| Slope Full | 0.004 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 58.0 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 10.4 in |
| Critical Depth | 12.0 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.007 ft/ft |

# Worksheet for Pipe Run - 10

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 24.0 in |
| Discharge | 14.10 cfs |

| Results | |
|---|---|
| Normal Depth | 13.7 in |
| Flow Area | 1.9 ft² |
| Wetted Perimeter | 3.4 ft |
| Hydraulic Radius | 6.5 in |
| Top Width | 1.98 ft |
| Critical Depth | 16.2 in |
| Percent Full | 57.2 % |
| Critical Slope | 0.006 ft/ft |
| Velocity | 7.59 ft/s |
| Velocity Head | 0.90 ft |
| Specific Energy | 2.04 ft |
| Froude Number | 1.382 |
| Maximum Discharge | 24.33 cfs |
| Discharge Full | 22.62 cfs |
| Slope Full | 0.004 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 57.2 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 13.7 in |
| Critical Depth | 16.2 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.006 ft/ft |

# Worksheet for Pipe Run - 11

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 18.0 in |
| Discharge | 4.60 cfs |

| Results | |
|---|---|
| Normal Depth | 8.3 in |
| Flow Area | 0.8 ft² |
| Wetted Perimeter | 2.2 ft |
| Hydraulic Radius | 4.3 in |
| Top Width | 1.50 ft |
| Critical Depth | 9.9 in |
| Percent Full | 46.3 % |
| Critical Slope | 0.006 ft/ft |
| Velocity | 5.75 ft/s |
| Velocity Head | 0.51 ft |
| Specific Energy | 1.21 ft |
| Froude Number | 1.386 |
| Maximum Discharge | 11.30 cfs |
| Discharge Full | 10.50 cfs |
| Slope Full | 0.002 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 46.3 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 8.3 in |
| Critical Depth | 9.9 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.006 ft/ft |

# Worksheet for Pipe Run - 12

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.020 ft/ft |
| Diameter | 24.0 in |
| Discharge | 24.60 cfs |

| Results | |
|---|---|
| Normal Depth | 15.8 in |
| Flow Area | 2.2 ft² |
| Wetted Perimeter | 3.8 ft |
| Hydraulic Radius | 6.9 in |
| Top Width | 1.90 ft |
| Critical Depth | 21.0 in |
| Percent Full | 65.8 % |
| Critical Slope | 0.011 ft/ft |
| Velocity | 11.23 ft/s |
| Velocity Head | 1.96 ft |
| Specific Energy | 3.27 ft |
| Froude Number | 1.843 |
| Maximum Discharge | 34.41 cfs |
| Discharge Full | 31.99 cfs |
| Slope Full | 0.012 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 65.8 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 15.8 in |
| Critical Depth | 21.0 in |
| Channel Slope | 0.020 ft/ft |
| Critical Slope | 0.011 ft/ft |

# Worksheet for Pipe Run - 13

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 36.0 in |
| Discharge | 67.40 cfs |

| Results | |
|---|---|
| Normal Depth | 29.9 in |
| Flow Area | 6.3 ft² |
| Wetted Perimeter | 6.9 ft |
| Hydraulic Radius | 10.9 in |
| Top Width | 2.26 ft |
| Critical Depth | 31.5 in |
| Percent Full | 83.0 % |
| Critical Slope | 0.009 ft/ft |
| Velocity | 10.75 ft/s |
| Velocity Head | 1.80 ft |
| Specific Energy | 4.29 ft |
| Froude Number | 1.137 |
| Maximum Discharge | 71.74 cfs |
| Discharge Full | 66.69 cfs |
| Slope Full | 0.010 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 83.0 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 29.9 in |
| Critical Depth | 31.5 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.009 ft/ft |

# Worksheet for Pipe Run - 14

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 24.0 in |
| Discharge | 13.30 cfs |

| Results | |
|---|---|
| Normal Depth | 13.2 in |
| Flow Area | 1.8 ft² |
| Wetted Perimeter | 3.3 ft |
| Hydraulic Radius | 6.4 in |
| Top Width | 1.99 ft |
| Critical Depth | 15.8 in |
| Percent Full | 55.1 % |
| Critical Slope | 0.006 ft/ft |
| Velocity | 7.49 ft/s |
| Velocity Head | 0.87 ft |
| Specific Energy | 1.97 ft |
| Froude Number | 1.398 |
| Maximum Discharge | 24.33 cfs |
| Discharge Full | 22.62 cfs |
| Slope Full | 0.003 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 55.1 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 13.2 in |
| Critical Depth | 15.8 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.006 ft/ft |

# Worksheet for Pipe Run - 15

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.010 | ft/ft |
| Diameter | 42.0 | in |
| Discharge | 80.10 | cfs |

| Results | | |
|---|---|---|
| Normal Depth | 28.3 | in |
| Flow Area | 6.9 | $ft^2$ |
| Wetted Perimeter | 6.7 | ft |
| Hydraulic Radius | 12.3 | in |
| Top Width | 3.28 | ft |
| Critical Depth | 33.6 | in |
| Percent Full | 67.4 | % |
| Critical Slope | 0.007 | ft/ft |
| Velocity | 11.61 | ft/s |
| Velocity Head | 2.09 | ft |
| Specific Energy | 4.45 | ft |
| Froude Number | 1.411 | |
| Maximum Discharge | 108.22 | cfs |
| Discharge Full | 100.60 | cfs |
| Slope Full | 0.006 | ft/ft |
| Flow Type | Supercritical | |

| GVF Input Data | | |
|---|---|---|
| Downstream Depth | 0.0 | in |
| Length | 0.0 | ft |
| Number Of Steps | 0 | |

| GVF Output Data | | |
|---|---|---|
| Upstream Depth | 0.0 | in |
| Profile Description | N/A | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.0 | % |
| Normal Depth Over Rise | 67.4 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 28.3 | in |
| Critical Depth | 33.6 | in |
| Channel Slope | 0.010 | ft/ft |
| Critical Slope | 0.007 | ft/ft |

# Worksheet for Pipe Run - 16

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.010 ft/ft |
| Diameter | 24.0 in |
| Discharge | 15.70 cfs |

| Results | |
|---|---|
| Normal Depth | 14.7 in |
| Flow Area | 2.0 ft² |
| Wetted Perimeter | 3.6 ft |
| Hydraulic Radius | 6.7 in |
| Top Width | 1.95 ft |
| Critical Depth | 17.1 in |
| Percent Full | 61.3 % |
| Critical Slope | 0.007 ft/ft |
| Velocity | 7.78 ft/s |
| Velocity Head | 0.94 ft |
| Specific Energy | 2.17 ft |
| Froude Number | 1.347 |
| Maximum Discharge | 24.33 cfs |
| Discharge Full | 22.62 cfs |
| Slope Full | 0.005 ft/ft |
| Flow Type | Supercritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 61.3 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 14.7 in |
| Critical Depth | 17.1 in |
| Channel Slope | 0.010 ft/ft |
| Critical Slope | 0.007 ft/ft |

# Worksheet for Pipe Run - 17

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Roughness Coefficient | 0.013 |
| Channel Slope | 0.008 ft/ft |
| Diameter | 42.0 in |
| Discharge | 95.00 cfs |

| Results | |
|---|---|
| Normal Depth | 38.1 in |
| Flow Area | 9.2 ft² |
| Wetted Perimeter | 8.8 ft |
| Hydraulic Radius | 12.5 in |
| Top Width | 2.03 ft |
| Critical Depth | 36.1 in |
| Percent Full | 90.8 % |
| Critical Slope | 0.008 ft/ft |
| Velocity | 10.35 ft/s |
| Velocity Head | 1.67 ft |
| Specific Energy | 4.84 ft |
| Froude Number | 0.858 |
| Maximum Discharge | 95.58 cfs |
| Discharge Full | 88.85 cfs |
| Slope Full | 0.009 ft/ft |
| Flow Type | Subcritical |

| GVF Input Data | |
|---|---|
| Downstream Depth | 0.0 in |
| Length | 0.0 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.0 in |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Average End Depth Over Rise | 0.0 % |
| Normal Depth Over Rise | 39.3 % |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 38.1 in |
| Critical Depth | 36.1 in |
| Channel Slope | 0.008 ft/ft |
| Critical Slope | 0.008 ft/ft |

# DETENTION & STORMWATER

# QUALITY POND

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

# 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 | 0.53 | inches | **Designer:** | **dlg** |
| ***Minor Storm: 1-Hour Rain Depth | 5-Year Event | 1.50 | inches | **Company:** | **Classic Consulting** |
| ***Major Storm: 1-Hour Rain Depth | 100-Year Event | 2.52 | inches | **Date:** | **August 17, 2020** |
| Optional User Defined Storm | CUHP | | | **Project:** | **Foursquare at Sterling Ranch East Filing No. 1 & Sterling Ranch East Filing No. 2** |
| (CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm | 100-Year Event | 2.52 | | **Location:** | **Pond 16 INTERIM** |
| Max Intensity for Optional User Defined Storm | 2.51496 | | | | |

**SITE INFORMATION (USER-INPUT)**

| Sub-basin Identifier | FIL 1A | FSQ | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receiving Pervious Area Soil Type | Sand | Sand | | | | | | | | | | | | |
| Total Area (ac., Sum of DCIA, UIA, RPA, & SPA) | 7.470 | 35.040 | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 2.480 | 8.140 | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, acres) | 2.760 | 5.700 | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, acres) | 2.230 | 6.730 | | | | | | | | | | | | |
| Separate Pervious Area (SPA, acres) | 0.000 | 14.470 | | | | | | | | | | | | |
| RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP) | C | C | | | | | | | | | | | | |

**CALCULATED RESULTS (OUTPUT)**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Calculated Area (ac, check against input) | 7.470 | 35.040 | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, %) | 33.2% | 23.2% | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, %) | 36.9% | 16.3% | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, %) | 29.9% | 19.2% | | | | | | | | | | | | |
| Separate Pervious Area (SPA, %) | 0.0% | 41.3% | | | | | | | | | | | | |
| $A_R$ (RPA / UIA) | 0.808 | 1.181 | | | | | | | | | | | | |
| $I_a$ Check | 0.550 | 0.460 | | | | | | | | | | | | |
| f / I for WQCV Event: | 11.0 | 11.0 | | | | | | | | | | | | |
| f / I for 5-Year Event: | 0.6 | 0.6 | | | | | | | | | | | | |
| f / I for 100-Year Event: | 0.6 | 0.6 | | | | | | | | | | | | |
| f / I for Optional User Defined Storm CUHP: | 0.57 | 0.57 | | | | | | | | | | | | |
| IRF for WQCV Event: | 0.63 | 0.58 | | | | | | | | | | | | |
| IRF for 5-Year Event: | 0.87 | 0.85 | | | | | | | | | | | | |
| IRF for 100-Year Event: | 0.88 | 0.86 | | | | | | | | | | | | |
| IRF for Optional User Defined Storm CUHP: | 0.88 | 0.86 | | | | | | | | | | | | |
| Total Site Imperviousness: $I_{total}$ | 70.1% | 39.5% | | | | | | | | | | | | |
| Effective Imperviousness for WQCV Event: | 56.6% | 32.7% | | | | | | | | | | | | |
| Effective Imperviousness for 5-Year Event: | 65.3% | 37.1% | | | | | | | | | | | | |
| Effective Imperviousness for 100-Year Event: | 65.7% | 37.3% | | | | | | | | | | | | |
| Effective Imperviousness for Optional User Defined Storm CUHP: | 65.7% | 37.3% | | | | | | | | | | | | |

**LID / EFFECTIVE IMPERVIOUSNESS CREDITS**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WQCV Event CREDIT: Reduce Detention By: | 18.3% | 10.5% | 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: | 6.0% | 5.7% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| User Defined CUHP CREDIT: Reduce Detention By: | 8.0% | 4.4% | | | | | | | | | | | | |

| | |
|---|---|
| **Total Site Imperviousness:** | **44.9%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **36.9%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **42.0%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **42.3%** |
| **Total Site Effective Imperviousness for Optional User Defined Storm CUHP:** | **42.3%** |

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

Please use the latest UD-BMP spreadsheet (v3.07) and UD-Detention spreadsheet (v4.06)

## Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016) **Sheet 1 of 4**

**Designer:** DLG
**Company:** CLASSIC CONSULTING ENGINEERS
**Date:** December 7, 2022
**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
**Location:** POND 16

Clarify that this is for the interim condition

| | |
|---|---|
| 1. Basin Storage Volume | |
| A) Effective Imperviousness of Tributary Area, $I_a$ | $I_a$ = 42.3 % |
| B) Tributary Area's Imperviousness Ratio (i = $I_a$/ 100 ) | i = 0.423 |
| C) Contributing Watershed Area | Area = 42.510 ac |
| D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm | $d_6$ = 0.42 in |
| E) Design Concept (Select EURV when also designing for flood control) | Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV) |
| F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN}$ = (1.0 * (0.91 * $i^3$ - 1.19 * $i^2$ + 0.78 * i) / 12 * Area ) | $V_{DESIGN}$= 0.659 ac-ft |
| G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER}$ = ($d_6$*($V_{DESIGN}$/0.43)) | $V_{DESIGN\ OTHER}$= 0.643 ac-ft |
| H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired) | $V_{DESIGN\ USER}$= ac-ft |
| I) Predominant Watershed NRCS Soil Group | Choose One: ◉ A ○ B ○ C / D |
| J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A$ = 1.68 * $i^{1.28}$ For HSG B: $EURV_B$ = 1.36 * $i^{1.08}$ For HSG C/D: $EURV_{C/D}$ = 1.20 * $i^{1.08}$ | EURV = 1.978 ac-f t |
| 2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.) | L : W = 2.0 : 1 |
| 3. Basin Side Slopes | |
| A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) | Z = 4.00 ft / ft |
| 4. Inlet | |
| A) Describe means of providing energy dissipation at concentrated inflow locations: | |

Conflicts with what is stated on page 5 above.

## Design Procedure Form: Extended Detention Basin (EDB)



**Designer:** DLG
**Company:** CLASSIC CONSULTING ENGINEERS
**Date:** December 7, 2022
**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
**Location:** POND 16

| | |
|---|---|
| 5. Forebay | |
| A) Minimum Forebay Volume ($V_{FMIN}$ = 3% of the WQCV) | $V_{FMIN}$ = 0.019 ac-ft |
| B) Actual Forebay Volume | $V_F$ = 0.190 ac-ft |
| C) Forebay Depth ($D_F$ = 18 inch maximum) | $D_F$ = 12.0 in |
| D) Forebay Discharge | |
| i) Undetained 100-year Peak Discharge | $Q_{100}$ = 92.70 cfs |
| ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) | $Q_F$ = 1.85 cfs |
| E) Forebay Discharge Design | Choose One: ○ Berm With Pipe ◉ Wall with Rect. Notch ○ Wall with V-Notch Weir (flow too small for berm w/ pipe) |
| F) Discharge Pipe Size (minimum 8-inches) | Calculated $D_P$ = in |
| G) Rectangular Notch Width | Calculated $W_N$ = 9.1 in |
| 6. Trickle Channel | |
| A) Type of Trickle Channel | Choose One: ○ Concrete ○ Soft Bottom |
| F) Slope of Trickle Channel | S = 0.0050 ft / ft |
| 7. Micropool and Outlet Structure | |
| A) Depth of Micropool (2.5-feet minimum) | $D_M$ = 2.5 ft |
| B) Surface Area of Micropool (10 $ft^2$ minimum) | $A_M$ = 650 sq ft |
| C) Outlet Type | Choose One: ◉ Orifice Plate ○ Other (Describe): |
| D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) | $D_{orifice}$ = 3.47 inches |
| E) Total Outlet Area | $A_{ot}$ = 42.47 square inches |

Per DCMv2 – Chap 4.2, trickle channel should at a minimum provide capacity equal to twice the release capacity at the upstream forebay outlet. Show these calcs in the drainage report and revise plans as needed.

check again once plans/calcs are revised per my comments.

## Design Procedure Form: Extended Detention Basin (EDB)



**Designer:** DLG
**Company:** CLASSIC CONSULTING ENGINEERS
**Date:** December 7, 2022
**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
**Location:** POND 16

| | |
|---|---|
| 8. Initial Surcharge Volume | |
| A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches) | $D_{IS}$ = 6 in |
| B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV) | $V_{IS}$ = 84.1 cu ft |
| C) Initial Surcharge Provided Above Micropool | $V_s$ = 325.0 cu ft |
| 9. Trash Rack | |
| A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$ | $A_t$ = 1,176 square inches |
| B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) | *Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.* |
| Other (Y/N): N | |
| C) Ratio of Total Open Area to Total Area (only for type 'Other') | User Ratio = |
| D) Total Water Quality Screen Area (based on screen type) | $A_{total}$ = 1656 sq. in. |
| E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E) | H= 10 feet |
| F) Height of Water Quality Screen ($H_{TR}$) | $H_{TR}$= 148 inches |
| G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended) | $W_{opening}$ = 12.0 inches |

## Design Procedure Form: Extended Detention Basin (EDB)



**Designer:** DLG
**Company:** CLASSIC CONSULTING ENGINEERS
**Date:** December 7, 2022
**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
**Location:** POND 16

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

11. Vegetation

Choose One
- (●) Irrigated
- ( ) Not Irrigated

AVOID PLACING IRRIGATION HEADS IN THE BOTTOM OF THE BASIN

12. Access

A) Describe Sediment Removal Procedures

Notes:

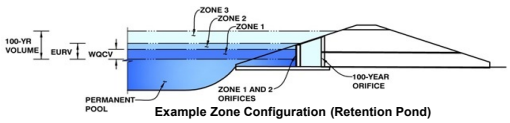
# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.05 (January 2022)*

**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1

**Basin ID:** POND FSD-16 INTERIM

Please use the latest UD-BMP spreadsheet (v3.07) and UD-Detention spreadsheet (v4.06)




**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | EDB | |
| Watershed Area = | 42.51 | acres |
| Watershed Length = | 1,800 | ft |
| Watershed Length to Centroid = | 900 | ft |
| Watershed Slope = | 0.040 | ft/ft |
| Watershed Imperviousness = | 42.30% | 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 | |

Conflicts with what is stated on page 5 above.

Type A is correct

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) = | 0.659 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 1.978 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 1.490 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.999 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 2.405 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 3.135 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 3.848 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 4.774 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.48 in.) = | 7.951 | acre-feet | 3.48 | inches |
| Approximate 2-yr Detention Volume = | 1.263 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 1.670 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 2.054 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 2.539 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 2.862 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 3.296 | acre-feet | | |

Define Zones and Basin Geometry

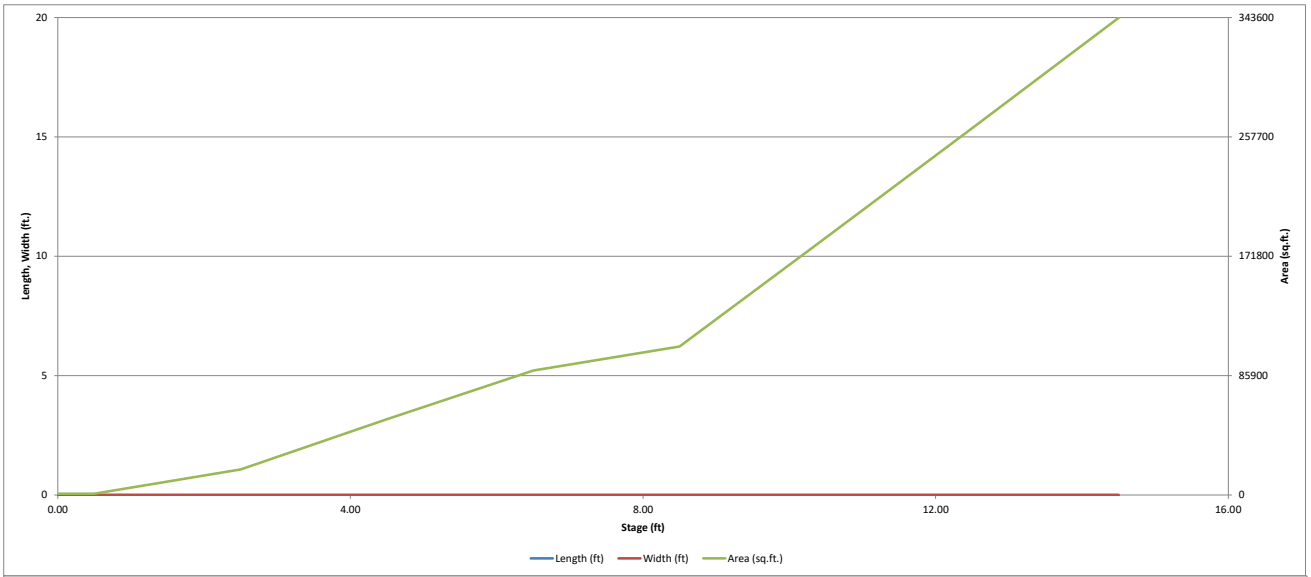
| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.659 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 1.320 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 1.318 | acre-feet |
| Total Detention Basin Volume = | 3.296 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| Initial 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 |

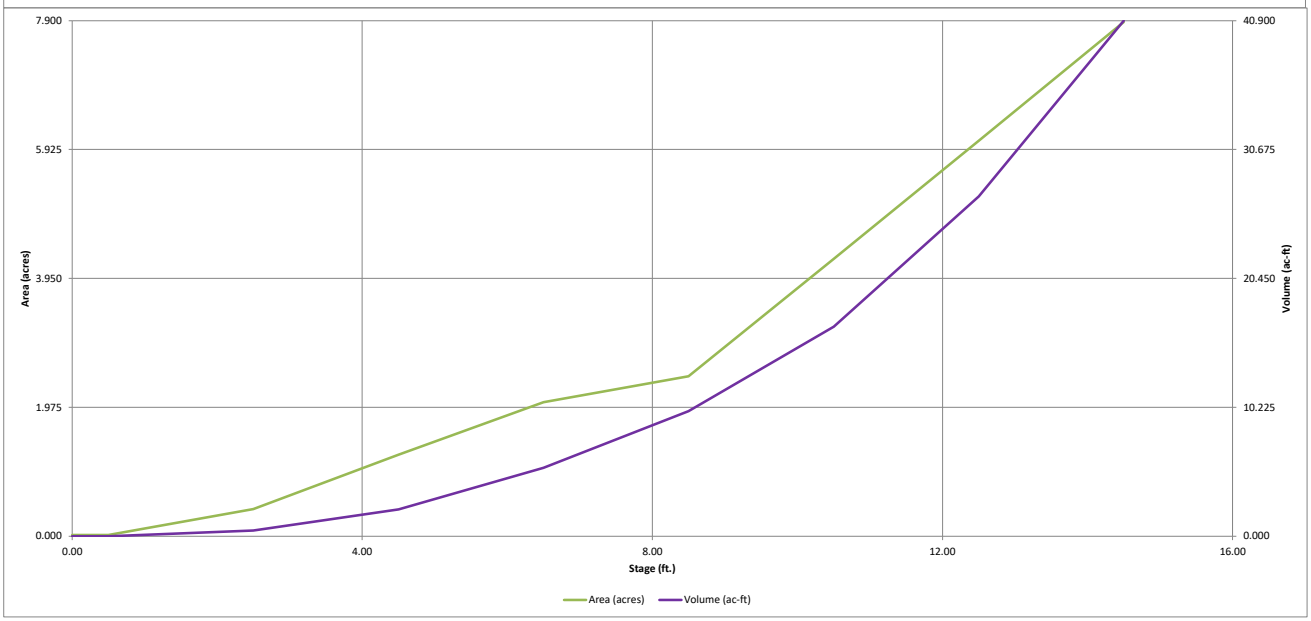
Depth Increment = ft

| 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 | -- | -- | -- | 1,027 | 0.024 | | |
| **7092** | -- | 0.50 | -- | -- | -- | 1,027 | 0.024 | 514 | 0.012 |
| **7094** | -- | 2.50 | -- | -- | -- | 18,288 | 0.420 | 19,828 | 0.455 |
| **7096** | -- | 4.50 | -- | -- | -- | 54,450 | 1.250 | 92,566 | 2.125 |
| **7098** | -- | 6.50 | -- | -- | -- | 89,516 | 2.055 | 236,532 | 5.430 |
| **7100** | -- | 8.50 | -- | -- | -- | 106,783 | 2.451 | 432,831 | 9.936 |
| **7102** | -- | 10.50 | -- | -- | -- | 185,108 | 4.249 | 724,722 | 16.637 |
| **7104** | -- | 12.50 | -- | -- | -- | 263,928 | 6.059 | 1,173,758 | 26.946 |
| **7106** | -- | 14.50 | -- | -- | -- | 343,298 | 7.881 | 1,780,984 | 40.886 |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.05 (January 2022)*



Rows highlighted below identify those that don't match what is shown on plans and details in CDs sheets 21 and 23

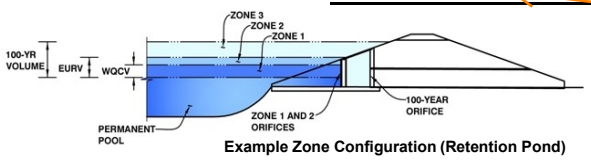
# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.05 (January 2022)*

**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1

**Basin ID:** POND FSD-16 INTERIM

come up with a way (explanation/nomenclature) to clarify that this is the 2nd interim condition, the first being approved and built with CDR221. Otherwise there will be two "interim" condition spreadsheets that represent different snapshots in time/development.




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.91 | 0.659 | Orifice Plate |
| Zone 2 (EURV) | 4.39 | 1.320 | Orifice Plate |
| Zone 3 (100-year) | 5.33 | 1.318 | Weir&Pipe (Restrict) |
| Total (all zones) | | 3.296 | |

**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 = | N/A | ft² |
| Depth at top of Zone using Orifice Plate = | 10.00 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 30.00 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | N/A | sq. 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 | 2.50 | 5.00 | 7.50 | | | | |
| X Orifice Area (sq. inches) | 3.50 | 8.00 | 18.00 | 18.00 | | | | |

| | 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)**

| | Not Selected | Not Selected | | | Not Selected | Not Selected | |
|---|---|---|---|---|---|---|---|
| Invert of Vertical Orifice = | N/A | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Area = | N/A | N/A | ft² |
| Depth at top of Zone using Vertical Orifice = | N/A | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Centroid = | N/A | N/A | feet |
| Vertical Orifice Diameter = | N/A | 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 = | 10.00 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 10.00 | N/A | feet |
| ✓ Overflow Weir Front Edge Length = | 20.00 | N/A | feet | Overflow Weir Slope Length = | 4.00 | N/A | feet |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 8.01 | N/A | |
| ✓ Horiz. Length of Weir Sides = | 4.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 55.68 | N/A | ft² |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 27.84 | 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 = | 2.50 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 6.95 | N/A | ft² |
| X Outlet Pipe Diameter = | 48.00 | N/A | inches | Outlet Orifice Centroid = | 1.24 | N/A | feet |
| X Restrictor Plate Height Above Pipe Invert = | 26.00 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 1.65 | N/A | radians |

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**

**User Input: Emergency Spillway (Rectangular or Trapezoidal)**

| | | | | |
|---|---|---|---|---|
| X Spillway Invert Stage= | 12.00 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.99 feet |
| ✓ Spillway Crest Length = | 165.00 | feet | Stage at Top of Freeboard = | 13.99 feet |
| X Spillway End Slopes = | 6.00 | H:V | Basin Area at Top of Freeboard = | 7.42 acres |
| ✓ Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 36.98 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).*

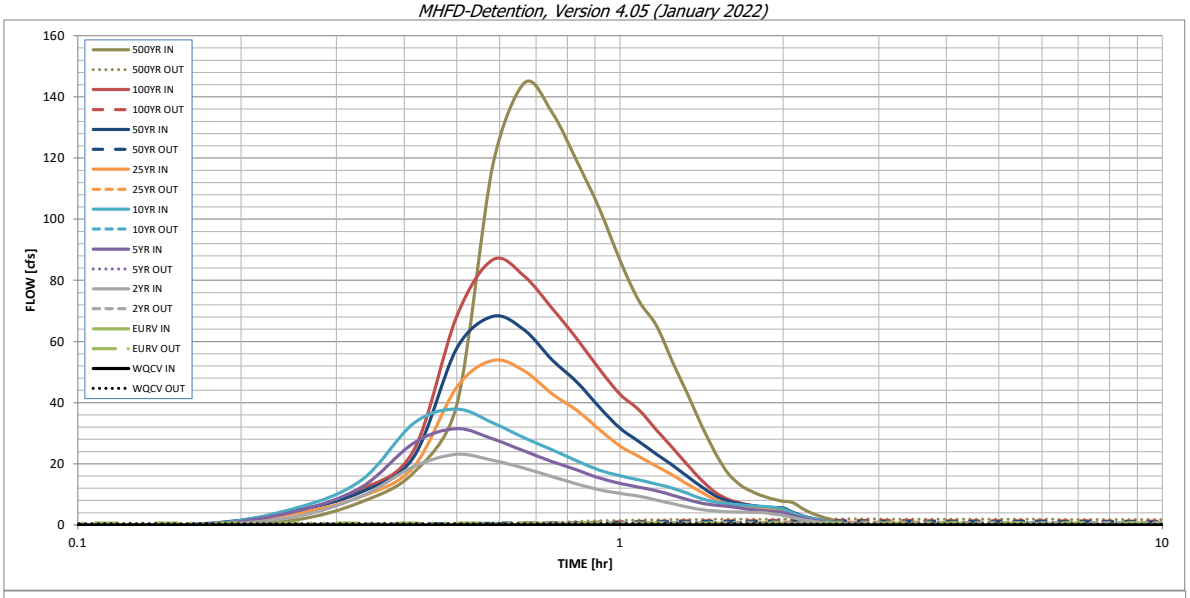
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.48 |
| CUHP Runoff Volume (acre-ft) = | 0.659 | 1.978 | 1.490 | 1.999 | 2.405 | 3.135 | 3.848 | 4.774 | 7.951 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 1.490 | 1.999 | 2.405 | 3.135 | 3.848 | 4.774 | 7.951 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.4 | 0.7 | 1.0 | 9.4 | 18.8 | 30.7 | 69.3 |
| 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 | 0.22 | 0.44 | 0.72 | 1.63 |
| Peak Inflow Q (cfs) = | N/A | N/A | 23.1 | 31.5 | 37.9 | 53.8 | 68.2 | 86.8 | 144.6 |
| Peak Outflow Q (cfs) = | 0.4 | 0.6 | 0.5 | 0.6 | 0.6 | 0.9 | 1.2 | 1.4 | 2.0 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.8 | 0.6 | 0.1 | 0.1 | 0.0 | 0.0 |
| Structure Controlling Flow = | Plate | Plate | Plate | Plate | Plate | Plate | Plate | Plate | Plate |
| 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 | 70 | 62 | 71 | 77 | 87 | 93 | 99 | 114 |
| Time to Drain 99% of Inflow Volume (hours) = | **45** | 74 | 65 | 75 | 82 | 94 | 100 | 108 | >120 |
| Maximum Ponding Depth (ft) = | 2.91 | 4.38 | 3.85 | 4.31 | 4.63 | 5.14 | 5.56 | 6.06 | 7.54 |
| Area at Maximum Ponding Depth (acres) = | 0.59 | 1.20 | 0.98 | 1.17 | 1.30 | 1.50 | 1.68 | 1.88 | 2.26 |
| Maximum Volume Stored (acre-ft) = | 0.662 | 1.978 | 1.400 | 1.895 | 2.291 | 2.992 | 3.676 | 4.565 | 7.652 |

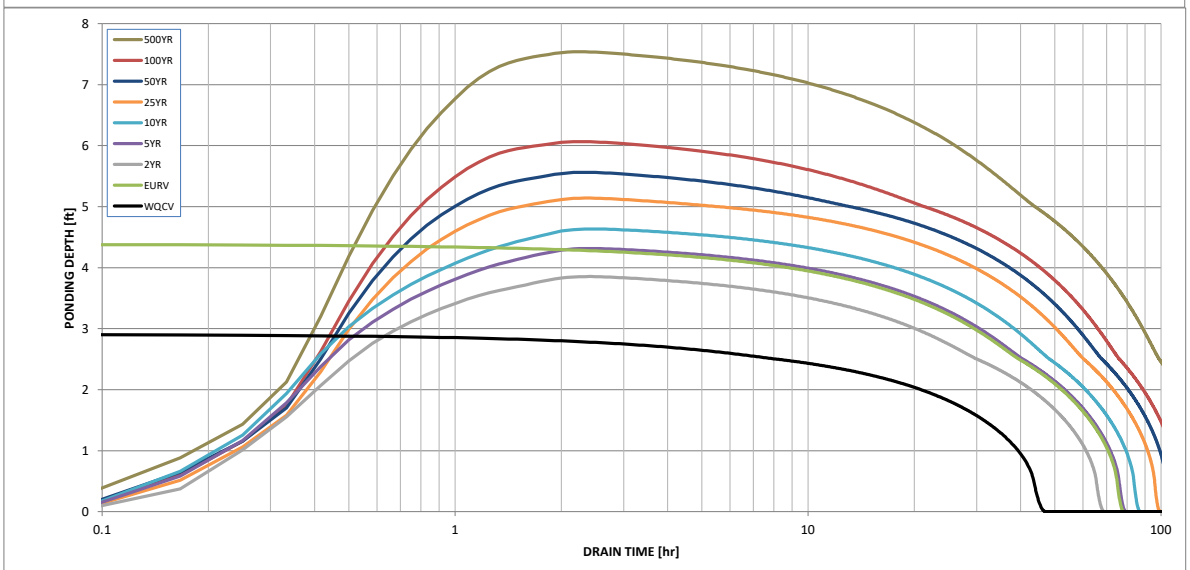
Rows highlighted above identify those that don't match what is shown on plans and details in CDs sheets 21 and 23

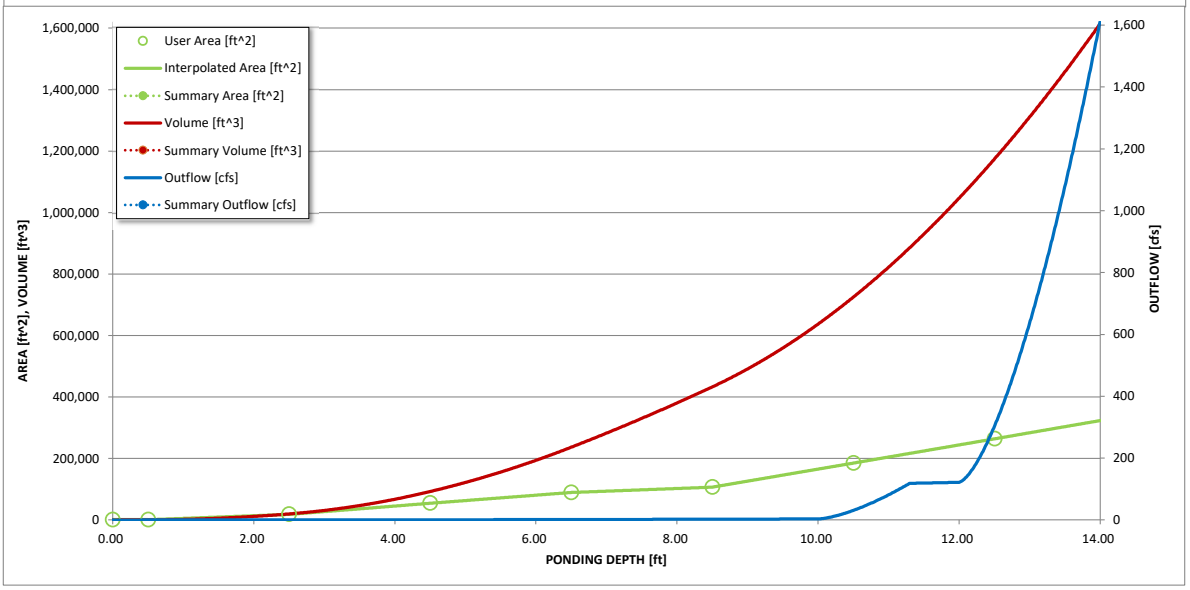
The plans and ultimate condition UD-detention spreadsheet show 12.5ft. I would think they wouldn't be different. Revise this to 12.5ft to match other calcs/plans.

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.05 (January 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 | 0.30 | 0.03 | 1.50 |
| | 0:15:00 | 0.00 | 0.00 | 2.63 | 4.28 | 5.34 | 3.60 | 4.52 | 4.43 | 7.48 |
| | 0:20:00 | 0.00 | 0.00 | 9.41 | 12.34 | 14.59 | 9.25 | 10.81 | 11.61 | 17.13 |
| | 0:25:00 | 0.00 | 0.00 | 19.09 | 26.79 | 33.24 | 19.04 | 22.31 | 24.50 | 39.16 |
| | 0:30:00 | 0.00 | 0.00 | 23.07 | 31.46 | 37.88 | 45.01 | 57.73 | 68.23 | 117.81 |
| | 0:35:00 | 0.00 | 0.00 | 21.11 | 28.10 | 33.40 | 53.82 | 68.23 | 86.78 | 144.59 |
| | 0:40:00 | 0.00 | 0.00 | 18.55 | 24.12 | 28.48 | 50.28 | 63.68 | 81.27 | 134.88 |
| | 0:45:00 | 0.00 | 0.00 | 15.76 | 20.74 | 24.58 | 42.86 | 53.94 | 70.85 | 118.91 |
| | 0:50:00 | 0.00 | 0.00 | 13.39 | 17.95 | 20.95 | 37.41 | 46.71 | 60.78 | 103.43 |
| | 0:55:00 | 0.00 | 0.00 | 11.52 | 15.31 | 17.92 | 31.19 | 38.53 | 50.94 | 86.65 |
| | 1:00:00 | 0.00 | 0.00 | 10.30 | 13.61 | 16.10 | 25.87 | 31.65 | 42.81 | 73.33 |
| | 1:05:00 | 0.00 | 0.00 | 9.42 | 12.37 | 14.72 | 22.40 | 27.30 | 37.66 | 65.36 |
| | 1:10:00 | 0.00 | 0.00 | 8.15 | 11.20 | 13.38 | 19.20 | 23.19 | 31.16 | 53.40 |
| | 1:15:00 | 0.00 | 0.00 | 6.94 | 9.75 | 12.01 | 16.32 | 19.52 | 25.29 | 42.64 |
| | 1:20:00 | 0.00 | 0.00 | 5.86 | 8.25 | 10.32 | 13.30 | 15.74 | 19.54 | 32.35 |
| | 1:25:00 | 0.00 | 0.00 | 5.03 | 7.07 | 8.53 | 10.68 | 12.43 | 14.55 | 23.52 |
| | 1:30:00 | 0.00 | 0.00 | 4.54 | 6.42 | 7.52 | 8.27 | 9.47 | 10.61 | 16.86 |
| | 1:35:00 | 0.00 | 0.00 | 4.31 | 6.09 | 6.95 | 6.89 | 7.84 | 8.38 | 13.10 |
| | 1:40:00 | 0.00 | 0.00 | 4.18 | 5.50 | 6.53 | 6.11 | 6.91 | 7.18 | 10.93 |
| | 1:45:00 | 0.00 | 0.00 | 4.10 | 5.02 | 6.23 | 5.62 | 6.34 | 6.39 | 9.45 |
| | 1:50:00 | 0.00 | 0.00 | 4.04 | 4.67 | 6.02 | 5.28 | 5.95 | 5.87 | 8.46 |
| | 1:55:00 | 0.00 | 0.00 | 3.56 | 4.40 | 5.74 | 5.06 | 5.70 | 5.49 | 7.76 |
| | 2:00:00 | 0.00 | 0.00 | 3.13 | 4.09 | 5.23 | 4.90 | 5.51 | 5.24 | 7.28 |
| | 2:05:00 | 0.00 | 0.00 | 2.38 | 3.11 | 3.97 | 3.74 | 4.20 | 3.94 | 5.44 |
| | 2:10:00 | 0.00 | 0.00 | 1.76 | 2.29 | 2.89 | 2.73 | 3.05 | 2.87 | 3.94 |
| | 2:15:00 | 0.00 | 0.00 | 1.30 | 1.68 | 2.11 | 1.99 | 2.23 | 2.10 | 2.87 |
| | 2:20:00 | 0.00 | 0.00 | 0.94 | 1.22 | 1.53 | 1.45 | 1.62 | 1.54 | 2.10 |
| | 2:25:00 | 0.00 | 0.00 | 0.68 | 0.86 | 1.10 | 1.03 | 1.15 | 1.09 | 1.48 |
| | 2:30:00 | 0.00 | 0.00 | 0.47 | 0.60 | 0.77 | 0.72 | 0.81 | 0.77 | 1.04 |
| | 2:35:00 | 0.00 | 0.00 | 0.32 | 0.42 | 0.54 | 0.51 | 0.57 | 0.54 | 0.73 |
| | 2:40:00 | 0.00 | 0.00 | 0.20 | 0.28 | 0.35 | 0.34 | 0.38 | 0.36 | 0.47 |
| | 2:45:00 | 0.00 | 0.00 | 0.11 | 0.17 | 0.20 | 0.20 | 0.22 | 0.21 | 0.27 |
| | 2:50:00 | 0.00 | 0.00 | 0.05 | 0.09 | 0.09 | 0.10 | 0.11 | 0.10 | 0.13 |
| | 2:55:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 |
| | 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 |

# 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 | 0.53 | inches | **Designer:** | **dlg** |
| ***Minor Storm: 1-Hour Rain Depth | 5-Year Event | 1.50 | inches | **Company:** | **Classic Consulting** |
| ***Major Storm: 1-Hour Rain Depth | 100-Year Event | 2.52 | inches | **Date:** | **August 17, 2020** |
| Optional User Defined Storm | CUHP | | | **Project:** | **Foursquare at Sterling Ranch East Filing No. 1 & Sterling Ranch East Filing No. 2** |
| (CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm | 100-Year Event | 2.52 | | **Location:** | **Pond 16 ULTIMATE** |

Max Intensity for Optional User Defined Storm: 2.51496

**SITE INFORMATION (USER-INPUT)**

| Sub-basin Identifier | FIL 1A | FSQ | FUTURE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Receiving Pervious Area Soil Type | Sand | Sand | Sand | | | | | | | | | | | |
| Total Area (ac., Sum of DCIA, UIA, RPA, & SPA) | 7.470 | 35.040 | 178.390 | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 2.480 | 8.140 | 25.950 | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, acres) | 2.760 | 5.700 | 72.810 | | | | | | | | | | | |
| Receiving Pervious Area (RPA, acres) | 2.230 | 6.730 | 58.630 | | | | | | | | | | | |
| Separate Pervious Area (SPA, acres) | 0.000 | 14.470 | 21.000 | | | | | | | | | | | |
| RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP) | C | C | C | | | | | | | | | | | |

**CALCULATED RESULTS (OUTPUT)**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Calculated Area (ac, check against input) | 7.470 | 35.040 | 178.390 | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, %) | 33.2% | 23.2% | 14.5% | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, %) | 36.9% | 16.3% | 40.8% | | | | | | | | | | | |
| Receiving Pervious Area (RPA, %) | 29.9% | 19.2% | 32.9% | | | | | | | | | | | |
| Separate Pervious Area (SPA, %) | 0.0% | 41.3% | 11.8% | | | | | | | | | | | |
| $A_R$ (RPA / UIA) | 0.808 | 1.181 | 0.805 | | | | | | | | | | | |
| $I_a$ Check | 0.550 | 0.460 | 0.550 | | | | | | | | | | | |
| f / I for WQCV Event: | 11.0 | 11.0 | 11.0 | | | | | | | | | | | |
| f / I for 5-Year Event: | 0.6 | 0.6 | 0.6 | | | | | | | | | | | |
| f / I for 100-Year Event: | 0.6 | 0.6 | 0.6 | | | | | | | | | | | |
| f / I for Optional User Defined Storm CUHP: | 0.57 | 0.57 | 0.57 | | | | | | | | | | | |
| IRF for WQCV Event: | 0.63 | 0.58 | 0.63 | | | | | | | | | | | |
| IRF for 5-Year Event: | 0.87 | 0.85 | 0.87 | | | | | | | | | | | |
| IRF for 100-Year Event: | 0.88 | 0.86 | 0.88 | | | | | | | | | | | |
| IRF for Optional User Defined Storm CUHP: | 0.88 | 0.86 | 0.88 | | | | | | | | | | | |
| Total Site Imperviousness: $I_{total}$ | 70.1% | 39.5% | 55.4% | | | | | | | | | | | |
| Effective Imperviousness for WQCV Event: | 56.6% | 32.7% | 40.4% | | | | | | | | | | | |
| Effective Imperviousness for 5-Year Event: | 65.3% | 37.1% | 50.0% | | | | | | | | | | | |
| Effective Imperviousness for 100-Year Event: | 65.7% | 37.3% | 50.5% | | | | | | | | | | | |
| Effective Imperviousness for Optional User Defined Storm CUHP: | 65.7% | 37.3% | 50.5% | | | | | | | | | | | |

**LID / EFFECTIVE IMPERVIOUSNESS CREDITS**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WQCV Event CREDIT: Reduce Detention By: | 18.3% | 10.5% | 18.3% | 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: | 6.0% | 5.7% | 8.6% | 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: | 8.0% | 4.4% | 8.6% | | | | | | | | | | | |

| | |
|---|---|
| **Total Site Imperviousness:** | **53.3%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **39.8%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **48.4%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **48.9%** |
| **Total Site Effective Imperviousness for Optional User Defined Storm CUHP:** | **48.9%** |

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

Please use the latest UD-BMP spreadsheet (v3.07) and UD-Detention spreadsheet (v4.06)

## Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016) 

**Designer:** DLG
**Company:** CLASSIC CONSULTING
**Date:** December 7, 2022
**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
**Location:** POND 16 ULTIMATE

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, $I_a$ — $I_a$ = 48.9 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.489

C) Contributing Watershed Area — Area = 220.900 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — $d_6$ = 0.42 in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- ○ Water Quality Capture Volume (WQCV)
- ◉ Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)
$V_{DESIGN}$ = 3.742 ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$
$V_{DESIGN\ OTHER}$ = 3.655 ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)
$V_{DESIGN\ USER}$ = ac-ft

I) Predominant Watershed NRCS Soil Group

Conflicts with what is stated on page 5 above.

Choose One
- ◉ A
- ○ B
- ○ C / D

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
EURV = 12.378 ac-f t

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.)
L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred)
Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:

## Design Procedure Form: Extended Detention Basin (EDB)



| | |
|---|---|
| **Designer:** | DLG |
| **Company:** | CLASSIC CONSULTING |
| **Date:** | December 7, 2022 |
| **Project:** | STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1 |
| **Location:** | POND 16 ULTIMATE |

| | |
|---|---|
| 5. Forebay | |
| A) Minimum Forebay Volume ($V_{FMIN}$ = 3% of the WQCV) | $V_{FMIN}$ = 0.110 ac-ft |
| B) Actual Forebay Volume | $V_F$ = 0.110 ac-ft |
| C) Forebay Depth ($D_F$ = 30 inch maximum) | $D_F$ = 12.0 in |
| D) Forebay Discharge | |
| i) Undetained 100-year Peak Discharge | $Q_{100}$ = 499.00 cfs |
| ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) | $Q_F$ = 9.98 cfs |
| E) Forebay Discharge Design | Choose One: ○ Berm With Pipe ● Wall with Rect. Notch ○ Wall with V-Notch Weir |
| F) Discharge Pipe Size (minimum 8-inches) | Calculated $D_P$ = in |
| G) Rectangular Notch Width | Calculated $W_N$ = 38.4 in |
| 6. Trickle Channel | |
| A) Type of Trickle Channel | Choose One: ● Concrete ○ Soft Bottom |
| F) Slope of Trickle Channel | S = 0.0050 ft / ft |
| 7. Micropool and Outlet Structure | |
| A) Depth of Micropool (2.5-feet minimum) | $D_M$ = 2.5 ft |
| B) Surface Area of Micropool (10 $ft^2$ minimum) | $A_M$ = 1000 sq ft |
| C) Outlet Type | Choose One: ● Orifice Plate ○ Other (Describe): |
| D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) | $D_{orifice}$ = 10.00 inches |
| E) Total Outlet Area | $A_{ot}$ = 54.00 square inches |

Specify with a PDF note in the righthand margin here (once the spreadsheet is printed to pdf) that these forebay calcs actually represent the combined volume needed for the proposed 3 forebays. That way it is clear that no single forebay in the pond will need a 38.4in wide notch. When the time comes to size/design those forebays, you'll have to do this spreadsheet for each forebay (instead of for the whole pond) with the trib area to each forebay on page 1.

Per DCMv2 – Chap 4.2, trickle channel should at a minimum provide capacity equal to twice the release capacity at the upstream forebay outlet. Show these calcs in the drainage report and revise plans as needed (now or when the ultimate condition is designed in the future).

## Design Procedure Form: Extended Detention Basin (EDB)



**Designer:** DLG
**Company:** CLASSIC CONSULTING
**Date:** December 7, 2022
**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
**Location:** POND 16 ULTIMATE

does not match what is shown on sheet 23 of CDs. The smallest dimension of the trash rack openings should be less than the smallest dimension orifice (length or width in this case)

8. Initial Surcharge Volume

| | | | |
|---|---|---|---|
| A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches) | $D_{IS}$ = | 6 | in |
| B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV) | $V_{IS}$ = | 477.6 | cu ft |
| C) Initial Surcharge Provided Above Micropool | $V_s$ = | 500.0 | cu ft |

9. Trash Rack

| | | | |
|---|---|---|---|
| A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$ | $A_t$ = | 804 | square inches |
| B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) | | *Aluminum Amico-Klemp SR Series with Cross Rods 4" O.C.* | |
| Other (Y/N): | | N | |
| C) Ratio of Total Open Area to Total Area (only for type 'Other') | User Ratio = | | |
| D) Total Water Quality Screen Area (based on screen type) | $A_{total}$ = | 1044 | sq. in. |
| E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E) | H= | 10 | feet |
| F) Height of Water Quality Screen ($H_{TR}$) | $H_{TR}$= | 148 | inches |
| G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended) | $W_{opening}$ = | 12.0 | inches |

## Design Procedure Form: Extended Detention Basin (EDB)



**Designer:** DLG
**Company:** CLASSIC CONSULTING
**Date:** December 7, 2022
**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
**Location:** POND 16 ULTIMATE

| | |
|---|---|
| 10. Overflow Embankment<br>A) Describe embankment protection for 100-year and greater overtopping:<br>B) Slope of Overflow Embankment<br>(Horizontal distance per unit vertical, 4:1 or flatter preferred) | |
| 11. Vegetation | Choose One<br>○ Irrigated<br>○ Not Irrigated |
| 12. Access<br>A) Describe Sediment Removal Procedures | |

Notes:

Clarify that this is the "Ultimate (Future) Condition"

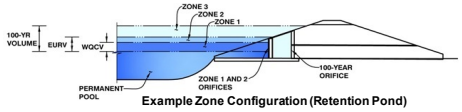
# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.05 (January 2022)*

**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1

**Basin ID:** POND FSD-16

Please use the latest UD-BMP spreadsheet (v3.07) and UD-Detention spreadsheet (v4.06)




**Example Zone Configuration (Retention Pond)**

Conflicts with what is stated on page 5 above

Type A is correct

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | EDB | |
| Watershed Area = | 220.90 | acres |
| Watershed Length = | 4,000 | ft |
| Watershed Length to Centroid = | 2,000 | ft |
| Watershed Slope = | 0.040 | ft/ft |
| Watershed Imperviousness = | 48.90% | percent |
| Percentage Hydrologic Soil Group A = | 75.0% | percent |
| Percentage Hydrologic Soil Group B = | 25.0% | 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) = | 3.742 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 12.165 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 9.612 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 12.723 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 15.734 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 20.864 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 24.964 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 30.507 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.48 in.) = | 48.117 | acre-feet | 3.48 | inches |
| Approximate 2-yr Detention Volume = | 8.133 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 10.834 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 13.557 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 16.099 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 17.679 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 19.927 | acre-feet | | |

## Define Zones and Basin Geometry

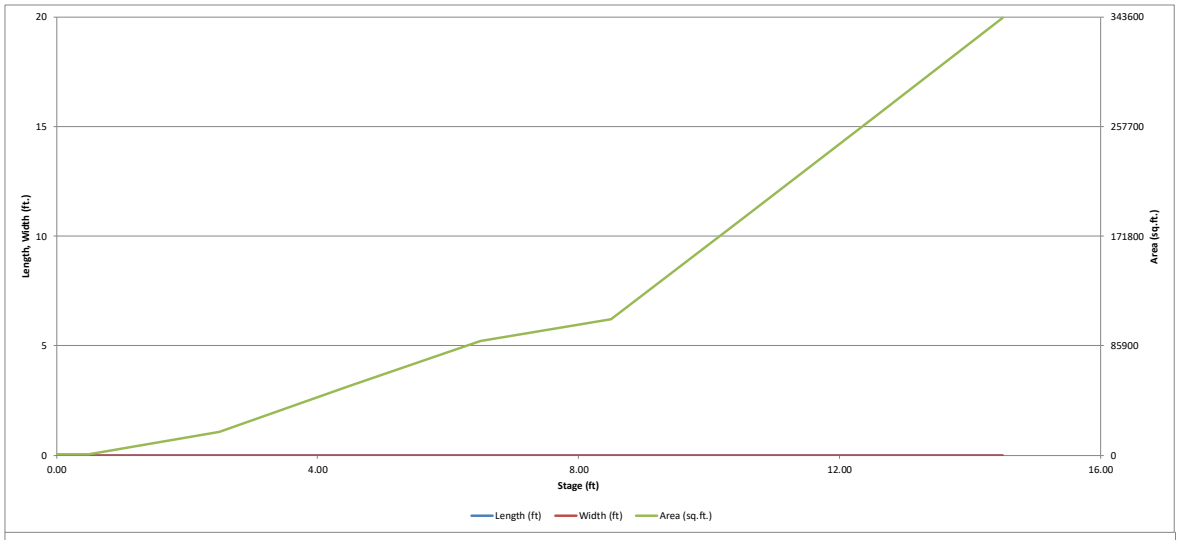
| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 3.742 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 8.423 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 7.762 | acre-feet |
| Total Detention Basin Volume = | 19.927 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| 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 |

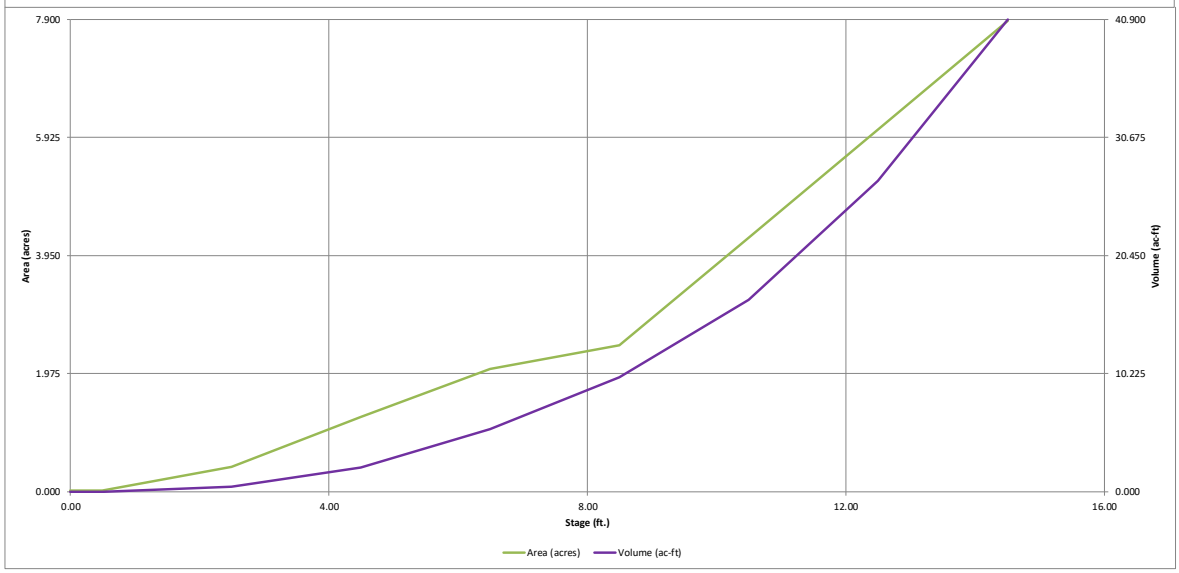
Depth Increment = ft

| 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 | -- | -- | -- | 1,027 | 0.024 | | |
| **7092** | -- | 0.50 | -- | -- | -- | 1,027 | 0.024 | 514 | 0.012 |
| **7094** | -- | 2.50 | -- | -- | -- | 18,288 | 0.420 | 19,828 | 0.455 |
| **7096** | -- | 4.50 | -- | -- | -- | 54,450 | 1.250 | 92,566 | 2.125 |
| **7098** | -- | 6.50 | -- | -- | -- | 89,516 | 2.055 | 236,532 | 5.430 |
| **7100** | -- | 8.50 | -- | -- | -- | 106,783 | 2.451 | 432,831 | 9.936 |
| **7102** | -- | 10.50 | -- | -- | -- | 185,108 | 4.249 | 724,722 | 16.637 |
| **7104** | -- | 12.50 | -- | -- | -- | 263,928 | 6.059 | 1,173,758 | 26.946 |
| **7106** | -- | 14.50 | -- | -- | -- | 343,298 | 7.881 | 1,780,984 | 40.886 |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.05 (January 2022)*



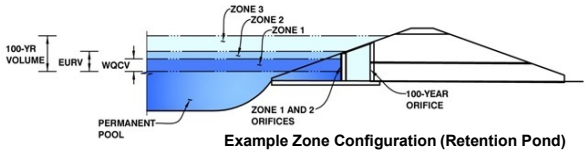
Rows highlighted below identify those that don't match what is shown on plans and details in CDs, sheets 21 and 23. But maybe since this is for the ultimate condition, the outlet structure is going to be modified later on to meet the calcs shown in this sheet? At least the orifice plate can be easily modified in the ultimate condition, but I wouldn't think that you'd want to dig up the outlet pipe and spillway when constructing the ultimate condition.

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.05 (January 2022)*

**Project:** STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1

**Basin ID:** POND FSD-16




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 5.60 | 3.742 | Orifice Plate |
| Zone 2 (EURV) | 9.30 | 8.423 | Orifice Plate |
| Zone 3 (100-year) | 11.22 | 7.762 | Weir&Pipe (Restrict) |
| Total (all zones) | | 19.927 | |

**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)**

| | | | | | |
|---|---|---|---|---|---|
| Centroid of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | N/A | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 10.00 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 30.00 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | N/A | sq. 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 | 2.50 | 5.00 | 7.50 | | | | |
| Orifice Area (sq. inches) | 10.00 | 14.00 | 18.00 | 18.00 | | | | |

| | 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)**

| | Not Selected | Not Selected | | | Not Selected | Not Selected | |
|---|---|---|---|---|---|---|---|
| Invert of Vertical Orifice = | N/A | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Area = | N/A | N/A | $ft^2$ |
| Depth at top of Zone using Vertical Orifice = | N/A | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Centroid = | N/A | N/A | feet |
| Vertical Orifice Diameter = | N/A | 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 = | 10.00 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 10.00 | N/A | feet |
| Overflow Weir Front Edge Length = | 20.00 | N/A | feet | Overflow Weir Slope Length = | 4.00 | N/A | feet |
| Overflow Weir Grate Slope = | 0.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 8.01 | N/A | |
| Horiz. Length of Weir Sides = | 4.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 55.68 | N/A | $ft^2$ |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 27.84 | 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 = | 2.50 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 6.95 | N/A | $ft^2$ |
| Outlet Pipe Diameter = | 48.00 | N/A | inches | Outlet Orifice Centroid = | 1.24 | N/A | feet |
| Restrictor Plate Height Above Pipe Invert = | 26.00 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 1.65 | N/A | radians |

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**

**User Input: Emergency Spillway (Rectangular or Trapezoidal)**

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 12.50 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.99 | feet |
| Spillway Crest Length = | 165.00 | feet | Stage at Top of Freeboard = | 14.49 | feet |
| Spillway End Slopes = | 6.00 | H:V | Basin Area at Top of Freeboard = | 7.87 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 40.81 | acre-ft |

**Calculated Parameters for Spillway**

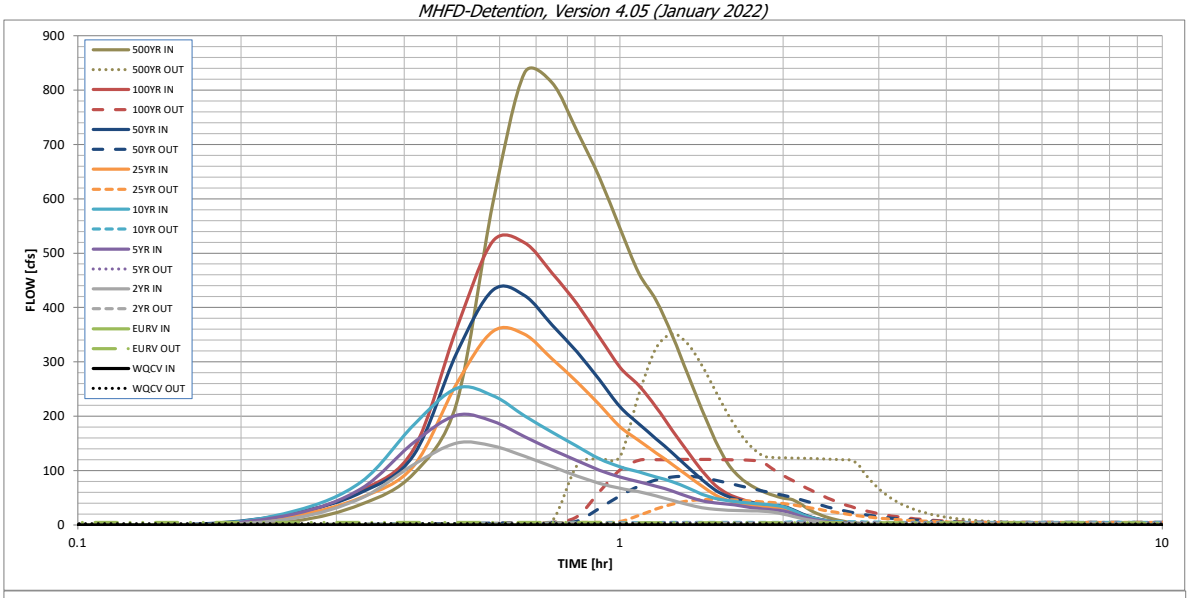
**Routed Hydrograph Results**

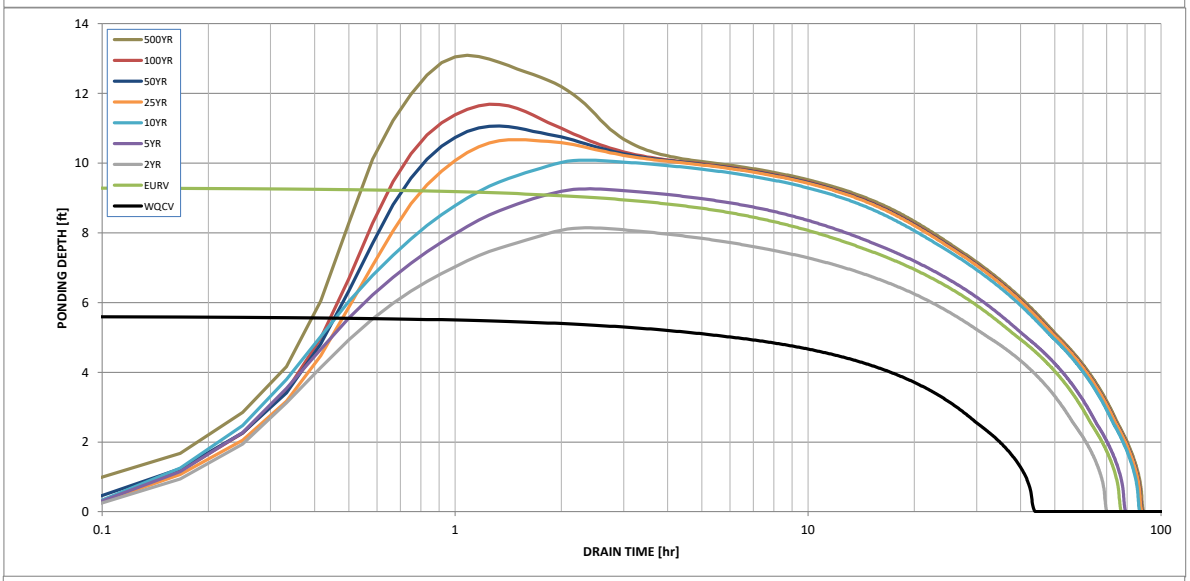
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

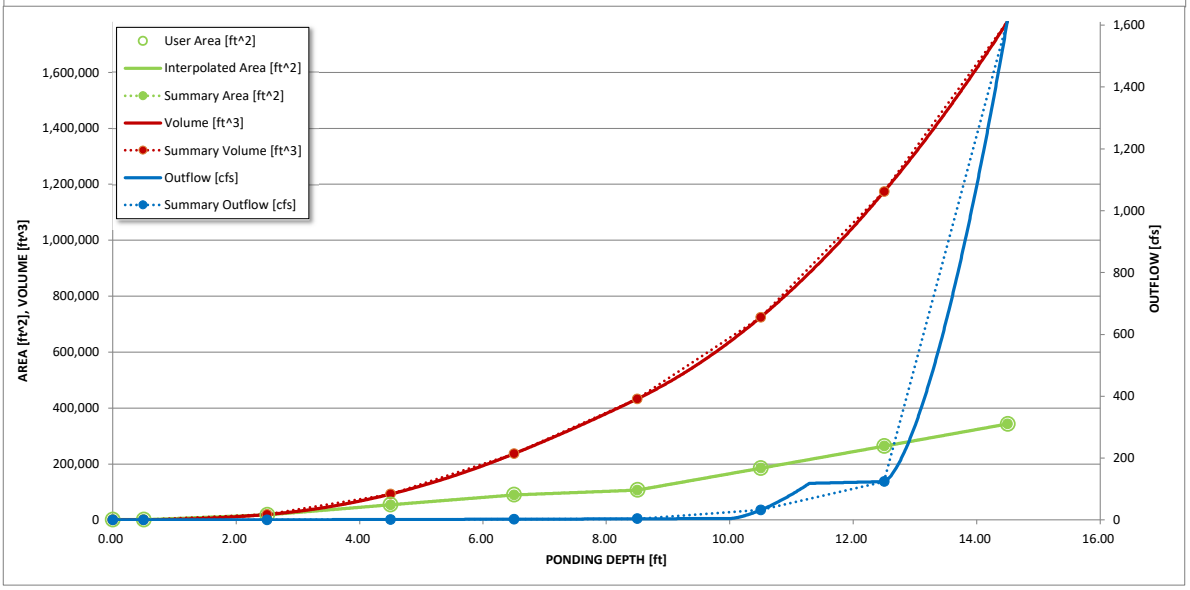
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.48 |
| CUHP Runoff Volume (acre-ft) = | 3.742 | 12.165 | 9.612 | 12.723 | 15.734 | 20.864 | 24.964 | 30.507 | 48.117 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 9.612 | 12.723 | 15.734 | 20.864 | 24.964 | 30.507 | 48.117 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 2.7 | 4.5 | 23.4 | 95.7 | 140.7 | 204.0 | 401.9 |
| 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 | 0.11 | 0.43 | 0.64 | 0.92 | 1.82 |
| Peak Inflow Q (cfs) = | N/A | N/A | 150.6 | 202.0 | 251.4 | 356.3 | 431.8 | 522.1 | 831.8 |
| Peak Outflow Q (cfs) = | 2.1 | 4.3 | 3.6 | 4.3 | 6.4 | 47.1 | 89.5 | 120.4 | 351.0 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.9 | 0.3 | 0.5 | 0.6 | 0.6 | 0.9 |
| Structure Controlling Flow = | Plate | Plate | Plate | Plate | 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 | 0.8 | 1.5 | 2.1 | 2.2 |
| Max Velocity through Grate 2 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Time to Drain 97% of Inflow Volume (hours) = | 39 | 66 | 61 | 68 | 73 | 72 | 70 | 69 | 64 |
| Time to Drain 99% of Inflow Volume (hours) = | **42** | 72 | 66 | 74 | 81 | 81 | 80 | 79 | 75 |
| Maximum Ponding Depth (ft) = | 5.60 | 9.30 | 8.14 | 9.26 | 10.08 | 10.67 | 11.06 | 11.68 | 13.08 |
| Area at Maximum Ponding Depth (acres) = | 1.69 | 3.17 | 2.38 | 3.13 | 3.86 | 4.39 | 4.75 | 5.32 | 6.59 |
| Maximum Volume Stored (acre-ft) = | 3.744 | 12.185 | 9.043 | 12.028 | 14.893 | 17.329 | 19.111 | 22.282 | 30.613 |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.05 (January 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 | 1.41 | 0.14 | 6.99 |
| | 0:15:00 | 0.00 | 0.00 | 12.21 | 20.07 | 24.98 | 16.83 | 21.70 | 20.67 | 37.86 |
| | 0:20:00 | 0.00 | 0.00 | 49.11 | 66.72 | 79.33 | 50.64 | 59.60 | 63.19 | 94.42 |
| | 0:25:00 | 0.00 | 0.00 | 111.20 | 151.82 | 184.04 | 108.46 | 128.80 | 139.80 | 224.58 |
| | 0:30:00 | 0.00 | 0.00 | 150.58 | 201.95 | 251.41 | 259.91 | 316.40 | 362.03 | 592.28 |
| | 0:35:00 | 0.00 | 0.00 | 145.26 | 190.30 | 237.77 | 356.29 | 431.75 | 522.15 | 831.79 |
| | 0:40:00 | 0.00 | 0.00 | 126.21 | 162.37 | 200.87 | 350.63 | 422.14 | 519.41 | 813.28 |
| | 0:45:00 | 0.00 | 0.00 | 107.35 | 138.30 | 170.70 | 305.16 | 367.71 | 463.17 | 724.72 |
| | 0:50:00 | 0.00 | 0.00 | 90.18 | 118.39 | 144.43 | 262.80 | 318.16 | 406.47 | 639.02 |
| | 0:55:00 | 0.00 | 0.00 | 76.60 | 100.58 | 121.54 | 220.91 | 267.11 | 345.70 | 546.49 |
| | 1:00:00 | 0.00 | 0.00 | 67.44 | 88.14 | 107.09 | 180.79 | 217.40 | 290.26 | 463.21 |
| | 1:05:00 | 0.00 | 0.00 | 61.04 | 79.31 | 97.31 | 155.18 | 186.12 | 256.61 | 413.13 |
| | 1:10:00 | 0.00 | 0.00 | 53.26 | 71.33 | 88.27 | 132.49 | 158.30 | 216.52 | 348.07 |
| | 1:15:00 | 0.00 | 0.00 | 44.89 | 62.10 | 79.24 | 111.15 | 132.30 | 173.45 | 277.16 |
| | 1:20:00 | 0.00 | 0.00 | 37.56 | 52.35 | 68.40 | 90.25 | 106.66 | 134.49 | 212.48 |
| | 1:25:00 | 0.00 | 0.00 | 31.86 | 44.41 | 56.53 | 71.39 | 83.51 | 100.06 | 155.43 |
| | 1:30:00 | 0.00 | 0.00 | 28.64 | 40.34 | 48.93 | 55.02 | 63.82 | 72.90 | 112.14 |
| | 1:35:00 | 0.00 | 0.00 | 27.11 | 38.32 | 44.73 | 45.13 | 52.04 | 56.99 | 86.82 |
| | 1:40:00 | 0.00 | 0.00 | 26.29 | 35.19 | 41.78 | 39.43 | 45.14 | 48.00 | 71.90 |
| | 1:45:00 | 0.00 | 0.00 | 25.79 | 31.89 | 39.63 | 35.92 | 40.84 | 41.87 | 61.48 |
| | 1:50:00 | 0.00 | 0.00 | 25.41 | 29.52 | 38.17 | 33.49 | 37.92 | 37.83 | 54.46 |
| | 1:55:00 | 0.00 | 0.00 | 23.08 | 27.78 | 36.48 | 31.93 | 36.06 | 35.00 | 49.47 |
| | 2:00:00 | 0.00 | 0.00 | 20.13 | 25.91 | 33.55 | 30.83 | 34.76 | 33.03 | 46.07 |
| | 2:05:00 | 0.00 | 0.00 | 15.98 | 20.83 | 26.66 | 25.16 | 28.31 | 26.61 | 36.85 |
| | 2:10:00 | 0.00 | 0.00 | 11.72 | 15.13 | 19.21 | 18.14 | 20.36 | 19.15 | 26.37 |
| | 2:15:00 | 0.00 | 0.00 | 8.55 | 10.99 | 13.86 | 13.11 | 14.68 | 13.86 | 19.02 |
| | 2:20:00 | 0.00 | 0.00 | 6.18 | 7.93 | 10.00 | 9.50 | 10.63 | 10.10 | 13.83 |
| | 2:25:00 | 0.00 | 0.00 | 4.42 | 5.54 | 7.09 | 6.70 | 7.49 | 7.15 | 9.76 |
| | 2:30:00 | 0.00 | 0.00 | 3.05 | 3.78 | 4.93 | 4.66 | 5.19 | 4.95 | 6.75 |
| | 2:35:00 | 0.00 | 0.00 | 2.07 | 2.60 | 3.42 | 3.29 | 3.67 | 3.50 | 4.74 |
| | 2:40:00 | 0.00 | 0.00 | 1.30 | 1.72 | 2.21 | 2.18 | 2.42 | 2.30 | 3.09 |
| | 2:45:00 | 0.00 | 0.00 | 0.72 | 1.02 | 1.26 | 1.29 | 1.43 | 1.35 | 1.79 |
| | 2:50:00 | 0.00 | 0.00 | 0.32 | 0.50 | 0.58 | 0.63 | 0.69 | 0.65 | 0.84 |
| | 2:55:00 | 0.00 | 0.00 | 0.11 | 0.16 | 0.17 | 0.20 | 0.22 | 0.20 | 0.25 |
| | 3:00:00 | 0.00 | 0.00 | 0.01 | 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 |

**Figure 13-12c. Emergency Spillway Protection**

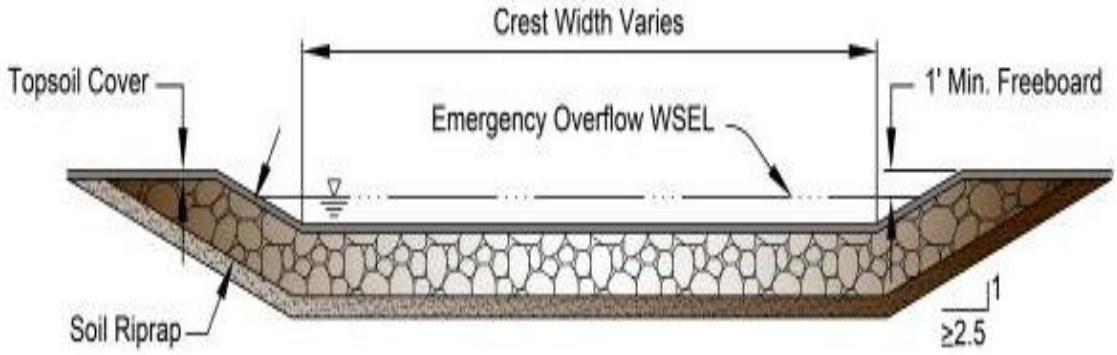
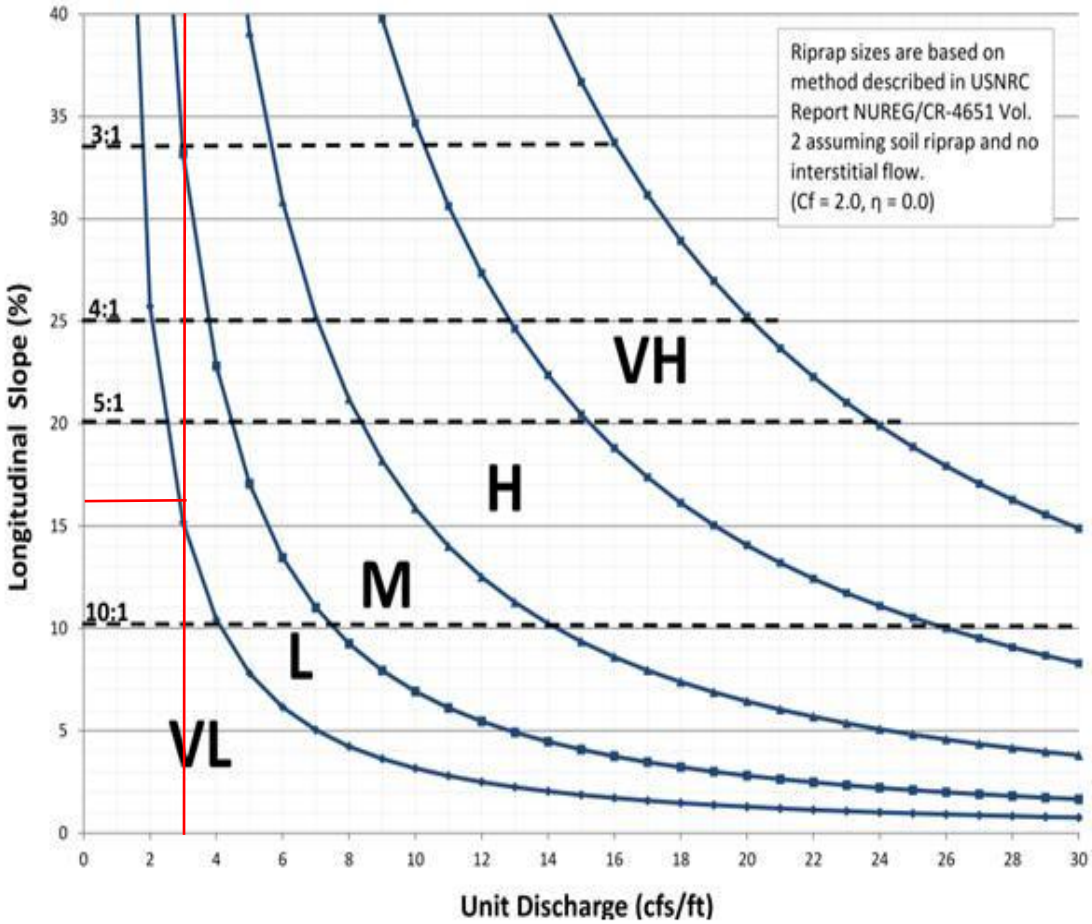


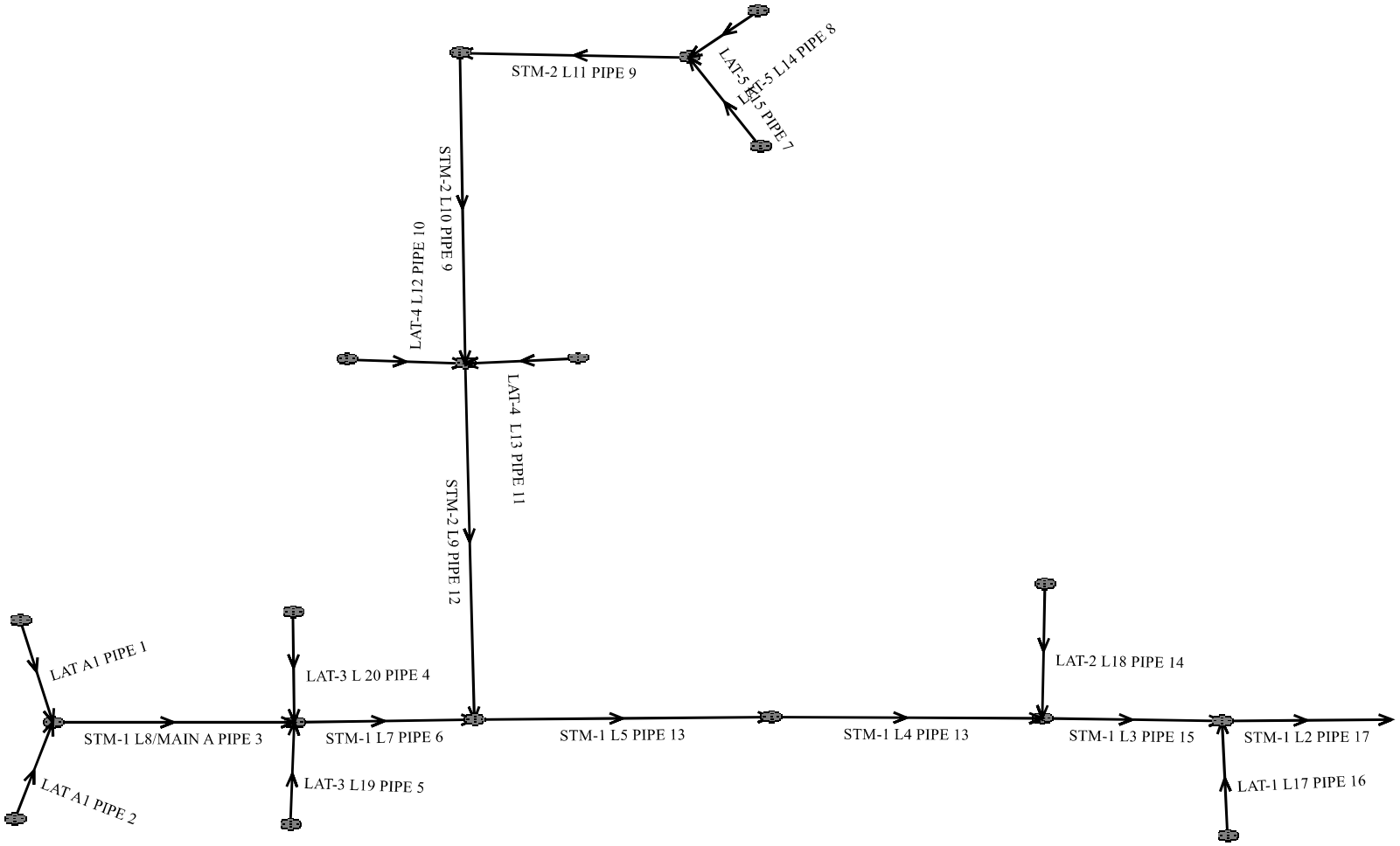

**Figure 13-12d. Riprap Types for Emergency Spillway Protection**



# HYDRAULIC GRADE LINE (HGL)

# CALCULATIONS

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS


STM-2 L11 PIPE 9
LAT-5 L14 PIPE 8
LAT-5 L15 PIPE 7
STM-2 L10 PIPE 9
LAT-4 L12 PIPE 10
LAT-4 L13 PIPE 11
STM-2 L9 PIPE 12
LAT A1 PIPE 1
LAT-3 L 20 PIPE 4
LAT-2 L18 PIPE 14
STM-1 L8/MAIN A PIPE 3
STM-1 L7 PIPE 6
STM-1 L5 PIPE 13
STM-1 L4 PIPE 13
STM-1 L3 PIPE 15
STM-1 L2 PIPE 17
LAT A1 PIPE 2
LAT-3 L19 PIPE 5
LAT-1 L17 PIPE 16

# System Input Summary 100 year

**Backwater Calculations:**

**Tailwater Elevation (ft):** 7097.55

---

**Manhole Input Summary:**

| | | Given Flow | | Sub Basin Information | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Element Name** | **Ground Elevation (ft)** | **Total Known Flow (cfs)** | **Local Contribution (cfs)** | **Drainage Area (Ac.)** | **Runoff Coefficient** | **5yr Coefficient** | **Overland Length (ft)** | **Overland Slope (%)** | **Gutter Length (ft)** | **Gutter Velocity (fps)** |
| OUTFALL 1 | 7102.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-1 L1 PIPE 17 | 7107.04 | 92.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-1 L2 PIPE 17 | 7111.17 | 92.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-1 L3 PIPE 15 | 7112.39 | 77.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT-2 L18 PIPE 14 | 7112.63 | 13.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-1 L4 PIPE 13 | 7117.81 | 65.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-1 L5 PIPE 13 | 7117.57 | 65.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-1 L7 PIPE 6 | 7116.79 | 44.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT-3 L19 PIPE 5 | 7116.90 | 6.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STM-1 L8/MAIN A PIPE 3 | 7117.53 | 25.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT A1 PIPE 2 | 7117.80 | 9.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT A1 PIPE 1 | 7118.07 | 16.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT-3 L 20 PIPE 4 | 7116.90 | 14.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-2 L9 PIPE 12 | 7119.40 | 22.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-2 L10 PIPE 9 | 7126.37 | 6.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STM-2 L11 PIPE 9 | 7125.97 | 6.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT-5 L15 PIPE 7 | 7126.07 | 5.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT-5 L14 PIPE 8 | 7126.07 | 1.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT-4 L13 PIPE 11 | 7119.57 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT-4 L12 PIPE 10 | 7119.57 | 14.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAT-1 L17 PIPE 16 | 7111.06 | 15.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

**Manhole Output Summary:**

| | Local Contribution | | | | | Total Design Flow | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Element Name** | **Overland Time (min)** | **Gutter Time (min)** | **Basin Tc (min)** | **Intensity (in/hr)** | **Local Contrib (cfs)** | **Coeff. Area** | **Intensity (in/hr)** | **Manhole Tc (min)** | **Peak Flow (cfs)** | **Comment** |
| OUTFALL 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 7.97 | 11.63 | 0.14 | 92.70 | |
| STM-1 L1 PIPE 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 92.70 | |
| STM-1 L2 PIPE 17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 92.70 | |
| STM-1 L3 PIPE 15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 77.80 | |
| LAT-2 L18 PIPE 14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 13.30 | |
| STM-1 L4 PIPE 13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 65.20 | |
| STM-1 L5 PIPE 13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 65.20 | |
| STM-1 L7 PIPE 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 44.00 | |
| LAT-3 L19 PIPE 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.10 | |
| STM-1 L8/MAIN A PIPE 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 25.50 | |
| LAT A1 PIPE 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.90 | |
| LAT A1 PIPE 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 16.10 | |
| LAT-3 L 20 PIPE 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 14.00 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STM-2 L9 PIPE 12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 22.20 | |
| STM-2 L10 PIPE 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.70 | |
| STM-2 L11 PIPE 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.70 | |
| LAT-5 L15 PIPE 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.80 | |
| LAT-5 L14 PIPE 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.30 | |
| LAT-4 L13 PIPE 11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | |
| LAT-4 L12 PIPE 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 14.10 | |
| LAT-1 L17 PIPE 16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 15.70 | |

**Sewer Input Summary:**

| | | Elevation | | | Loss Coefficients | | | Given Dimensions | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Element Name** | **Sewer Length (ft)** | **Downstream Invert (ft)** | **Slope (%)** | **Upstream Invert (ft)** | **Mannings n** | **Bend Loss** | **Lateral Loss** | **Cross Section** | **Rise (ft or in)** | **Span (ft or in)** |
| STM-1 L1 PIPE 17 | 79.03 | 7094.50 | 0.8 | 7095.13 | 0.013 | 0.05 | 1.00 | CIRCULAR | 42.00 in | 42.00 in |
| STM-1 L2 PIPE 17 | 119.33 | 7095.24 | 0.8 | 7096.19 | 0.013 | 0.10 | 1.00 | CIRCULAR | 42.00 in | 42.00 in |
| STM-1 L3 PIPE 15 | 68.60 | 7097.20 | 2.2 | 7098.71 | 0.013 | 0.05 | 0.25 | CIRCULAR | 42.00 in | 42.00 in |
| LAT-2 L18 PIPE 14 | 24.67 | 7101.69 | 3.6 | 7102.58 | 0.013 | 1.00 | 0.00 | CIRCULAR | 24.00 in | 24.00 in |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| STM-1 L4 PIPE 13 | 368.17 | 7099.21 | 1.0 | 7102.89 | 0.013 | 0.05 | 0.25 | CIRCULAR | 36.00 in | 36.00 in |
| STM-1 L5 PIPE 13 | 278.55 | 7102.99 | 1.0 | 7105.78 | 0.013 | 0.10 | 1.00 | CIRCULAR | 36.00 in | 36.00 in |
| STM-1 L7 PIPE 6 | 84.52 | 7106.24 | 4.4 | 7109.96 | 0.013 | 0.05 | 0.25 | CIRCULAR | 30.00 in | 30.00 in |
| LAT-3 L19 PIPE 5 | 5.67 | 7113.06 | 1.9 | 7113.17 | 0.013 | 1.00 | 0.00 | CIRCULAR | 18.00 in | 18.00 in |
| STM-1 L8/MAIN A PIPE 3 | 500.69 | 7110.46 | 0.5 | 7112.96 | 0.013 | 0.05 | 0.25 | CIRCULAR | 30.00 in | 30.00 in |
| LAT A1 PIPE 2 | 5.68 | 7113.96 | 0.5 | 7113.99 | 0.013 | 1.01 | 0.00 | CIRCULAR | 18.00 in | 18.00 in |
| LAT A1 PIPE 1 | 26.95 | 7113.46 | 0.5 | 7113.59 | 0.013 | 0.48 | 0.00 | CIRCULAR | 24.00 in | 24.00 in |
| LAT-3 L 20 PIPE 4 | 24.67 | 7112.55 | 1.0 | 7112.80 | 0.013 | 1.00 | 0.00 | CIRCULAR | 24.00 in | 24.00 in |
| STM-2 L9 PIPE 12 | 249.88 | 7106.86 | 3.1 | 7114.61 | 0.013 | 1.00 | 0.00 | CIRCULAR | 24.00 in | 24.00 in |
| STM-2 L10 PIPE 9 | 490.62 | 7115.44 | 1.0 | 7120.35 | 0.013 | 0.05 | 1.00 | CIRCULAR | 18.00 in | 18.00 in |
| STM-2 L11 PIPE 9 | 48.37 | 7120.65 | 1.0 | 7121.13 | 0.013 | 1.00 | 1.00 | CIRCULAR | 18.00 in | 18.00 in |
| LAT-5 L15 PIPE 7 | 26.43 | 7121.64 | 1.0 | 7121.90 | 0.013 | 0.29 | 0.00 | CIRCULAR | 18.00 in | 18.00 in |
| LAT-5 L14 PIPE 8 | 9.55 | 7121.63 | 1.0 | 7121.73 | 0.013 | 0.29 | 0.00 | CIRCULAR | 18.00 in | 18.00 in |
| LAT-4 L13 PIPE 11 | 5.67 | 7115.61 | 1.1 | 7115.67 | 0.013 | 1.00 | 0.00 | CIRCULAR | 18.00 in | 18.00 in |
| LAT-4 L12 PIPE 10 | 24.67 | 7115.11 | 1.0 | 7115.36 | 0.013 | 1.00 | 0.00 | CIRCULAR | 24.00 in | 24.00 in |
| LAT-1 L17 PIPE 16 | 38.87 | 7100.03 | 7.8 | 7103.06 | 0.013 | 1.00 | 0.00 | CIRCULAR | 24.00 in | 24.00 in |

**Sewer Flow Summary:**

| | Full Flow Capacity | | Critical Flow | | Normal Flow | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Element Name** | **Flow (cfs)** | **Velocity (fps)** | **Depth (in)** | **Velocity (fps)** | **Depth (in)** | **Velocity (fps)** | **Froude Number** | **Flow Condition** | **Flow (cfs)** | **Surcharged Length (ft)** | **Comment** |
| STM-1 L1 PIPE 17 | 90.23 | 9.38 | 42.00 | 9.64 | 42.00 | 9.64 | 0.00 | Pressurized | 92.70 | 79.03 | |
| STM-1 L2 PIPE 17 | 90.23 | 9.38 | 42.00 | 9.64 | 42.00 | 9.64 | 0.00 | Pressurized | 92.70 | 119.33 | |
| STM-1 L3 PIPE 15 | 149.63 | 15.55 | 33.10 | 9.57 | 21.49 | 15.70 | 2.33 | Supercritical Jump | 77.80 | 48.64 | |
| LAT-2 L18 PIPE 14 | 43.04 | 13.70 | 15.75 | 6.09 | 9.16 | 12.07 | 2.83 | Supercritical | 13.30 | 0.00 | |
| STM-1 L4 PIPE 13 | 66.88 | 9.46 | 31.06 | 10.06 | 28.72 | 10.78 | 1.20 | Supercritical Jump | 65.20 | 224.20 | |
| STM-1 L5 PIPE 13 | 66.88 | 9.46 | 31.06 | 10.06 | 28.72 | 10.78 | 1.20 | Supercritical | 65.20 | 0.00 | |
| STM-1 L7 PIPE 6 | 86.27 | 17.57 | 26.49 | 9.59 | 15.18 | 17.66 | 3.12 | Supercritical Jump | 44.00 | 31.37 | |
| LAT-3 L19 PIPE 5 | 14.52 | 8.22 | 11.45 | 5.14 | 8.14 | 7.86 | 1.92 | Supercritical | 6.10 | 0.00 | |
| STM-1 L8/MAIN A PIPE 3 | 29.08 | 5.92 | 20.65 | 7.08 | 21.78 | 6.68 | 0.90 | Pressurized | 25.50 | 500.69 | |
| LAT A1 PIPE 2 | 7.45 | 4.21 | 18.00 | 5.60 | 18.00 | 5.60 | 0.00 | Pressurized | 9.90 | 5.68 | |
| LAT A1 PIPE 1 | 16.04 | 5.11 | 24.00 | 5.12 | 24.00 | 5.12 | 0.00 | Pressurized | 16.10 | 26.95 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LAT-3 L 20 PIPE 4 | 22.68 | 7.22 | 16.17 | 6.22 | 13.64 | 7.60 | 1.39 | Supercritical | 14.00 | 0.00 | |
| STM-2 L9 PIPE 12 | 39.94 | 12.71 | 20.18 | 7.87 | 12.78 | 13.05 | 2.49 | Supercritical Jump | 22.20 | 50.16 | |
| STM-2 L10 PIPE 9 | 10.53 | 5.96 | 12.02 | 5.34 | 10.43 | 6.31 | 1.31 | Supercritical Jump | 6.70 | 109.28 | |
| STM-2 L11 PIPE 9 | 10.53 | 5.96 | 12.02 | 5.34 | 10.43 | 6.31 | 1.31 | Supercritical | 6.70 | 0.00 | |
| LAT-5 L15 PIPE 7 | 10.53 | 5.96 | 11.15 | 5.04 | 9.53 | 6.10 | 1.35 | Supercritical | 5.80 | 0.00 | |
| LAT-5 L14 PIPE 8 | 10.53 | 5.96 | 5.12 | 3.14 | 4.27 | 4.05 | 1.42 | Supercritical | 1.30 | 0.00 | |
| LAT-4 L13 PIPE 11 | 11.05 | 6.25 | 6.40 | 3.55 | 5.19 | 4.74 | 1.50 | Pressurized | 2.00 | 5.67 | |
| LAT-4 L12 PIPE 10 | 22.68 | 7.22 | 16.23 | 6.24 | 13.70 | 7.61 | 1.39 | Supercritical Jump | 14.10 | 22.98 | |
| LAT-1 L17 PIPE 16 | 63.35 | 20.17 | 17.14 | 6.54 | 8.14 | 16.72 | 4.19 | Supercritical | 15.70 | 0.00 | |

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

---

**Sewer Sizing Summary:**

| | | | Existing | | Calculated | | Used | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Element Name** | **Peak Flow (cfs)** | **Cross Section** | **Rise** | **Span** | **Rise** | **Span** | **Rise** | **Span** | **Area (ft^2)** | **Comment** |
| STM-1 L1 PIPE 17 | 92.70 | CIRCULAR | 42.00 in | 42.00 in | 48.00 in | 48.00 in | 42.00 in | 42.00 in | 9.62 | Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise |
| STM-1 L2 PIPE 17 | 92.70 | CIRCULAR | 42.00 in | 42.00 in | 48.00 in | 48.00 in | 42.00 in | 42.00 in | 9.62 | Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise |
| STM-1 L3 PIPE 15 | 77.80 | CIRCULAR | 42.00 in | 42.00 in | 33.00 in | 33.00 in | 42.00 in | 42.00 in | 9.62 | |
| LAT-2 L18 PIPE 14 | 13.30 | CIRCULAR | 24.00 in | 24.00 in | 18.00 in | 18.00 in | 24.00 in | 24.00 in | 3.14 | |
| STM-1 L4 PIPE 13 | 65.20 | CIRCULAR | 36.00 in | 36.00 in | 36.00 in | 36.00 in | 36.00 in | 36.00 in | 7.07 | |
| STM-1 L5 PIPE 13 | 65.20 | CIRCULAR | 36.00 in | 36.00 in | 36.00 in | 36.00 in | 36.00 in | 36.00 in | 7.07 | |
| STM-1 L7 PIPE 6 | 44.00 | CIRCULAR | 30.00 in | 30.00 in | 24.00 in | 24.00 in | 30.00 in | 30.00 in | 4.91 | |
| LAT-3 L19 PIPE 5 | 6.10 | CIRCULAR | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 1.77 | |
| STM-1 L8/MAIN A PIPE 3 | 25.50 | CIRCULAR | 30.00 in | 30.00 in | 30.00 in | 30.00 in | 30.00 in | 30.00 in | 4.91 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| LAT A1 PIPE 2 | 9.90 | CIRCULAR | 18.00 in | 18.00 in | 21.00 in | 21.00 in | 18.00 in | 18.00 in | 1.77 | Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise |
| LAT A1 PIPE 1 | 16.10 | CIRCULAR | 24.00 in | 24.00 in | 27.00 in | 27.00 in | 24.00 in | 24.00 in | 3.14 | Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise |
| LAT-3 L 20 PIPE 4 | 14.00 | CIRCULAR | 24.00 in | 24.00 in | 21.00 in | 21.00 in | 24.00 in | 24.00 in | 3.14 | |
| STM-2 L9 PIPE 12 | 22.20 | CIRCULAR | 24.00 in | 24.00 in | 21.00 in | 21.00 in | 24.00 in | 24.00 in | 3.14 | |
| STM-2 L10 PIPE 9 | 6.70 | CIRCULAR | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 1.77 | |
| STM-2 L11 PIPE 9 | 6.70 | CIRCULAR | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 1.77 | |
| LAT-5 L15 PIPE 7 | 5.80 | CIRCULAR | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 1.77 | |
| LAT-5 L14 PIPE 8 | 1.30 | CIRCULAR | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 1.77 | |
| LAT-4 L13 PIPE 11 | 2.00 | CIRCULAR | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 18.00 in | 1.77 | |
| LAT-4 L12 PIPE 10 | 14.10 | CIRCULAR | 24.00 in | 24.00 in | 21.00 in | 21.00 in | 24.00 in | 24.00 in | 3.14 | |
| LAT-1 L17 PIPE 16 | 15.70 | CIRCULAR | 24.00 in | 24.00 in | 18.00 in | 18.00 in | 24.00 in | 24.00 in | 3.14 | |

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.

- All hydraulics where calculated using the 'Used' parameters.

---

**Grade Line Summary:**

**Tailwater Elevation (ft):** 7097.55

| | Invert Elev. | | Downstream Manhole Losses | | HGL | | EGL | | |
|---|---|---|---|---|---|---|---|---|---|
| **Element Name** | **Downstream (ft)** | **Upstream (ft)** | **Bend Loss (ft)** | **Lateral Loss (ft)** | **Downstream (ft)** | **Upstream (ft)** | **Downstream (ft)** | **Friction Loss (ft)** | **Upstream (ft)** |
| STM-1 L1 PIPE 17 | 7094.50 | 7095.13 | 0.00 | 0.00 | 7098.00 | 7098.67 | 7099.44 | 0.67 | 7100.11 |
| STM-1 L2 PIPE 17 | 7095.24 | 7096.19 | 0.14 | 0.00 | 7098.81 | 7099.82 | 7100.25 | 1.01 | 7101.26 |
| STM-1 L3 PIPE 15 | 7097.20 | 7098.71 | 0.05 | 1.19 | 7101.48 | 7101.48 | 7102.50 | 0.39 | 7102.89 |
| LAT-2 L18 PIPE 14 | 7101.69 | 7102.58 | 0.28 | 0.00 | 7102.58 | 7103.89 | 7104.10 | 0.37 | 7104.47 |
| STM-1 L4 PIPE 13 | 7099.21 | 7102.89 | 0.07 | 0.69 | 7102.32 | 7105.48 | 7103.64 | 3.41 | 7107.05 |
| STM-1 L5 PIPE 13 | 7102.99 | 7105.78 | 0.13 | 0.00 | 7105.61 | 7108.37 | 7107.19 | 2.74 | 7109.94 |
| STM-1 L7 PIPE 6 | 7106.24 | 7109.96 | 0.06 | 1.01 | 7109.76 | 7112.17 | 7111.01 | 2.59 | 7113.60 |
| LAT-3 L19 PIPE 5 | 7113.06 | 7113.17 | 0.19 | 0.00 | 7113.87 | 7114.12 | 7114.48 | 0.05 | 7114.53 |
| STM-1 L8/MAIN A PIPE 3 | 7110.46 | 7112.96 | 0.02 | 1.14 | 7114.34 | 7116.27 | 7114.76 | 1.92 | 7116.68 |
| LAT A1 PIPE 2 | 7113.96 | 7113.99 | 0.49 | 0.00 | 7116.76 | 7116.81 | 7117.25 | 0.05 | 7117.30 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| LAT A1 PIPE 1 | 7113.46 | 7113.59 | 0.20 | 0.00 | 7116.47 | 7116.61 | 7116.88 | 0.14 | 7117.02 |
| LAT-3 L 20 PIPE 4 | 7112.55 | 7112.80 | 0.31 | 0.00 | 7113.69 | 7114.15 | 7114.59 | 0.16 | 7114.75 |
| STM-2 L9 PIPE 12 | 7106.86 | 7114.61 | 0.78 | 0.00 | 7109.94 | 7116.29 | 7110.71 | 6.54 | 7117.25 |
| STM-2 L10 PIPE 9 | 7115.44 | 7120.35 | 0.01 | 0.55 | 7117.59 | 7121.35 | 7117.82 | 3.98 | 7121.80 |
| STM-2 L11 PIPE 9 | 7120.65 | 7121.13 | 0.22 | 0.00 | 7121.57 | 7122.13 | 7122.13 | 0.44 | 7122.58 |
| LAT-5 L15 PIPE 7 | 7121.64 | 7121.90 | 0.05 | 0.00 | 7122.43 | 7122.83 | 7123.01 | 0.22 | 7123.22 |
| LAT-5 L14 PIPE 8 | 7121.63 | 7121.73 | 0.00 | 0.00 | 7122.56 | 7122.56 | 7122.58 | 0.01 | 7122.58 |
| LAT-4 L13 PIPE 11 | 7115.61 | 7115.67 | 0.02 | 0.00 | 7117.25 | 7117.26 | 7117.27 | 0.00 | 7117.28 |
| LAT-4 L12 PIPE 10 | 7115.11 | 7115.36 | 0.31 | 0.00 | 7117.25 | 7117.34 | 7117.57 | 0.09 | 7117.66 |
| LAT-1 L17 PIPE 16 | 7100.03 | 7103.06 | 0.39 | 0.00 | 7100.71 | 7104.49 | 7105.05 | 0.10 | 7105.15 |

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

# DRAINAGE MAPS

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

**STERLING RANCH EAST PRELIMINARY PLAN NO. 1**
**Pre-Developed Subcatchment Runoff**

| Subcatchment | Area (Ac.) | SWMM Imperv. (%) | Peak Runoff 5 yr. (CFS) | Peak Runoff 100 yr. (CFS) |
|---|---|---|---|---|
| EX-10 | 265.9 | 7% | 105 | 222 |
| EX10A | 153.5 | 5% | 46 | 103 |
| EX-11 | 214.3 | 4% | 54 | 129 |
| EX-13 | 94.8 | 6% | 36 | 85 |
| EX-4A | 44.2 | 8% | 19 | 50 |
| EX-5 | 26.2 | 8% | 12 | 32 |
| EX-7 | 152.8 | 5% | 46 | 105 |
| EX-7A | 2.4 | 2% | 1 | 5 |
| EX-8 | 32.2 | 2% | 5 | 23 |
| EX-8A | 6.6 | 2% | 2 | 9 |
| EX-9 | 139.3 | 8% | 59 | 122 |
| EX-9A | 21.8 | 5% | 7 | 19 |
| TR-12 | 4.7 | 5% | 2 | 9 |
| TR-20 | 23.2 | 7% | 10 | 32 |
| TR-4 | 4.4 | 5% | 2 | 9 |
| TR-5 | 13.7 | 5% | 5 | 17 |
| TR-6 | 1.5 | 5% | 1 | 4 |
| TR-7 | 2.6 | 5% | 1 | 5 |




**LEGEND**

| DESCRIPTION | SYMBOL |
|---|---|
| EXISTING GROUND CONTOUR | 6910 |
| PROPOSED FINISHED CONTOUR | 6910 |
| SUB-BASIN BOUNDARY | |
| SAND CREEK EAST FORK BASIN LINE | |
| DESIGN POINT | 4 |
| BASIN IDENTIFIER / AREA IN ACRES | BB 10.0 |
| EXISTING DIRECTION OF FLOW | |
| EXISTING STORM SEWER | |

SAND CREEK FLOWS
(PER FEMA)
Q100 YR. = 2600 CFS

(PER KIOWA DBPS)
REACH SC-9
SEGMENT NO. 171
Q10 YR. = 630 CFS
Q100 YR. = 2170 CFS

(PER STERLING RANCH 2018 MDDP DP-77)
Q10 YR. = 581 CFS
Q100 YR. = 1468 CFS

EXIST. 36" CMP CULVERT
EXIST. 48" CMP CULVERT
EXIST. 60" CMP CULVERT
EXIST. 18" CMP CULVERT
EXIST. 30" RCP STORM OUTFALL
EXIST. DUAL 30" RCP CULVERTS
EXIST. 24" RCP STOCK POND OUTFALL
EXIST. STOCK POND
EXIST. TEMP. SEDIMENT BASIN
EXIST. DUAL 24" RCP CULVERTS
EXIST. POND 1
EXIST. DUAL ARCH CULVERTS
EXIST. RAIN GARDEN
EXIST. POND 2
EXIST. TEMP. SEDIMENT BASIN
EXIST. TEMP. SEDIMENT BASIN

ARROYA LANE
VOLLMER ROAD
POCO ROAD
ELK ANTLER LANE
OWL PERCH LOOP
BISON VALLEY TRAIL
ASPEN VALLEY RD.
TOMAHAWK TRAIL
FLAMING SUN DR.
OLD SETTLERS TRAIL
SAND CREEK EAST FORK
SAND CREEK REACH SC-9

OVERALL TIMBERRIDGE PROPERTY BOUNDARY
OVERALL STERLING RANCH PROPERTY BOUNDARY

UNPLATTED (5 AC. ± RESIDENTIAL)
UNPLATTED (FUTURE TIMBERRIDGE DEVELOPMENT RESIDENTIAL USE)
UNPLATTED (FUTURE STERLING RANCH RESIDENTIAL USE)

RETREAT AT TIMBERRIDGE FILING NO. 2
RETREAT AT TIMBERRIDGE FILING NO. 2 POND 1
RETREAT AT TIMBERRIDGE FILING NO. 1
INDIAN WELLS SUBD. FILING NO. 1

TR-12 4.7
TR-20 23.2
TR-4 4.4
TR-5 13.7
TR-6 1.5
TR-7 2.6
EX10 265.9
EX10A 153.5

SEE SHEET 2

CLASSIC CONSULTING
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

STERLING RANCH EAST
PRELIMINARY PLAN NO. 1
PRELIMINARY DRAINAGE REPORT
PRE-DEVELOPMENT DRAINAGE MAP

| | | | | | |
|---|---|---|---|---|---|
| DESIGNED BY | MAW | SCALE | | DATE | 4-1-22 |
| DRAWN BY | MAW | (H) 1"= 200' | | SHEET | 1 OF 6 |
| CHECKED BY | | (V) 1"= N/A | | JOB NO. | 1183.22 |

SEE SHEET 1

## LEGEND

| DESCRIPTION | SYMBOL |
|---|---|
| EXISTING GROUND CONTOUR | 6910 |
| PROPOSED FINISHED CONTOUR | 6910 |
| SUB-BASIN BOUNDARY | |
| SAND CREEK EAST FORK BASIN LINE | |
| DESIGN POINT | 4 |
| BASIN IDENTIFIER / AREA IN ACRES | BB 10.0 |
| EXISTING DIRECTION OF FLOW | |
| EXISTING STORM SEWER | |

**STERLING RANCH EAST PRELIMINARY PLAN NO. 1**
**Pre-Developed Subcatchment Runoff**

| Subcatchment | Area (Ac.) | SWMM Imperv. (%) | Peak Runoff 5 yr. (CFS) | Peak Runoff 100 yr. (CFS) |
|---|---|---|---|---|
| EX-10 | 265.9 | 7% | 105 | 222 |
| EX10A | 153.5 | 5% | 46 | 103 |
| EX-11 | 214.3 | 4% | 54 | 129 |
| EX-13 | 94.8 | 6% | 36 | 85 |
| EX-4A | 44.2 | 8% | 19 | 50 |
| EX-5 | 26.2 | 8% | 12 | 32 |
| EX-7 | 152.8 | 5% | 46 | 105 |
| EX-7A | 2.4 | 2% | 1 | 5 |
| EX-8 | 32.2 | 2% | 5 | 23 |
| EX-8A | 6.6 | 2% | 2 | 9 |
| EX-9 | 139.3 | 8% | 59 | 122 |
| EX-9A | 21.8 | 5% | 7 | 19 |
| TR-12 | 4.7 | 5% | 2 | 9 |
| TR-20 | 23.2 | 7% | 10 | 32 |
| TR-4 | 4.4 | 5% | 2 | 9 |
| TR-5 | 13.7 | 5% | 5 | 17 |
| TR-6 | 1.5 | 5% | 1 | 4 |
| TR-7 | 2.6 | 5% | 1 | 5 |

SAND CREEK REACH SC-10
BISON VALLEY
EXIST. POND 2
EXIST. TEMP. SEDIMENT BASIN
VOLLMER ROAD
(HOMESTEAD NORTH AT STERLING RANCH RESIDENTIAL USE)
HOMESTEAD NORTH PLATTED BOUNDARY
CLASSIC OWNERSHIP BOUNDARY
SAND CREEK REACH SC-9
EX-5 26.2
REFERENCE SAND CREEK CHANNEL IMPROVEMENTS PROPOSED WITH HOMESTEAD NORTH AT STERLING RANCH FIL.NO. 1 PREPARED BY JR ENG. (PCD NO. SF-22-013)
BRIARGATE BLVD. (130' ROW)
UNPLATTED (FUTURE STERLING RANCH RESIDENTIAL USE)
SAND CREEK EAST FORK
EX-7 152.8
EX-9 139.3
EX10A 153.5
EX-11 214.3
EX10 265.9
INDIAN WELLS SUBD. FILING NO. 1
TOMAHAWK TRAIL
STAPLETON ROAD
BOW VALLEY SUBD.
EX-13 94.8
UNPLATTED (FUTURE STERLING RANCH RESIDENTIAL USE)
OVERALL STERLING RANCH PROPERTY BOUNDARY
UNPLATTED ELITE PROPERTIES OF AMERICA, INC. (CLASSIC HOMES)
UNPLATTED BUFORD/BENNETT
HOMESTEAD AT STERLING RANCH FILING NO. 2
EX-4A 44.2
HOMESTEAD AT STERLING RANCH FILING NO. 1
SAND CREEK REACH SC-8
REFERENCE SAND CREEK CHANNEL IMPROVEMENTS PROPOSED WITH HOMESTEAD NORTH AT STERLING RANCH FIL.NO. 1 PREPARED BY JR ENG. (PCD NO. SF-22-013)
CLASSIC OWNERSHIP BOUNDARY
**PROPOSED STERLING RANCH EAST FILING NO. 1**
UNPLATTED (FUTURE STERLING RANCH RESIDENTIAL USE)
STERLING RANCH RD. (80' ROW)
UNPLATTED (FUTURE STERLING RANCH RESIDENTIAL USE)
BRANDING IRON AT STERLING RANCH FILING NO. 2

SEE SHEET 3

N

200 100 0 200 400

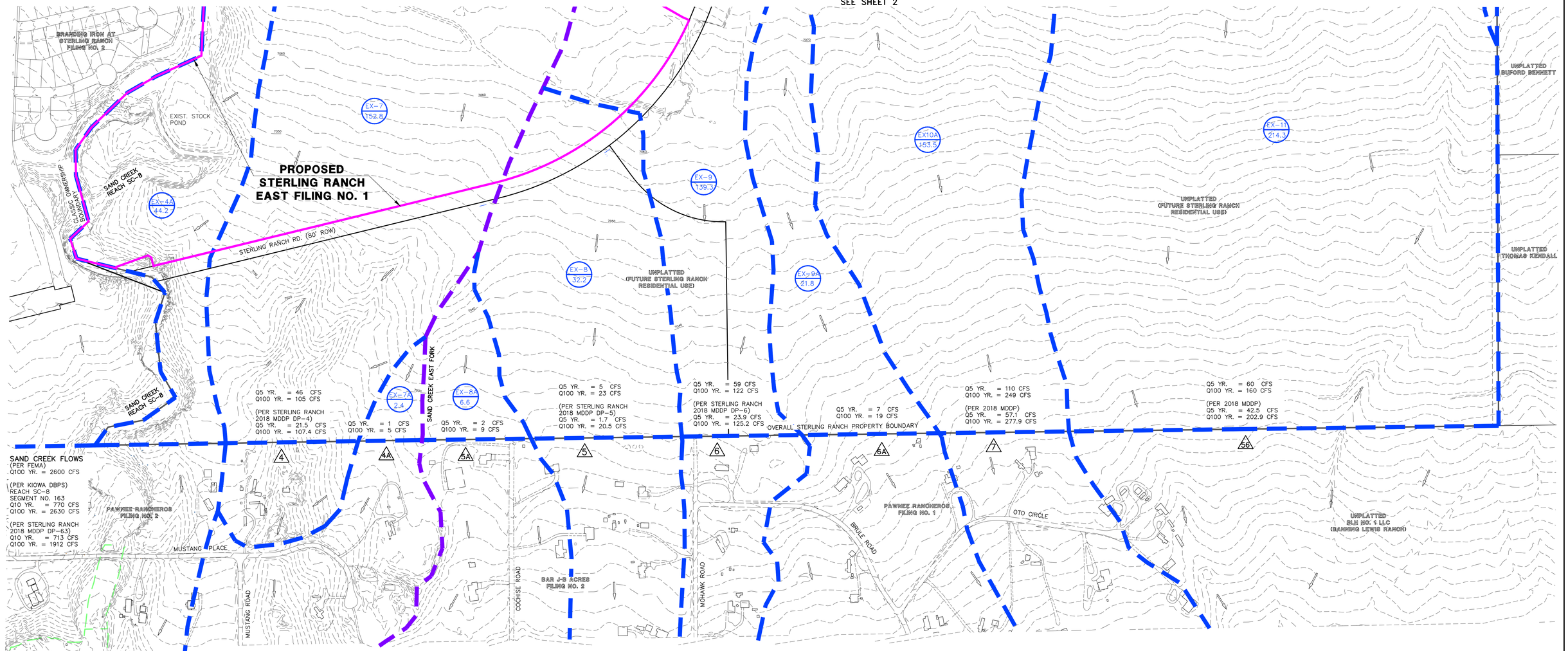
SCALE: 1" = 200'

CLASSIC CONSULTING SM
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799 (Fax)

STERLING RANCH EAST
PRELIMINARY PLAN NO. 1
PRELIMINARY DRAINAGE REPORT
PRE-DEVELOPMENT DRAINAGE MAP

| | | | |
|---|---|---|---|
| DESIGNED BY | MAW | SCALE | DATE 4-1-22 |
| DRAWN BY | MAW | (H) 1"= 200' | SHEET 2 OF 6 |
| CHECKED BY | | (V) 1"= N/A | JOB NO. 1183.22 |

SEE SHEET 2




**STERLING RANCH EAST PRELIMINARY PLAN NO. 1**
**Pre-Developed Subcatchment Runoff**

| Subcatchment | Area (Ac.) | SWMM Imperv. (%) | Peak Runoff 5 yr. (CFS) | Peak Runoff 100 yr. (CFS) |
|---|---|---|---|---|
| EX-10 | 265.9 | 7% | 105 | 222 |
| EX10A | 153.5 | 5% | 46 | 103 |
| EX-11 | 214.3 | 4% | 54 | 129 |
| EX-13 | 94.8 | 6% | 36 | 85 |
| EX-4A | 44.2 | 8% | 19 | 50 |
| EX-5 | 26.2 | 8% | 12 | 32 |
| EX-7 | 152.8 | 5% | 46 | 105 |
| EX-7A | 2.4 | 2% | 1 | 5 |
| EX-8 | 32.2 | 2% | 5 | 23 |
| EX-8A | 6.6 | 2% | 2 | 9 |
| EX-9 | 139.3 | 8% | 59 | 122 |
| EX-9A | 21.8 | 5% | 7 | 19 |
| TR-12 | 4.7 | 5% | 2 | 9 |
| TR-20 | 23.2 | 7% | 10 | 32 |
| TR-4 | 4.4 | 5% | 2 | 9 |
| TR-5 | 13.7 | 5% | 5 | 17 |
| TR-6 | 1.5 | 5% | 1 | 4 |
| TR-7 | 2.6 | 5% | 1 | 5 |

**STERLING RANCH EAST PRELIMINARY PLAN NO. 1**
**Pre-Developed Surface Routing**

| Design Point | Peak Runoff 5 yr. (CFS) | Peak Runoff 100 yr. (CFS) |
|---|---|---|
| DP4 | 46 | 105 |
| DP4A | 1 | 5 |
| DP5 | 5 | 23 |
| DP5A | 2 | 9 |
| DP6 | 59 | 122 |
| DP6A | 7 | 19 |
| DP7 | 110 | 249 |
| DP56 | 60 | 160 |
| DPEX-4A | 19 | 50 |
| DPEX-5 | 12 | 32 |

**LEGEND**

| DESCRIPTION | SYMBOL |
|---|---|
| EXISTING GROUND CONTOUR | 6910 |
| PROPOSED FINISHED CONTOUR | 6910 |
| SUB-BASIN BOUNDARY | |
| SAND CREEK EAST FORK BASIN LINE | |
| DESIGN POINT | 4 |
| BASIN IDENTIFIER / AREA IN ACRES | BB 10.0 |
| EXISTING DIRECTION OF FLOW | |
| EXISTING STORM SEWER | |

200 100 0 200 400

SCALE: 1" = 200'

CLASSIC CONSULTING SM
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799 (Fax)

STERLING RANCH EAST
PRELIMINARY PLAN NO. 1
PRELIMINARY DRAINAGE REPORT
PRE-DEVELOPMENT DRAINAGE MAP

| | | | | | |
|---|---|---|---|---|---|
| DESIGNED BY | MAW | SCALE | | DATE | 4-1-22 |
| DRAWN BY | MAW | (H) 1"= 200' | | SHEET | 3 OF 6 |
| CHECKED BY | | (V) 1"= N/A | | JOB NO. | 1183.22 |

SEE SHEET 4

**STERLING RANCH EAST PRELIMINARY PLAN NO. 1**
**Developed Subcatchment Runoff**

| Subcatchment | Area (Ac.) | SWWM Imperv. (%) | Peak Runoff 5 yr. (CFS) | Peak Runoff 100 yr. (CFS) |
|---|---|---|---|---|
| EF-A | 8.2 | 15% | 7 | 20 |
| EX10A | 60.4 | 5% | 18 | 50 |
| P1-A | 12.7 | 8% | 6 | 19 |
| P1-A1 | 5.0 | 45% | 11 | 21 |
| P1-A2 | 6.4 | 45% | 12 | 23 |
| P1-A3 | 1.8 | 50% | 5 | 9 |
| P1-A4 | 2.0 | 50% | 5 | 10 |
| P1-A5 | 5.7 | 45% | 13 | 25 |
| P1-A6 | 2.8 | 50% | 7 | 14 |
| P1-B | 35.5 | 38% | 55 | 108 |
| P1-C | 8.9 | 50% | 23 | 46 |
| P1-D | 31.4 | 38% | 53 | 102 |
| P1-E1 | 30.4 | 35% | 50 | 97 |
| P1-E2 | 21.8 | 40% | 41 | 80 |
| P1-F | 76.7 | 30% | 111 | 215 |
| P2-A | 22.2 | 10% | 13 | 41 |
| P2-B | 57.8 | 38% | 88 | 173 |
| P2-B1 | 2.5 | 50% | 7 | 13 |
| P2-B10 | 1.7 | 50% | 5 | 10 |
| P2-B2 | 1.9 | 50% | 5 | 10 |
| P2-B3 | 2.8 | 45% | 7 | 13 |
| P2-B4 | 1.6 | 50% | 4 | 8 |
| P2-B5 | 1.9 | 45% | 5 | 9 |
| P2-B6 | 1.1 | 50% | 3 | 6 |
| P2-B7 | 2.5 | 45% | 6 | 12 |
| P2-B8 | 1.2 | 50% | 3 | 7 |
| P2-B9 | 2.0 | 50% | 5 | 11 |
| P2-S1 | 35.6 | 40% | 68 | 133 |
| P3-A | 52.6 | 40% | 85 | 166 |
| P3-C | 1.7 | 11% | 1 | 5 |
| P3-S2 | 11.9 | 40% | 25 | 50 |
| P4-A | 25.8 | 35% | 41 | 80 |
| P4-B | 37.3 | 35% | 63 | 123 |
| SC-1 | 3.6 | 8% | 2 | 6 |
| SC-2 | 10.8 | 8% | 6 | 20 |
| SC-3 | 27.2 | 8% | 12 | 26 |
| SC-4 | 16.4 | 8% | 8 | 27 |
| TR-V | 2.1 | 19% | 2 | 6 |
| TR-W | 1.4 | 38% | 3 | 5 |

**STERLING RANCH EAST PRELIMINARY PLAN NO. 1**
**Developed Surface Routing**

| Design Point | Peak Runoff 5 yr. (CFS) | Peak Runoff 100 yr. (CFS) |
|---|---|---|
| DP-1 | 112 | 219 |
| DP-2 | 53 | 103 |
| DP-3 | 41 | 80 |
| DP-4 | 218 | 379 |
| DP-5 | 53 | 102 |
| DP-6 | 55 | 108 |
| DP-7 | 20 | 39 |
| DP-8 | 119 | 235 |
| DP-9 | 88 | 173 |
| DP-10 | 223 | 441 |
| DP-11 | 10 | 21 |
| DP-12 | 63 | 123 |
| DP-13 | 41 | 80 |
| DP-14 | 97 | 189 |
| DP-15 | 85 | 166 |
| DP-16 | 34 | 69 |

**STERLING RANCH EAST PRELIMINARY PLAN NO. 1**
**Pre-Developed Subcatchment Runoff**

| Subcatchment | Area (Ac.) | SWMM Imperv. (%) | Peak Runoff 5 yr. (CFS) | Peak Runoff 100 yr. (CFS) |
|---|---|---|---|---|
| EX-10 | 265.9 | 7% | 105 | 222 |
| EX10A | 153.5 | 5% | 46 | 103 |
| EX-11 | 214.3 | 4% | 54 | 129 |
| EX-13 | 94.8 | 6% | 36 | 85 |
| EX-4A | 44.2 | 8% | 19 | 50 |
| EX-5 | 26.2 | 8% | 12 | 32 |
| EX-7 | 152.8 | 5% | 46 | 105 |
| EX-7A | 2.4 | 2% | 1 | 5 |
| EX-8 | 32.2 | 2% | 5 | 23 |
| EX-8A | 6.6 | 2% | 2 | 9 |
| EX-9 | 139.3 | 8% | 59 | 122 |
| EX-9A | 21.8 | 5% | 7 | 19 |
| TR-12 | 4.7 | 5% | 2 | 9 |
| TR-20 | 23.2 | 7% | 10 | 32 |
| TR-4 | 4.4 | 5% | 2 | 9 |
| TR-5 | 13.7 | 5% | 5 | 17 |
| TR-6 | 1.5 | 5% | 1 | 4 |
| TR-7 | 2.6 | 5% | 1 | 5 |

**STERLING RANCH EAST PRELIMINARY PLAN NO. 1**
**Pond FSD-16 Tributary Area**

| Subcatchment | Area (Ac.) | Avg. Lot size (AC) | Effective Imperv. (%) |
|---|---|---|---|
| P1-A | 12.7 | N/A | 15% |
| P1-B | 35.5 | 7,500 | 55% |
| P1-C | 8.9 | N/A | 70% |
| P1-D | 31.4 | 6,500 | 60% |
| P1-E1 | 30.4 | 8,500 | 50% |
| P1-E2 | 21.8 | 7,500 | 55% |
| P1-F | 76.7 | 12,500 | 35% |
| TR-V | 2.1 | 17,500 | 27% |
| TR-W | 1.4 | 13,500 | 32% |
| TOTAL | 220.9 | | 46% |

Per my comment on page 114 below, we'd like to see a table like this for the interim condition that shows the 42.51ac tributary to the pond's interim condition (ie: the SW forebay in this case)

**POND FSD-16** (EDB)

TRIB. AREA = 220.9 AC.
WQCV = 3.6 AC.-FT.
EURV = 7.2 AC.-FT.
100 YR. = 12.4 AC.-FT.
TOTAL = 23.2 AC.-FT.

INFLOW: (SWMM MODEL)
Q5 = 323 CFS
Q100 = 499 CFS

OUTFLOW: (MHFD-DETENTION)
Q5 = 24.2 CFS
Q100 = 150.5 CFS

POND FSD-16 WILL OUTFALL DIRECTLY INTO 48" RCP PIPE SYSTEM CONSTRUCTED WITH BRIARGATE PKWY. EXTENSION. (REFERENCE JR ENG. STREET/STORM PLANS FOR BRIARGATE PKWY. AND STERLING RANCH RD. FOR OUTFALL DESIGN)

**LEGEND**

| DESCRIPTION | SYMBOL |
|---|---|
| EXISTING GROUND CONTOUR | 6910 |
| PROPOSED FINISHED CONTOUR | 6910 |
| BASIN BOUNDARY | |
| EAST FORK BASIN BOUNDARY | |
| DESIGN POINT | 15 |
| BASIN IDENTIFIER / AREA IN ACRES | BB 10.0 |
| EXISTING DIRECTION OF FLOW | |
| PROPOSED DIRECTION OF FLOW | |
| PROPOSED STORM SEWER | |
| PROPOSED STORM SEWER PER JR ENG. PLANS | |
| PROPOSED POND OUTFALL PER JR ENG. PLANS | |

add yellow shaded area to Legend.

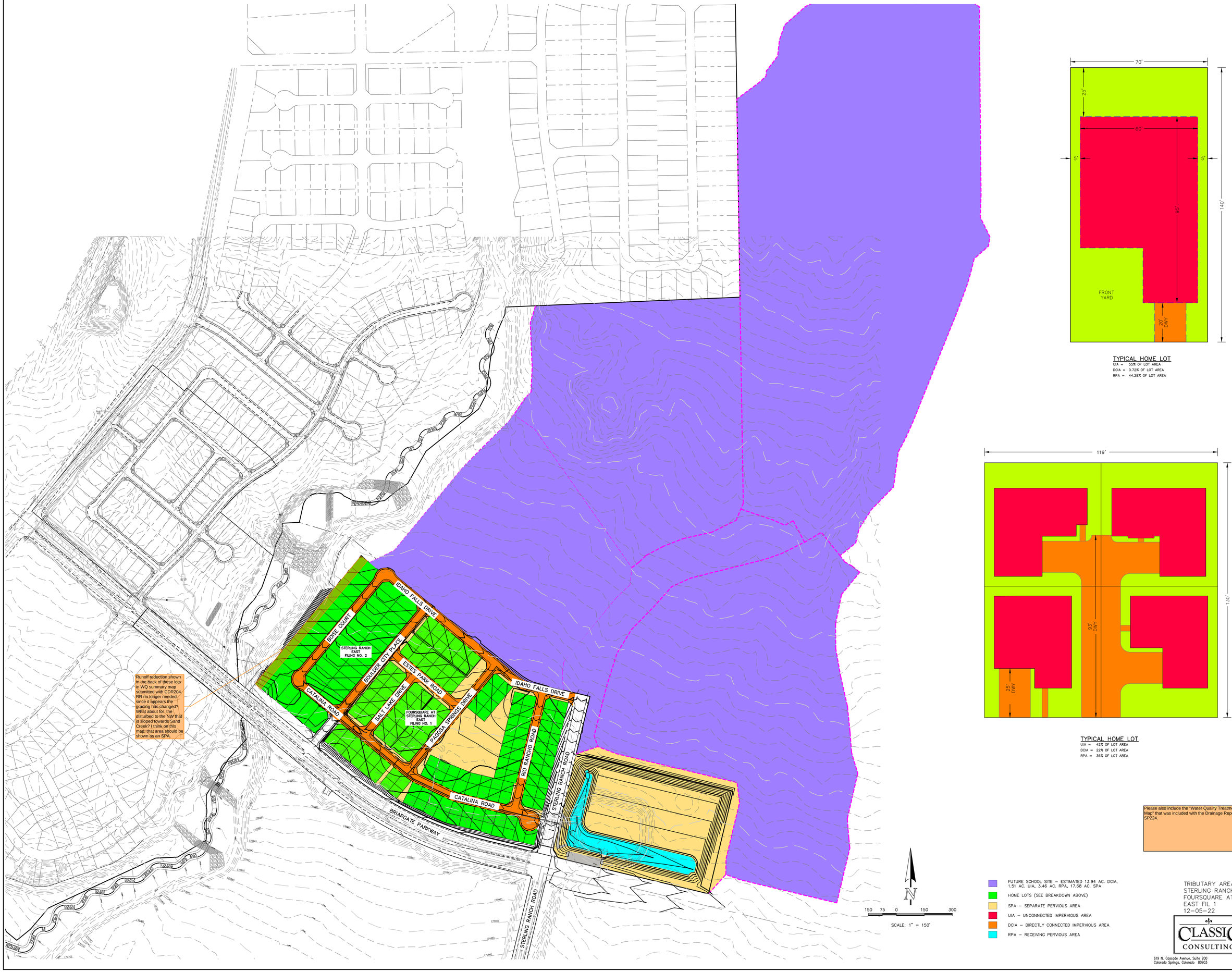
SCALE: 1" = 100'

SEE SHEET 6

CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

FOURSQUARE AT STERLING RANCH
PRELIMINARY PLAN / PUD
PRELIMINARY DRAINAGE REPORT
DEVELOPED DRAINAGE MAP

| | | | | | |
|---|---|---|---|---|---|
| DESIGNED BY | MAW | SCALE | | DATE | 9-30-22 |
| DRAWN BY | MAW | (H) 1"= 100' | | SHEET | 7 OF 7 |
| CHECKED BY | | (V) 1"= N/A | | JOB NO. | 1183.20 |







TYPICAL HOME LOT
UIA = 55% OF LOT AREA
DCIA = 0.72% OF LOT AREA
RPA = 44.28% OF LOT AREA




TYPICAL HOME LOT
UIA = 42% OF LOT AREA
DCIA = 22% OF LOT AREA
RPA = 36% OF LOT AREA

Please also include the "Water Quality Treatment Plan Map" that was included with the Drainage Report on SP224.

- FUTURE SCHOOL SITE – ESTIMATED 13.94 AC. DCIA, 1.51 AC. UIA, 3.46 AC. RPA, 17.68 AC. SPA
- HOME LOTS (SEE BREAKDOWN ABOVE)
- SPA – SEPARATE PERVIOUS AREA
- UIA – UNCONNECTED IMPERVIOUS AREA
- DCIA – DIRECTLY CONNECTED IMPERVIOUS AREA
- RPA – RECEIVING PERVIOUS AREA

TRIBUTARY AREA
STERLING RANCH EAST FIL NO. 1A
FOURSQUARE AT STERLING RANCH EAST FIL 1
12-05-22

CLASSIC CONSULTING
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

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

| Basin ID | Total Area (ac) | Total Proposed Disturbed Area (ac) | Area Trib to Pond A (ac) | Disturbed Area Treated via Runoff Reduction (ac) | Area Excluded from WQ per ECM App I.7.1.C.1 (ac) | Area Excluded from WQ per ECM App I.7.1.B.# (ac) | Applicable WQ Exclusions (App I.7.1.B.#) |
|---|---|---|---|---|---|---|---|
| A | 4.50 | 4.50 | 4.50 | - | | - | |
| B | 1.25 | 1.25 | - | 1.00 | 0.25 | - | |
| C | 6.00 | 4.00 | - | - | - | 4.00 | ECM App I.7.1.B.5 |
| D | 2.50 | 2.50 | 1.00 | - | 0.50 | 1.00 | ECM App I.7.1.B.7 |
| E | 3.00 | - | 3.00 | - | - | - | |
| F | 8.25 | - | - | - | - | - | |
| Total | 25.50 | 12.25 | 8.50 | 1.00 | 0.75 | 5.00 | |
| Comments | | *[For each row, the sum of the values in Columns 4-7 must be greater than or equal to the value in Column 3 above.]* | *[Values in this column can be more than Column 3 if over-treating non-disturbed areas.]* | See RR calc spreadsheet. | *[Total must be <20% of site and <1ac.]* | | |

1.18ac on pg 30 above

On the table on page 30 above, the total area is 54.96ac. And page 75 shows the forebay trib area as 42.51ac. So the map and table requested above will help us understand which areas are not trib to the forebay, while showing that WQ is .

See comments on Sterling Ranch East 2 (SF-22-037)

Label as "Pond FSD-16"

Show access road to future forebay

Show access road to future forebay

**LEGEND**

- EXISTING GROUND CONTOUR 5910
- PROPOSED FINISHED CONTOUR 5910
- SUBDIVISION BOUNDARY
- LOT LINE
- PROPOSED BASIN BOUNDARY
- OVERFLOW ROUTE
- DIRECTION OF DRAINAGE
- EXISTING STORM SEWER
- EXISTING STORM INLET
- PROPOSED STORM SEWER
- PROPOSED STORM INLET
- BASIN IDENTIFIER / AREA IN ACRES (D / 1.41)
- DESIGN POINT (2)
- PIPE RUN (2)

N

60 30 0 60 120

SCALE: 1" = 60'

**FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY**

| Pipe Run | Contributing Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity I(5) | Intensity I(100) | Flow Q(5) | Flow Q(100) | Pipe Size* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | DP 1 | 1.76 | 2.76 | 15.38 | 3.48 | 5.85 | 6.1 | 16.1 | 24" PUBLIC RCP STORM |
| 2 | DP 2 | 1.02 | 1.73 | 16.42 | 3.39 | 5.68 | 3.5 | 9.9 | 18" PUBLIC RCP STORM |
| 3 | PIPE 1 & PIPE 2 | 2.78 | 4.49 | 16.42 | 3.39 | 5.68 | 9.4 | 25.5 | 30" PUBLIC RCP STORM |
| 4 | DP 3 | 1.54 | 2.27 | 13.4 | 3.69 | 6.19 | 5.7 | 14.0 | 24" PUBLIC RCP STORM |
| 5 | DP 4 | 0.61 | 0.98 | 13.4 | 3.69 | 6.19 | 2.2 | 6.1 | 18" PUBLIC RCP STORM |
| 6 | PIPE 3, PIPE 4 & PIPE 5 | 4.93 | 7.74 | 16.4 | 3.39 | 5.68 | 16.7 | 44.0 | 30" PUBLIC RCP STORM |
| 7 | DP 5 | 0.66 | 0.97 | 14.7 | 3.56 | 5.97 | 2.3 | 5.8 | 18" PUBLIC RCP STORM |
| 8 | DP 6 | 0.14 | 0.15 | 5.0 | 5.17 | 8.68 | 0.7 | 1.3 | 18" PUBLIC RCP STORM |
| 9 | PIPE 7 & PIPE 8 | 0.80 | 1.13 | 14.7 | 3.56 | 5.97 | 2.9 | 6.7 | 18" PUBLIC RCP STORM |
| 10 | DP 7 | 1.50 | 2.28 | 13.4 | 3.69 | 6.19 | 5.5 | 14.1 | 24" PUBLIC RCP STORM |
| 11 | DP 8 | 0.30 | 0.71 | 12.2 | 3.83 | 6.42 | 1.1 | 4.6 | 18" PUBLIC RCP STORM |
| 12 | PIPE 9, PIPE 10, PIPE 11 | 2.60 | 4.12 | 14.7 | 3.56 | 5.97 | 9.3 | 24.6 | 24" PUBLIC RCP STORM |
| 13 | PIPE 6 & PIPE 12 | 7.53 | 11.86 | 16.4 | 3.39 | 5.68 | 25.5 | 67.4 | 36" PUBLIC RCP STORM |
| 14 | DP 9 INTERCEPTED | 2.05 | 2.23 | 14.7 | 3.56 | 5.97 | 7.3 | 13.3 | 24" PUBLIC RCP STORM |
| 15 | PIPE 13 & PIPE 14 | 9.58 | 14.10 | 16.4 | 3.39 | 5.68 | 32.4 | 80.1 | 42" PUBLIC RCP STORM |
| 16 | DP 10 | 1.00 | 2.62 | 14.7 | 3.56 | 5.97 | 3.6 | 15.7 | 24" PUBLIC RCP STORM |
| 17 | PIPE 15 & PIPE 16 | 10.58 | 16.72 | 16.4 | 3.39 | 5.68 | 35.8 | 95.0 | 42" PUBLIC RCP STORM |

**FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY**

| Design Point(s) | Contributing Basins | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc | Intensity I(5) | Intensity I(100) | Flow Q(5) | Flow Q(100) | Inlet Size |
|---|---|---|---|---|---|---|---|---|---|
| 1 | BASIN B | 1.76 | 2.76 | 15.4 | 3.48 | 5.85 | 6.1 | 16.1 | 10' TYPE R PUBLIC |
| 2 | BASIN A | 1.02 | 1.73 | 16.4 | 3.39 | 5.68 | 3.5 | 9.9 | 10' TYPE R PUBLIC |
| 3 | BASIN J | 1.54 | 2.27 | 13.4 | 3.69 | 6.19 | 5.7 | 14.0 | 10' TYPE R PUBLIC |
| 4 | BASIN K | 0.61 | 0.98 | 13.4 | 3.69 | 6.19 | 2.2 | 6.1 | 5' TYPE R PUBLIC |
| 5 | BASIN F & BASIN OS-3 | 0.66 | 0.97 | 14.7 | 3.56 | 5.97 | 2.3 | 5.8 | 5' TYPE R PUBLIC |
| 6 | BASIN G | 0.14 | 0.15 | 5.0 | 5.17 | 8.68 | 0.7 | 1.3 | 5' TYPE R PUBLIC |
| 7 | BASIN H | 1.50 | 2.28 | 13.4 | 3.69 | 6.19 | 5.5 | 14.1 | 10' TYPE R PUBLIC |
| 8 | BASIN I | 0.30 | 0.71 | 12.2 | 3.83 | 6.42 | 1.1 | 4.6 | 5' TYPE R PUBLIC |
| 9 | BASIN M & BASIN N | 2.15 | 3.66 | 14.7 | 3.56 | 5.97 | 7.6 | 21.9 | 15' TYPE R PUBLIC |
| 10 | BASIN L & FLOWBY DP 9 | 1.00 | 2.62 | 14.7 | 3.56 | 5.97 | 3.6 | 15.7 | 15' TYPE R PUBLIC |
| 11 | BASIN T & PIPE 17 | 11.48 | 20.64 | 16.4 | 3.39 | 5.68 | 39 | 117 | POND IN |

DRAINAGE MAP
STERLING RANCH EAST FIL 2
FOURSQUARE AT STERLING RANCH EAST FIL. NO. 1

CLASSIC CONSULTING
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)