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

March 2023

Prepared for:
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Job no. 2183.23
PCD File # SF2236 & SF2237

CLASSIC CONSULTING

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:

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

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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 (FSD 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. These sites will be constructed concurrently.

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 and Soil Group B Pring Coarse Sandy Loam (included for future areas) (See Appendix for Soil Map).

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 4.06 and UD-BMP version 3.07 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 (FSD Pond 16) and 44.02 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 (FSD 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 2% street slope = 12 cfs 4% street slope = 16.5 cfs 6% street slope = 19.5 cfs 8% street slope = 17.8 cfs 10% street slope = 16.5 cfs No curb overtopping.	1.5% street slope = 46 cfs 2% street slope = 44 cfs 4% street slope = 36 cfs 6% street slope = 32 cfs 8% street slope = 29 cfs 10% street slope = 27.5 cfs 12" maximum depth at flowline.
Residential w/Vertical Curb (6" Vertical Curb)	1.5% street slope = 13 cfs 2% street slope = 15 cfs 4% street slope = 20.5 cfs 6% street slope = 18 cfs 8% street slope = 16.8 cfs 10% street slope = 15.7 cfs No curb overtopping.	1.5% street slope = 45 cfs 2% street slope = 43 cfs 4% street slope = 35 cfs 6% street slope = 31 cfs 8% street slope = 28 cfs 10% street slope = 26.5 cfs 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. Homes near sump inlets shall be constructed at least 1 foot above the 100-year water surface ponding elevation. 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 shall 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 FSD 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 = 5.2 cfs, Q_{100} = 14.6 cfs) consists of developed flows from Basin B. Basin B is 4.99 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 = 3.6 cfs, Q_{100} = 10.0 cfs) consists of developed flows from Basin A. Basin A is 2.90 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 24” 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 = 8.2 cfs, Q_{100} = 23.1 cfs) consists of developed flows from Basin J. Basin J is 3.87 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 6). 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 7). The emergency overflow route for this inlet will overtop curb behind Design Point 4 to Tract A and then to Briargate Parkway.

Flows do not match
hydrology spreadsheet

Design Point 5 (Q_5 = 3.0 cfs, Q_{100} = 7.0 cfs) consists of developed flows from Basin D, Basin F and Basin OS-1. Basin D is 0.20 acres of Idaho Falls Drive. 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 10’ Type R sump inlet will intercept flows. Flow will be conveyed by a proposed 18” RCP public storm sewer (Pipe 9). The emergency overflow route for this inlet will be south to Design Point 6.

Unresolved:
Hydrology spreadsheet and drainage map have different areas for this basin. Revise so all 3 locations show the same area

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 10). 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 12). 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 13). 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 16).

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 10 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 18). 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 = 2.3 cfs, Q_{100} = 5.1 cfs) consists of developed flows from Basin R and Basin S. Basin R is 0.33 acres and Basin S is 1.00 acres of proposed residential development with associated streets, landscaping, and homes. Developed flows travel south in the east curbline of Boulder City Place to a proposed public 15’ Type R at-grade inlet at Design Point 11. This at-grade inlet will intercept (Q_5= 2.3 cfs, Q_{100}= 5.1 cfs) with a flow-by of (Q_5= 0.0 cfs, Q_{100}= 0.0 cfs). Intercepted flows will be conveyed by a proposed 18” RCP public storm sewer (Pipe 4).

Flows do not match hydrology spreadsheet

Design Point 12 (Q_5 = 3.6 cfs, Q_{100} = 15.7 cfs) consists of developed flows from Basin C and Basin Q. Basin C is 0.72 acres of open space tract that will discharge directly Briargate Parkway. Basin Q 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 and these flows were accounted for at this design point.

Indicate what design flows were in the previous report for the existing inlet

Design Point 13 (Q_5 = 5.4 cfs, Q_{100} = 15.1 cfs) consists of developed flows from Basin OS-2. Basin OS-2 is 4.35 acres of future residential development with associated streets, landscaping, and homes located north of Foursquare at Sterling Ranch East Filing No. 1 with the future extension of Sterling Ranch Road. Future Final Drainage Report for this area will detail this basin. For this report it is assumed that Developed flows travel south in the west curbline of future Sterling Ranch Road to a future public 15' Type R at-grade inlet at Design Point 13. This at-grade inlet will intercept (Q_5= 5.4 cfs, Q_{100}= 10.8 cfs) with a flow-by of (Q_5= 0.0 cfs, Q_{100}= 4.3 cfs) that will travel in the west curb line of Sterling Ranch Road to Design Point 15. Intercepted flows will be conveyed by a future public storm sewer constructed with future development.

Design Point 14 (Q_5 = 4.0 cfs, Q_{100} = 11.2 cfs) consists of developed flows from Basin OS-3. Basin OS-3 is 3.23 acres of future residential development with associated streets, landscaping, and homes located north of Foursquare at Sterling Ranch East Filing No. 1 with the future extension of Sterling Ranch Road. Future Final Drainage Report for this area will detail this basin. For this report it is assumed that Developed flows travel south in the east curbline of future Sterling Ranch Road to a future public 15' Type R at-grade inlet at Design Point 14. This at-grade inlet will intercept (Q_5= 4.0 cfs, Q_{100}= 9.1 cfs) with a flow-by of (Q_5= 0.0 cfs, Q_{100}= 2.1 cfs) that will travel in the east curb line of Sterling Ranch Road to Design Point 16. Intercepted flows will be conveyed by a future public storm sewer constructed with future development.

Design Point 15 (Q_5 = 2.9 cfs, Q_{100} = 10.1 cfs) consists of developed flows from Basin O and flow-by from Design Point 13. Basin O is 1.11 acres of open space tract and Sterling Ranch Road. Developed flows travel south in the west curb line of Sterling Ranch Road to a public 15' Type R at-grade inlet at Design Point 15. This at-grade inlet will intercept (Q_5= 2.9 cfs, Q_{100}= 8.9 cfs) with a flow-by of (Q_5= 0.0 cfs, Q_{100}= 2.1 cfs) that will travel in the east curb line of Sterling Ranch Road. 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 and were accounted for in that report.

Indicate what design flows were in the previous report for the existing inlet

& Basin OS-4 per
hydrology spreadshe

Design Point 16 (Q_5 = 2.7 cfs, Q_{100} = 7.4 cfs) consists of developed flows from Basin U and flow-by from Design Point 14. Basin U is 0.60 acres of open space tract and Sterling Ranch Road. Developed flows travel south in the west curb line of Sterling Ranch Road to a public 15’ Type R at-grade inlet at Design Point 16. This at-grade inlet will intercept (Q_5= 2.9 cfs, Q_{100}= 7.6 cfs) with a flow-by of (Q_5= 0.0 cfs, Q_{100}= 0.40 cfs) that will travel in the east curb line of Sterling Ranch Road. 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 and were accounted for in that report.

Design Point 17 (Q_5 = 1.3 cfs, Q_{100} = 4.2 cfs) consists of developed flows from Basin V and flow-by from Design Point 15 & 16. Basin V is 0.45 acres of Sterling Ranch Road. Developed flows travel south in the curb lines of Sterling Ranch Road. Design Point represents flows from Sterling Ranch Road that enter 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 and were accounted for in that report.

Design Point 18 (Q_5 = 0.7 cfs, Q_{100} = 2.4 cfs) consists of developed flows from Basin P.
Basin P 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-A2 in the Sterling Ranch East Filing No. 1 Final Drainage Report and these flows were accounted for at this design point.

Design Point 19 (Q_5 = 48 cfs, Q_{100} = 130 cfs) consists of Basin T and Pipe 22 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 22 **(Q_5 = 49.8 cfs, Q_{100} = 121.5 cfs)** is a public 48” RCP storm.

Basin E (Q_5 = 2.2 cfs, Q_{100} = 16.3 cfs) is 7.82 acres of open space tract and adjacent Sand Creek (Reach SC-9) channel improvements and rear landscaped yards that are within the boundary of Sterling Ranch East Filing No. 2. This is shown as a portion of Basin SC-4 in the SKP-22-004/SP-22-004 MDDP

Amendment for Sterling Ranch East and consists of the anticipated rear yards of the lots adjacent to the creek that will continue to sheet flows directly towards the Sand Creek corridor. At this time, these rear yards are not able to be captured and routed to a formal stormwater quality facility. However, given the minimal unconnected impervious area and sizeable receiving pervious are within this basin, the WQCV reduction = 100% with 0 untreated WQCV. (See Appendix for references) All channel work is completed per the “Final Drainage Report for Sand Creek Restoration,” by JR Engineering LLC, dated September 2022.

Tract I per Final Plat SF2236

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)

<u>Private FSD POND-16</u>

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. The interim condition consists of developed flows from both Foursquare at Sterling Ranch East Filing No. 1 and Sterling Ranch East Filing No. 2 as these sites will be constructed concurrently. 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.

Unresolved from Submittal 1: Clarify if anything on the pond (like the orifice plate) will be updated with this specific proposed project (SF2237). Because no orifice plate details were included with the CDs. Will this project be constructed at the same time as Four Square? So the orifice plate will being installed with Four Square will also account for the development of SF2237? Just add some more explanation to clarify these uncertainties.

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 44.02 acres. Per the IRF spread sheet a 100 Year Event 44.40% imperviousness will be used in the interim condition (see appendix). This total ultimate area is estimated at 220.90 acres. Per the IRF spread sheet a 100 Year Event 49.30% imperviousness will be used in the ultimate condition (See IRF Spreadsheet in Appendix)

Per information in Appendix (reference materials from previous reports, page 115) interim condition also accounted for full 220.9 acres at a 26% imperviousness

<u>Interim Condition (Sterling Ranch East Filing No. 2 & Foursquare at Sterling Ranch East Filing No. 1)</u>

delete extra decimal point

Per UD-Detention spreadsheet a 0.702 ac-ft. WQVC, 1.478 ac-ft. EURV, and a 3.5.81 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, 9.0, 16.0 and 16.0 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 170' 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

Plat has district listed as "Sterling Ranch Metropolitan District No. 3"

Planned release per the UD-Detention spreadsheet from the Full Spectrum EDB will be **Q_5= 0.70 cfs, Q_{100}= 1.60 cfs**. Allowable release into the existing 48" RCP outfall pipe at this location is anticipated to release rate of (Q_{100} = 156.6 cfs). <u>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.</u>

revise?

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

The Ultimate condition is an estimate only for the full assumed tributary area to Pond FSD 16 at full building out. I will be constructed with future developments. Per UD-Detention spreadsheet a 3.762 ac-ft. WQVC, 8.526ac-ft. EURV, and a 20.079 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, 16.0 and 16.0 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 170' 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= 4.1 cfs, Q_{100}= 120.5 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)

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

1. **Employ Runoff Reduction Practices:** Proposed urban lot impervious area (roof tops, patios, etc.) will sheet flow across landscape areas (yards) and open space areas to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets or detention facilities. This will minimize directly connected impervious areas within the project site. Water quality reduction will be employed for specific areas that are anticipated not able to be captured and routed to SWQ facilities.

2. **Stabilize Drainageways:** After developed flows utilize the runoff reduction practices through the front and rear yards, developed flows will travel via curb and gutter within the public streets of the development and eventually public storm systems. These collected flows are then routed directly to multiple extended detention basins (full-spectrum facilities). Sand Creek improvements and restoration plans are being proposed for this entire reach as described in "Final Design Report for Sand Creek Restoration", prepared by JR Engineering, LLC, dated September 2022.

3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV and excess urban runoff volume (EURV) in the proposed Full-Spectrum permanent Extended Detention Basins designed per current El Paso County drainage criteria.

Unresolved from submittal 1: except for the area of disturbance on the western boundary of this site? Discuss applicable exclusion(s).

4. **Consider need for Industrial and Commercial BMPs**: No industrial uses are proposed within this development. A site-specific storm water quality and erosion control plan and narrative will be submitted along with the grading and erosion control plan. Details such as site-specific sediment and erosion control construction BMP's as well as temporary and permanent BMP's were detailed in this plan and narrative to protect receiving waters. BMP's will be constructed and maintained as the development has been graded and erosion control methods employed.

DRAINAGE AND BRIDGE FEES

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

State what 2023 drainage and bridge fees are for Sand Creek Drainage basin.

The fees are calculated using the following impervious acreage method approved by El Paso County. The Sterling Ranch East Filing Filing No. 2 has a total area of 16.841 acres with the following different land uses proposed:

STERLING RANCH EAST FILING NO. 2

5.756 Ac.	Sand Creek Corridor (Tract)
1.087 Ac.	Open Space (Tract
9.998 Ac.	0.25 Ac. avg. lot size
16.841Ac.	**Total**

Avg Lot size is 7600 sf, approx 1/6 of an acre. % impervious is 52%

Need to break out the 2.676 acres for ROW and use 100% impervious for that area

The percent imperviousness for this subdivision is calculated as follows:

Fees for Sand Creek Drainage Corridor

(Per El Paso County Percent Impervious Chart: 2%)

5.756 Ac. x 2% = **0.115 Impervious Ac.**

Update based on comments above.

Avg Lot Size is 7600 sf

Fees for 1/4 Ac. lots (Avg. lot size of 9,800 SF)

(Per El Paso County Percent Impervious Chart: 40%)

9.998Ac. x 40% = **3.999 Impervious Ac.**

Total Impervious Acreage: **4.114 Imp. Ac.**

Areas do not match

STERLING RANCH EAST FILING No. 2 (6.718 Impervious acres)

DRAINAGE FEE:

$23,821/acre x 4.114 acres $ 98,002.45

BRIDGE FEE:

$9,743/acre x 4.114 acres $ 40,082.70

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

The fees are calculated using the following impervious acreage method approved by El Paso County. The Foursquare at Sterling Ranch East Filing No. 1 has a total area of 36.647 acres with the following different land uses proposed:

FOURSQUARE AT STERLING RANCH EAST FILING NO. 1

11.191 Ac.	Detention Facilities & Park (Tract I)
5.141 Ac.	Open Space (Tracts A, B, C, D, G, E, F)
20.315 Ac.	0.125 Ac. avg. lot size
36.647Ac.	**Total**

Need to break out the 6
ROW and use 100% im
that area

The percent imperviousness for this subdivision is calculated as follows:

Fees for Detention Facilities & Park

(Per El Paso County Percent Impervious Chart: 7**%**)

11.191 Ac. x 7% = **0.783 Impervious Ac.**

Remove extra digit.

Fees for 1/8 Ac. lots (Avg. lot size of 3,900SF)

(Per El Paso County Percent Impervious Chart: 65**%**)

20.315 Ac. x 65% = **13,204 Impervious Ac**

FOURSQUARE AT STERLING RANCH EAST FILING No. 1 (13.987 Impervious acres)

DRAINAGE FEE:

$23,821/acre x 13.987 acres	$ 333,1184.33

BRIDGE FEE:

$9,743/acre x 13.987 acres	$ 136,275.34

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

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 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:

Construction Cost Opinion needs to be added back in.

David L Gibson P.E.
Project Manager

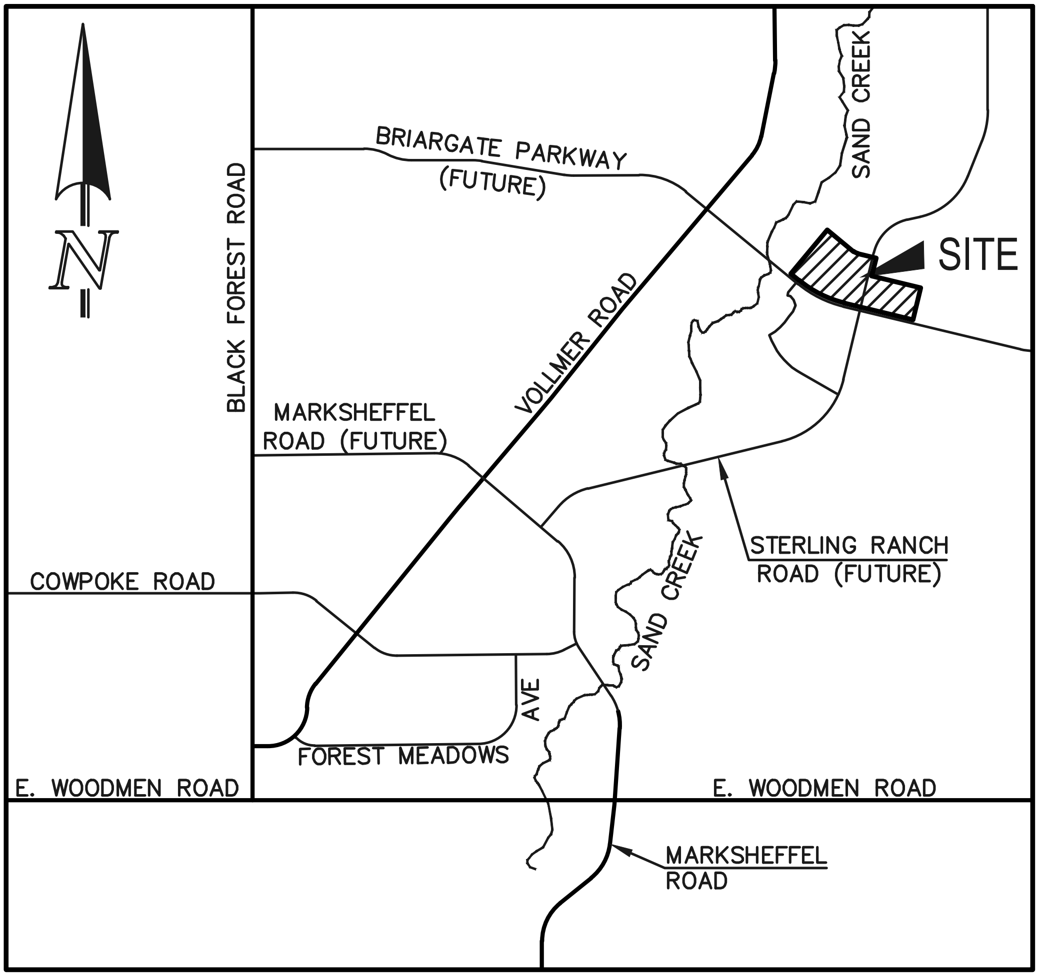
dlg/118323/FDR-SRE FILING 1ª FSQ SER FILING 1.docx

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

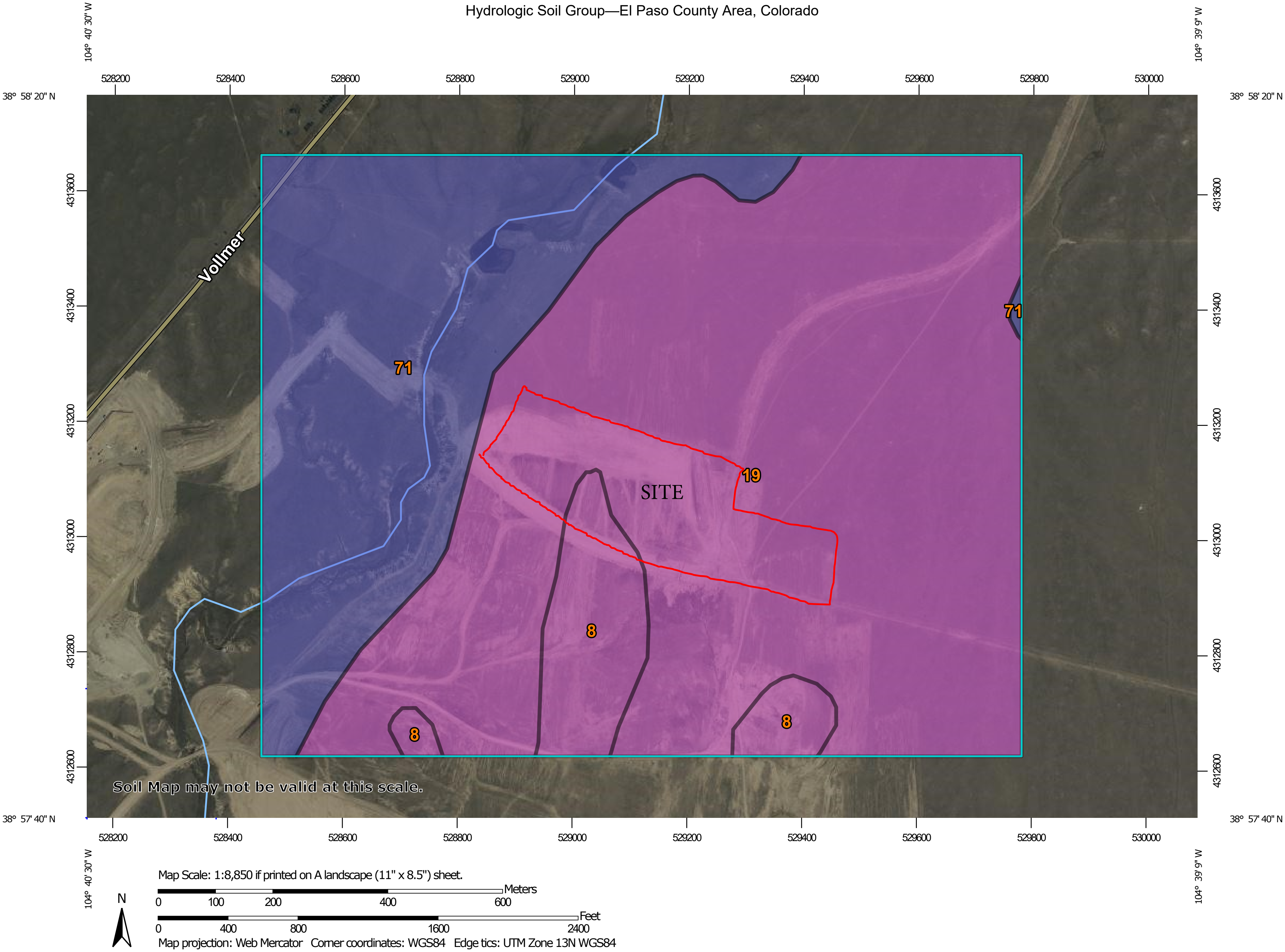


VICINITY MAP

NOT TO SCALE

SOILS MAP (S.C.S. SURVEY)

Hydrologic Soil Group—El Paso County Area, Colorado



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

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

MAP LEGEND

Area of Interest (AOI)

▭ Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

〰 Streams and Canals

Transportation

┼┼┼ Rails
〰 Interstate Highways
〰 US Routes
〰 Major Roads
〰 Local Roads

Background

▨ Aerial Photography

MAP INFORMATION

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

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.

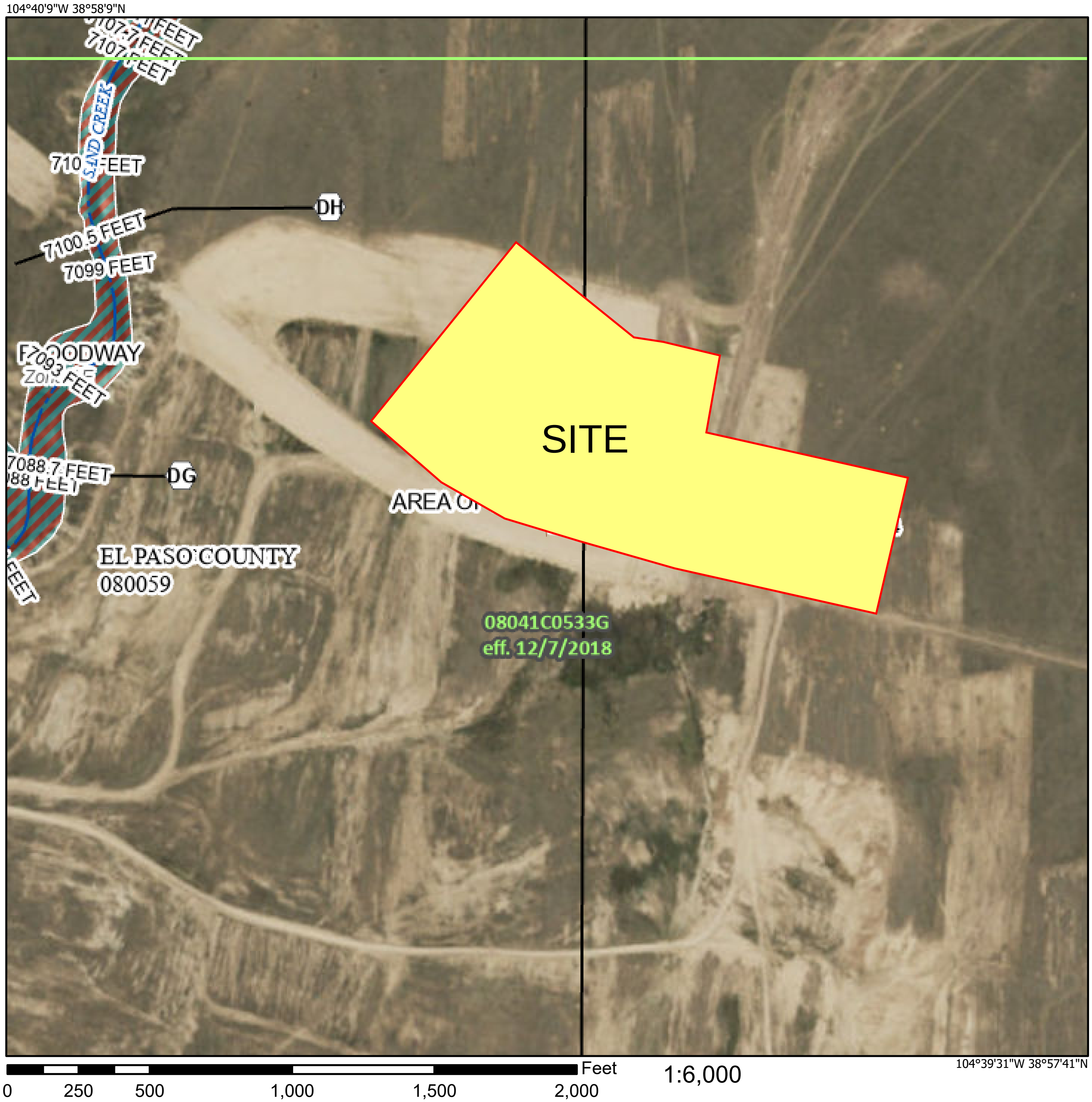
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over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

F.E.M.A. MAP

National Flood Hazard Layer FIRMette

FEMA



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	(B) 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8 — — —	Coastal Transect
	~~ 513 ~~~	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

JOB NAME: *STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1*
JOB NUMBER: *1183.23*
DATE: *03/16/23*
CALCULATED BY: *DLG*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	DEVELOPED AREA (LOTS/ROADS)				LANDSCAPE TRACTS/UNDEVELOPED AREA				WEIGHTED				WEIGHTED CA		
		AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	**USE**	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**
A	2.90	2.90	0.23	0.30	0.50	0.00	0.02	0.08	0.35	1/4 RES	0.23	0.30	0.50	**0.67**	**0.87**	**1.45**
B	4.99	4.99	0.23	0.30	0.50	0.00	0.02	0.08	0.35	1/4 RES	0.23	0.30	0.50	**1.15**	**1.50**	**2.50**
C	0.72	0.19	0.89	0.90	0.96	0.53	0.02	0.08	0.35	ROAD/TRACT	0.25	0.30	0.51	**0.18**	**0.21**	**0.37**
D	0.20	0.20	0.89	0.90	0.96	0.00	0.02	0.08	0.35	ROAD	0.89	0.90	0.96	**0.18**	**0.18**	**0.19**
E	7.82	1.70	0.89	0.90	0.96	6.12	0.02	0.08	0.35	LANDSCAPE/TRACT	0.21	0.26	0.48	**1.64**	**2.02**	**3.77**
F	0.49	0.49	0.89	0.90	0.96	0.00	0.02	0.08	0.35	ROAD	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	ROAD	0.89	0.90	0.96	**0.14**	**0.14**	**0.15**
H	4.01	4.01	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**1.64**	**1.80**	**2.37**
I	1.68	1.09	0.41	0.45	0.59	0.59	0.02	0.08	0.35	1/8 RES/TRACT	0.27	0.32	0.51	**0.46**	**0.54**	**0.85**
J	3.87	3.87	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**1.59**	**1.74**	**2.28**
K	1.83	1.83	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**0.75**	**0.82**	**1.08**
L	2.20	2.20	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**0.90**	**0.99**	**1.30**
M	4.10	4.10	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**1.68**	**1.85**	**2.42**
N	3.00	1.23	0.41	0.45	0.59	1.77	0.02	0.08	0.35	1/8 RES/TRACT	0.18	0.23	0.45	**0.54**	**0.70**	**1.35**
O	1.11	0.74	0.89	0.90	0.96	0.37	0.02	0.08	0.35	ROAD/TRACT	0.60	0.63	0.76	**0.67**	**0.70**	**0.84**
P	0.63	0.10	0.89	0.90	0.96	0.53	0.02	0.08	0.35	LANDSCAPE TRACT	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	LANDSCAPE TRACT	0.19	0.24	0.47	**0.10**	**0.12**	**0.24**
R	0.33	0.33	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**0.14**	**0.15**	**0.19**
S	1.00	1.00	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**0.41**	**0.45**	**0.59**
T	11.19	0.00	0.89	0.90	0.96	11.19	0.02	0.08	0.35	POND/TRACT	0.02	0.08	0.35	**0.22**	**0.90**	**3.92**
U	0.60	0.60	0.89	0.90	0.96	0.00	0.02	0.08	0.35	ROAD	0.89	0.90	0.96	**0.53**	**0.54**	**0.58**
V	0.45	0.35	0.89	0.90	0.96	0.10	0.02	0.08	0.35	ROAD/TRACT	0.70	0.72	0.82	**0.31**	**0.32**	**0.37**
P1-A2	6.59	4.20	0.89	0.90	0.96	2.39	0.02	0.08	0.35	TRACT/ROAD	0.57	0.62	0.75	**3.79**	**4.09**	**4.94**
OS-1	2.18	2.18	0.23	0.30	0.50	0.00	0.02	0.08	0.35	FUT 1/4 RES	0.23	0.30	0.50	**0.50**	**0.65**	**1.09**
OS-2	4.35	4.35	0.23	0.30	0.50	0.00	0.02	0.08	0.35	FUT 1/4 RES	0.23	0.30	0.50	**1.00**	**1.31**	**2.18**
OS-3	3.23	3.23	0.23	0.30	0.50	0.00	0.02	0.08	0.35	FUT 1/4 RES	0.23	0.30	0.50	**0.74**	**0.97**	**1.62**
OS-4	0.36	0.36	0.23	0.30	0.50	0.00	0.02	0.08	0.35	FUT 1/4 RES	0.23	0.30	0.50	**0.08**	**0.11**	**0.18**

Unresolved:
Impervious (roads) and Pervious areas (lots, landscape, tracts, etc) need to be split apart with their C-values. Would be easiest to have 3 columns for "land use": Impervious (roads), Development (1/4 ac, 1/8 ac, etc) and then Undeveloped Area.

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

Unresolved:
Table will be reviewed on next submittal after C-values have been revised

$V = C_v S_w^{0.5}$ 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

	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
BASIN	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	0.67	0.87	1.45	0.08	50	2	8.2	300	2.0%	2.8	1.8	10.0	3.29	4.13	6.93	2.2	**3.6**	**10.0**
B	1.15	1.50	2.50	0.08	100	2.5	13.6	300	2.0%	2.8	1.8	15.4	2.78	3.48	5.85	3.2	**5.2**	**14.6**
C	0.18	0.21	0.37	0.08	50	1	10.4	0	0.0%	0.0	0.0	10.4	3.25	4.08	6.84	0.6	**0.9**	**2.5**
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	1.64	2.02	3.77	0.08	100	3	12.8	0	0.0%	0.0	0.0	12.8	3.00	3.76	6.31	4.9	**7.6**	**23.8**
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	1.64	1.80	2.37	0.08	100	4	11.7	300	2.0%	2.8	1.8	13.4	2.94	3.69	6.19	4.8	**6.7**	**14.6**
I	0.46	0.54	0.85	0.08	100	4	11.7	100	2.0%	2.8	0.6	12.2	3.05	3.83	6.42	1.4	**2.1**	**5.5**
J	1.59	1.74	2.28	0.08	100	4	11.7	300	2.0%	2.8	1.8	13.4	2.94	3.69	6.19	4.7	**6.4**	**14.1**
K	0.75	0.82	1.08	0.08	100	4	11.7	300	2.0%	2.8	1.8	13.4	2.94	3.69	6.19	2.2	**3.0**	**6.7**
L	0.90	0.99	1.30	0.08	100	4	11.7	300	2.0%	2.8	1.8	13.4	2.94	3.69	6.19	2.7	**3.7**	**8.0**
M	1.68	1.85	2.42	0.08	100	4	11.7	300	2.0%	2.8	1.8	13.4	2.94	3.69	6.19	4.9	**6.8**	**15.0**
N	0.54	0.70	1.35	0.08	100	2	14.7	0	0.0%	0.0	0.0	14.7	2.84	3.56	5.97	1.5	**2.5**	**8.0**
O	0.67	0.70	0.84	0.08	50	5	6.1	300	2.0%	2.8	1.8	7.9	3.58	4.49	7.54	2.4	**3.1**	**6.3**
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

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$

$$V = C_v S_w^{0.5}$$

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 CA(2)	CA(5)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS 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	0.14	0.15	0.19	0.08	100	4	11.7	50	2.0%	2.8	0.3	11.9	3.08	3.86	6.48	0.4	**0.6**	**1.3**
S	0.41	0.45	0.59	0.08	100	4	11.7	50	2.0%	2.8	0.3	11.9	3.08	3.86	6.48	1.3	**1.7**	**3.8**
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**
U	0.53	0.54	0.58	0.08	0	0	0.0	300	2.0%	2.8	1.8	5.0	4.12	5.17	8.68	2.2	**2.8**	**5.0**
V	0.31	0.32	0.37	0.08	50	2	8.2	100	2.0%	2.8	0.6	8.8	3.44	4.32	7.25	1.1	**1.4**	**2.7**
P1-A2	3.79	4.09	4.94	0.08	10	0.5	3.4	2350	0.9%	1.9	11.8	15.2	2.79	3.50	5.87	10.6	**14.3**	**29.0**
OS-1	0.50	0.65	1.09	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**	**6.5**
OS-2	1.00	1.31	2.18	0.08	50	2	8.2	300	2.0%	2.8	1.8	10.0	3.29	4.13	6.93	3	**5**	**15**
OS-3	0.74	0.97	1.62	0.08	50	2	8.2	300	2.0%	2.8	1.8	10.0	3.29	4.13	6.93	2	**4**	**11**
OS-4	0.08	0.11	0.18	0.08	50	2	8.2	0	0.0%	0.0	0.0	8.2	3.53	4.42	7.42	0	**0**	**1**

JOB NAME: ***STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1***
JOB NUMBER: ***1183.23***
DATE: ***03/16/23***
CALCULATED BY: ***DLG***

Unresolved:
Table will be reviewed on next submittal after C-values have been revised & flow rates updated

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMAR

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	1.50	2.50	15.4	3.48	5.85	5.2	14.6	10' TYPE R SUMP PUBLIC
2	BASIN A	0.87	1.45	10.0	4.13	6.93	3.6	10.0	10' TYPE R SUMP PUBLIC
3	BASIN J	1.74	2.28	13.4	3.69	6.19	6.4	14.1	10' TYPE R SUMP PUBLIC
4	BASIN K	0.82	1.08	13.4	3.69	6.19	3.0	6.7	5' TYPE R SUMP PUBLIC
5	BASIN D, BASIN F & BASIN OS-1	1.28	1.75	14.7	3.56	5.97	4.5	10.5	10' TYPE R SUMP PUBLIC
6	BASIN G	0.14	0.15	5.0	5.17	8.68	0.7	1.3	5' TYPE R SUMP PUBLIC
7	BASIN H	1.80	2.37	13.4	3.69	6.19	6.7	14.6	10' TYPE R SUMP PUBLIC
8	BASIN I	0.54	0.85	12.2	3.83	6.42	2.1	5.5	5' TYPE R SUMP PUBLIC
9	BASIN M & BASIN N	2.54	3.76	14.7	3.56	5.97	9.0	22.5	15' TYPE R AT GRADE PUBLIC
10	BASIN L & FLOWBY DP 9	1.21	2.70	14.7	3.56	5.97	4.3	16.1	15' TYPE R SUMP PUBLIC
11	BASIN R & S	0.60	0.78	11.9	3.86	6.48	2.3	5.1	15' TYPE R AT GRADE PUBLIC
12	BASIN P1-A2(INCLUDE C & Q)	4.09	4.94	15.2	3.50	5.87	14.3	29.0	EX 20' TYPE R AT GRADE PUBLIC
13	BASIN OS-2	1.31	2.18	10.0	4.13	6.93	5.4	15.1	FUTURE 15' TYPE R AT GRADE PUBLIC
14	BASIN OS-3	0.97	1.62	10.0	4.13	6.93	4.0	11.2	FUTURE 15' TYPE R AT GRADE PUBLIC
15	BASIN O & FLOW-BY DP 13	0.70	1.46	10.0	4.13	6.93	2.9	10.1	15' TYPE R AT GRADE PUBLIC

Does not include CA values from Basins C & Q

JOB NAME: *STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1*
JOB NUMBER: *1183.23*
DATE: *03/16/23*
CALCULATED BY: *DLG*

Per report, Flow-by is from DP 14

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
16	BASIN U, OS-4, & FLOW-BY DP 15	0.65	1.07	10.0	4.13	6.93	2.7	7.4	15' TYPE R AT GRADE PUBLIC
17	BASIN V & FLOW-BY DP 15 & 16	0.32	0.61	10.0	4.13	6.93	1.3	4.2	EXISTING 20' TYPE R SUMP PUBLIC
18	BASIN P	0.13	0.28	5.0	5.17	8.68	0.7	2.4	EXISTING 20' TYPE R AT GRADE PUBLIC
19	BASIN T & PIPE 17	13.84	22.16	15.4	3.48	5.85	48	130	POND IN

Per report, Pipe 22

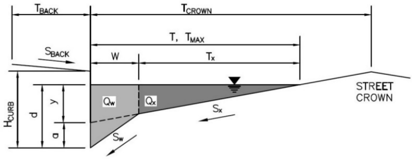
Unresolved:
Inlet calculation spreadsheets will be reviewed with next submittal when flows have been revised.

MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. 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	

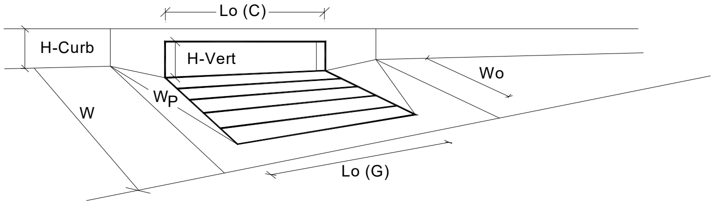
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input) ▾ CDOT Type R Curb Opening		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
Open Area 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
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	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)	$Q_{PEAK\ REQUIRED}$ =	5.2	14.6	cfs

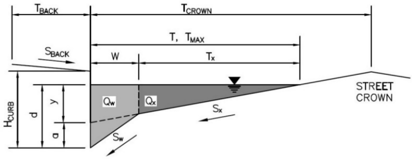
MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. 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	

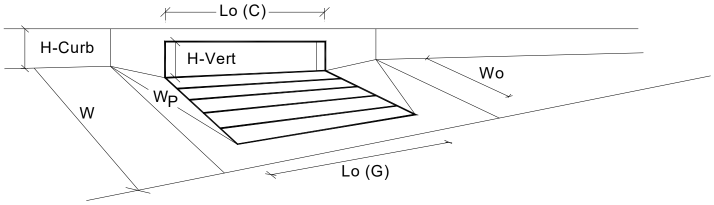
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

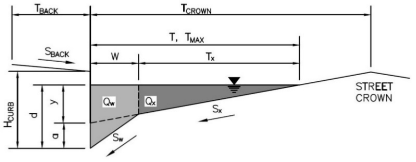


Design Information (Input)	CDOT Type R Curb Opening ▾	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
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
Open Area 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
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	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)	$Q_{PEAK\ REQUIRED}$ =	3.6	10.0	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 FIL. NO. 1
Inlet ID: INLET DP 3



Gutter Geometry:

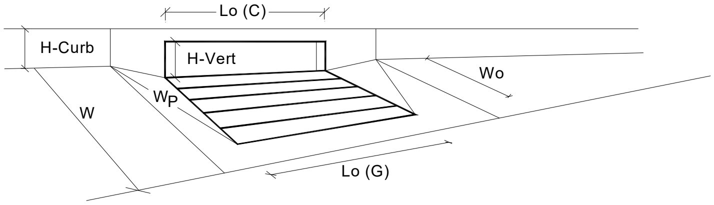
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		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 Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	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
Open Area 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
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	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)	$Q_{PEAK\ REQUIRED}$ =	6.4	14.1	cfs

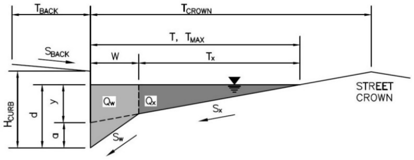
MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. NO. 1

Inlet ID: INLET DP 4

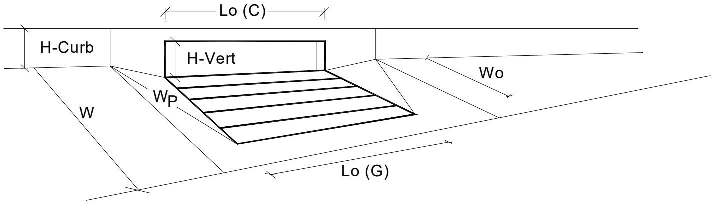


Gutter Geometry:

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 not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening	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
Open Area 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
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	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)	$Q_{PEAK\ REQUIRED}$ =	3.0	6.7	cfs

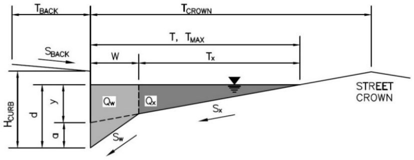
MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. 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	

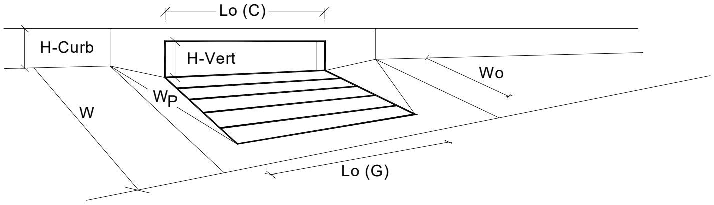
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



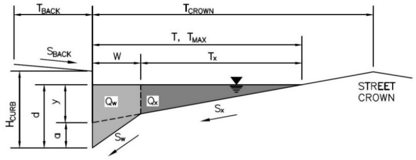
Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	4.6	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
Open Area 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} =	0.30	0.30	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.84	0.84	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.3**	**6.3**	**cfs**
WARNING: Inlet Capacity < Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	4.5	10.5	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 FIL. NO. 1

Inlet ID: INLET DP 6



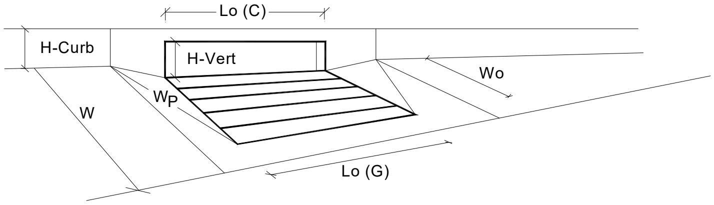
Gutter Geometry:

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 not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



		MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening ▼			
Type of Inlet	Type =	CDOT Type R Curb Opening	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	4.6	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
Open Area 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	

		MINOR	MAJOR	
Low Head Performance Reduction (Calculated)				
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.30	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

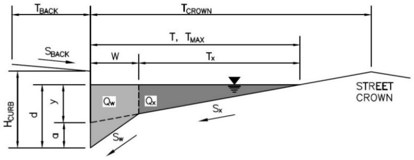
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**4.6**	**4.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.3	cfs

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 FIL. NO. 1

Inlet ID: INLET DP 7



Gutter Geometry:

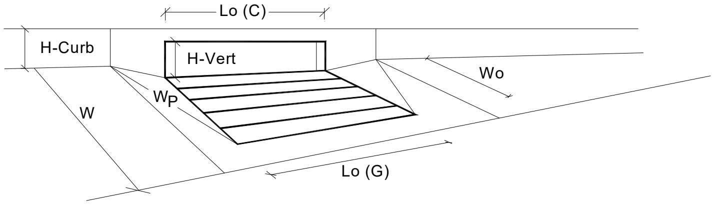
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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 not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening ▾	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
Open Area 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
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	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)	$Q_{PEAK\ REQUIRED}$ =	6.7	14.6	cfs

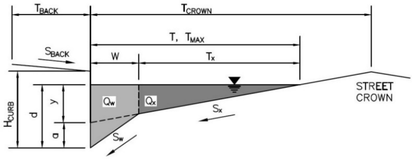
MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. NO. 1

Inlet ID: INLET DP 8



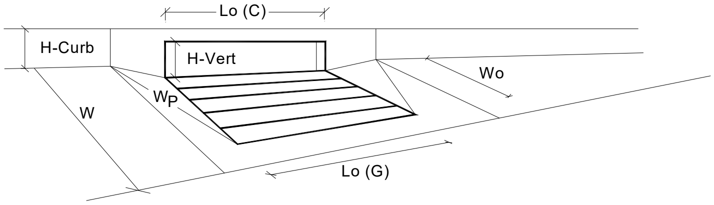
Gutter Geometry:

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 not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input) CDOT Type R Curb Opening ▾		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
Open Area 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
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	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)	$Q_{PEAK\ REQUIRED}$ =	2.1	5.5	cfs

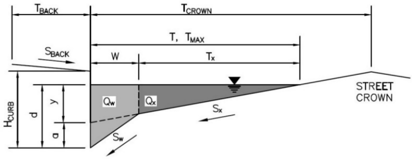
MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. NO. 1**

Inlet ID: **AT GRADE INLET DP 9**



<u>Gutter Geometry:</u>

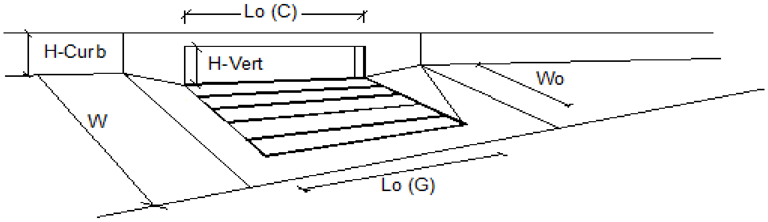
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		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 peak flow of 9.00 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 22.50 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening	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 =**	**7.9**	**13.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.1**	**9.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**88**	**59**	**%**

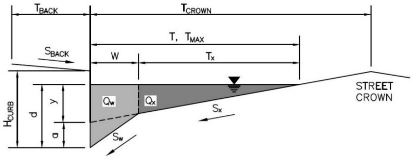
MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. 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	

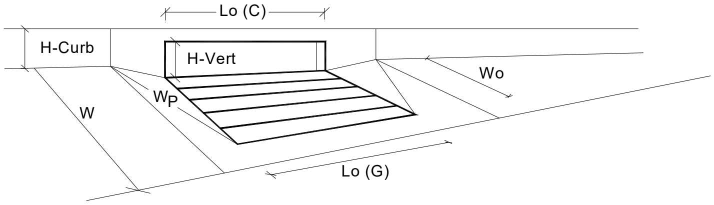
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



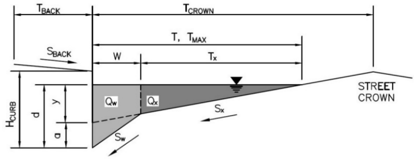
Design Information (Input)	CDOT Type R Curb Opening ▾		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (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
Open Area 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
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.79	0.88	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**10.9**	**19.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		$Q_{PEAK\ REQUIRED}$ =	4.1	16.1	cfs

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

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

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

Inlet ID: AT GRADE INLET DP 11



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 =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	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)		☐	☑	

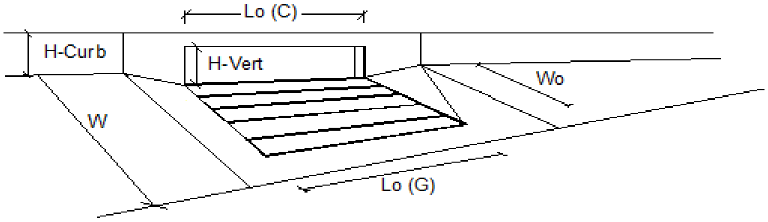
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**15.1**	**49.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.30 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.10 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



CDOT Type R Curb Opening ▾

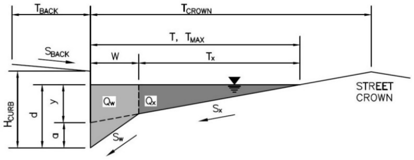
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.3**	**5.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. NO. 1**
Inlet ID: **FUTURE AT GRADE DP 13**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5	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} =	26.0	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 =	0.035	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

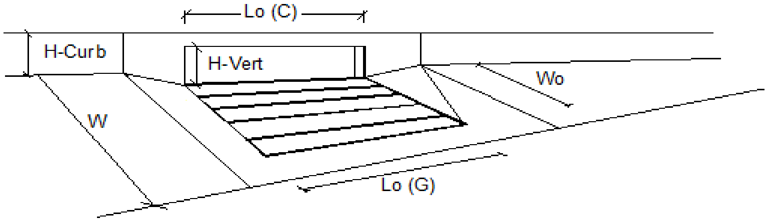
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.3	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**27.0**	**79.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 5.40 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 15.10 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



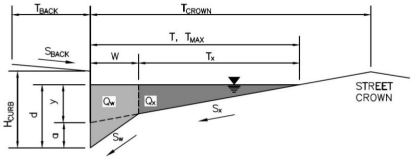
Design Information (Input) CDOT Type R Curb Opening ▼		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit 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 =**	**5.4**	**10.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**4.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**71**	**%**

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 FIL. NO. 1
Inlet ID: FUTURE AT GRADE DP 14



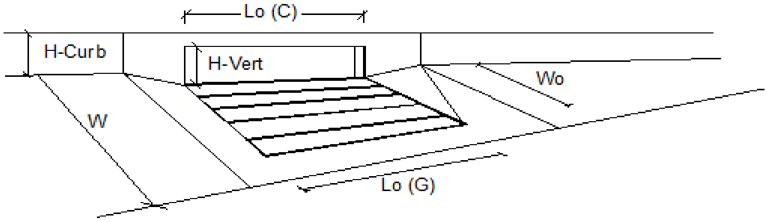
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5		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} =	26.0		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 =	0.035		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.3	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 Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**27.0**	**79.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.00 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 11.20 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		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 =**	**4.0**	**9.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**81**	**%**

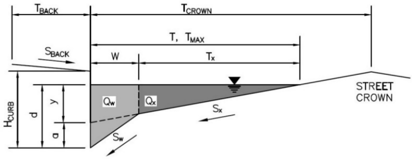
MHFD-Inlet, Version 5.02 (August 2022)

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 FIL. NO. 1

Inlet ID: AT GRADE INLET DP 15



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5	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} =	26.0	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 =	0.030	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.3	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

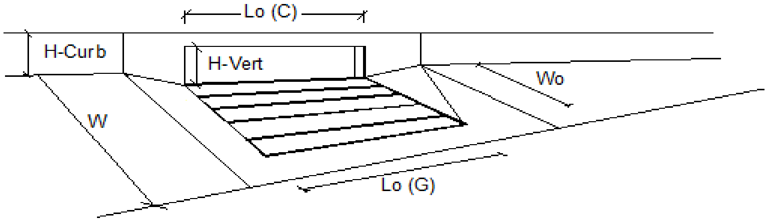
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**22.6**	**67.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.90 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 10.10 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening	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	

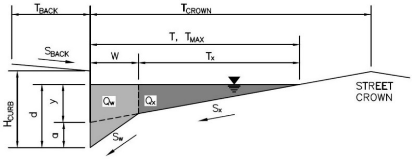
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.9**	**8.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**88**	**%**

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 FIL. NO. 1

Inlet ID: AT GRADE INLET DP 16



Gutter Geometry:

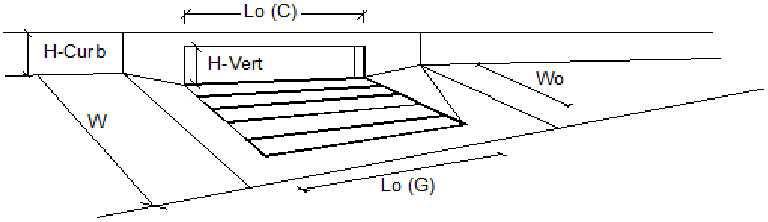
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0		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 =	0.030		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.020		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.3	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 Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**22.6**	**67.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.90 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.00 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		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 =**	**2.9**	**7.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**95**	**%**

JOB NAME: ***STERLING RANCH EAST FIL NO. 2 & FOURSQUARE AT STERLING RANCH EAST FIL NO. 1***
JOB NUMBER: ***1183.23***
DATE: ***03/16/23***
CALCULATED BY: ***DLG***

Unresolved:
Table will be reviewed on next submittal when flows have been revised

* 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		
					I(5)	I(100)	Q(5)	Q(100)	Pipe Size*
1	DP 1	1.50	2.50	15.4	3.48	5.85	5.2	14.6	24" PUBLIC RCP STORM
2	DP 2	0.87	1.45	10.0	4.13	6.93	3.6	10.0	24" PUBLIC RCP STORM
3	PIPE 1 & PIPE 2	2.37	3.95	15.4	3.48	5.85	8.2	23.1	24" PUBLIC RCP STORM
4	DP 11	0.60	0.78	11.9	3.86	6.48	2.3	5.1	18" PUBLIC RCP STORM
5	PIPE 3 & 4	2.97	4.73	15.4	3.48	5.85	10.3	27.7	30" PUBLIC RCP STORM
6	DP 3	1.74	2.28	13.4	3.69	6.19	6.4	14.1	24" PUBLIC RCP STORM
7	DP 4	0.82	1.08	13.4	3.69	6.19	3.0	6.7	18" PUBLIC RCP STORM
8	PIPE 5, PIPE 6 & PIPE 7	5.53	8.09	15.4	3.48	5.85	19.3	47.3	36" PUBLIC RCP STORM
9	DP 5	1.28	1.75	14.7	3.56	5.97	4.5	10.5	18" PUBLIC RCP STORM
10	DP 6	0.14	0.15	5.0	5.17	8.68	0.7	1.3	18" PUBLIC RCP STORM
11	PIPE 9 & PIPE 10	1.42	1.91	14.7	3.56	5.97	5.0	11.4	24" PUBLIC RCP STORM
12	DP 7	1.80	2.37	13.4	3.69	6.19	6.7	14.6	24" PUBLIC RCP STORM
13	DP 8	0.54	0.85	12.2	3.83	6.42	2.1	5.5	18" PUBLIC RCP STORM
14	PIPE 11, PIPE 12, PIPE 13	3.76	5.12	14.7	3.56	5.97	13.4	30.6	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: ***03/16/23***
CALCULATED BY: ***DLG***

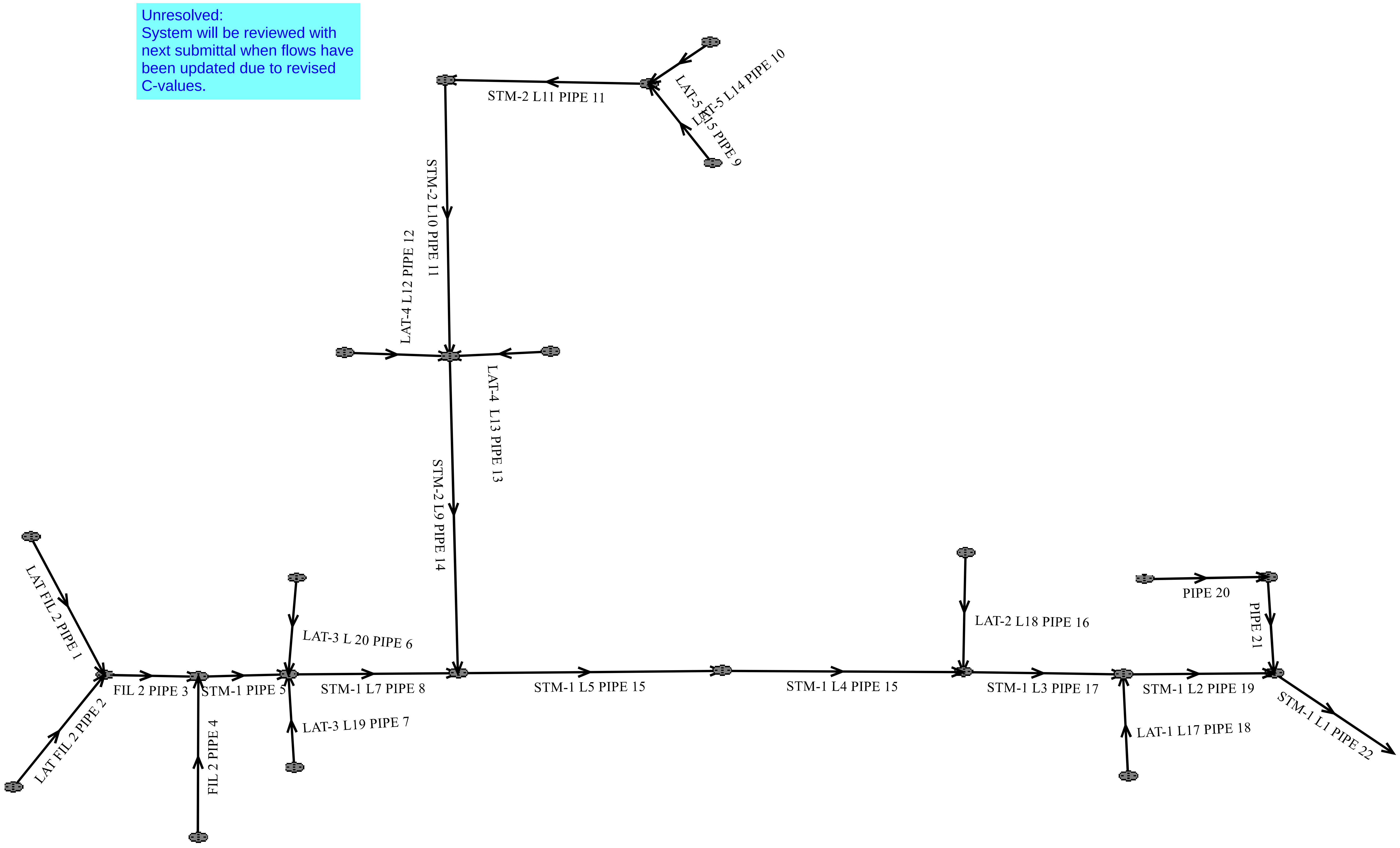
* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

					Intensity		Flow		
Pipe Run	**Contributing Basins**	**Equivalent CA(5)**	**Equivalent CA(100)**	**Maximum Tc**	**I(5)**	**I(100)**	**Q(5)**	**Q(100)**	**Pipe Size***
15	PIPE 8 & PIPE 14	9.29	13.21	15.4	3.48	5.85	32.4	77.3	42" PUBLIC RCP STORM
16	DP 9 INTERCEPTED	2.44	2.33	14.7	3.56	5.97	8.7	13.9	24" PUBLIC RCP STORM
17	PIPE 15 & PIPE 16	11.73	15.55	15.4	3.48	5.85	40.9	90.9	42" PUBLIC RCP STORM
18	DP 10	1.21	2.70	14.7	3.56	5.97	4.3	16.1	24" PUBLIC RCP STORM
19	PIPE 17 & PIPE 18	12.94	18.25	15.4	3.48	5.85	45.1	106.7	42" PUBLIC RCP STORM
20	DP 15 INTERCEPTED	0.70	1.46	10.0	4.13	6.93	2.9	10.1	42" PUBLIC RCP STORM
21	DP 16 INTERCEPTED & PIPE 20	1.34	2.53	10.0	4.13	6.93	5.5	17.5	42" PUBLIC RCP STORM
22	PIPE 19 & PIPE 21	14.29	20.77	15.4	3.48	5.85	49.8	121.5	48" PUBLIC RCP STORM

HYDRAULIC GRADE LINE (HGL)

CALCULATIONS



Unresolved:
System will be reviewed with next submittal when flows have been updated due to revised C-values.

System Input Summary 100 YEAR

Backwater Calculations:

Tailwater Elevation (ft): 7097.60

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 22	7107.04	121.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 21	7107.94	17.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 20	7107.94	10.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STM-1 L2 PIPE 19	7111.34	106.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STM-1 L3 PIPE 17	7112.39	90.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT-2 L18 PIPE 16	7112.63	13.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STM-1 L4 PIPE 15	7117.81	77.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STM-1 L5 PIPE 15	7117.57	77.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STM-1 L7 PIPE 8	7116.79	47.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT-3 L19 PIPE 7	7116.90	6.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

STM-1 PIPE 5	7118.50	27.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIL 2 PIPE 3	7117.53	23.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT FIL 2 PIPE 2	7117.80	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT FIL 2 PIPE 1	7118.07	14.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIL 2 PIPE 4	7118.03	11.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT-3 L 20 PIPE 6	7116.90	14.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STM-2 L9 PIPE 14	7119.40	30.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STM-2 L10 PIPE 11	7126.37	11.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STM-2 L11 PIPE 11	7125.97	11.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT-5 L15 PIPE 9	7126.07	10.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT-5 L14 PIPE 10	7126.07	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT-4 L13 PIPE 13	7119.57	5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT-4 L12 PIPE 12	7119.57	14.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT-1 L17 PIPE 18	7111.06	16.10	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	10.45	11.63	0.14	121.50	
STM-1 L1 PIPE 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	121.50	
PIPE 21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.50	
PIPE 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.10	
STM-1 L2 PIPE 19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	106.70	
STM-1 L3 PIPE 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	90.90	
LAT-2 L18 PIPE 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.90	
STM-1 L4 PIPE 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	77.30	
STM-1 L5 PIPE 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	77.30	
STM-1 L7 PIPE 8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.30	
LAT-3 L19 PIPE 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.70	
STM-1 PIPE 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.70	
FIL 2 PIPE 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.10	
LAT FIL 2 PIPE 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	
LAT FIL 2 PIPE 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.60	
FIL 2 PIPE 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.40	
LAT-3 L 20 PIPE 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.10	
STM-2 L9 PIPE 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.60	
STM-2 L10 PIPE 11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.40	
STM-2 L11 PIPE 11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.40	

LAT-5 L15 PIPE 9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.50	
LAT-5 L14 PIPE 10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	
LAT-4 L13 PIPE 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	
LAT-4 L12 PIPE 12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.60	
LAT-1 L17 PIPE 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.10	

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 22	79.03	7094.50	0.8	7095.13	0.013	0.05	1.00	CIRCULAR	48.00 in	48.00 in
PIPE 21	16.81	7101.80	2.0	7102.14	0.013	0.29	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 20	59.63	7102.46	1.7	7103.47	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
STM-1 L2 PIPE 19	93.14	7099.80	0.8	7100.55	0.013	0.10	0.25	CIRCULAR	42.00 in	42.00 in
STM-1 L3 PIPE 17	94.79	7100.65	0.8	7101.41	0.013	0.05	0.25	CIRCULAR	42.00 in	42.00 in
LAT-2 L18 PIPE 16	24.67	7107.27	2.0	7107.76	0.013	1.00	0.00	CIRCULAR	24.00 in	24.00 in
STM-1 L4 PIPE 15	368.17	7101.75	0.8	7104.70	0.013	0.05	0.25	CIRCULAR	42.00 in	42.00 in
STM-1 L5 PIPE 15	278.55	7104.81	0.5	7106.20	0.013	0.05	1.00	CIRCULAR	42.00 in	42.00 in
STM-1 L7 PIPE 8	84.52	7106.69	1.0	7107.54	0.013	0.05	0.25	CIRCULAR	36.00 in	36.00 in
LAT-3 L19 PIPE 7	5.67	7113.06	1.9	7113.17	0.013	1.00	0.00	CIRCULAR	18.00 in	18.00 in
STM-1 PIPE 5	369.56	7107.64	0.5	7109.49	0.013	0.05	0.25	CIRCULAR	36.00 in	36.00 in
FIL 2 PIPE 3	125.71	7109.56	1.0	7110.82	0.013	0.05	0.25	CIRCULAR	36.00 in	36.00 in
LAT FIL 2 PIPE 2	5.68	7112.86	0.5	7112.89	0.013	1.01	0.00	CIRCULAR	24.00 in	24.00 in

LAT FIL 2 PIPE 1	26.95	7112.86	0.5	7112.99	0.013	0.48	0.00	CIRCULAR	24.00 in	24.00 in
FIL 2 PIPE 4	29.86	7112.73	1.0	7113.03	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
LAT-3 L 20 PIPE 6	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 14	249.88	7106.86	1.6	7110.86	0.013	1.00	0.00	CIRCULAR	30.00 in	30.00 in
STM-2 L10 PIPE 11	490.62	7112.01	1.7	7120.35	0.013	0.05	0.25	CIRCULAR	24.00 in	24.00 in
STM-2 L11 PIPE 11	48.37	7120.65	1.0	7121.13	0.013	1.00	1.00	CIRCULAR	24.00 in	24.00 in
LAT-5 L15 PIPE 9	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 10	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 13	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 12	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 18	24.38	7102.06	8.2	7104.06	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 22	128.82	10.25	39.79	10.91	37.10	11.66	1.17	Supercritical	121.50	0.00	
PIPE 21	14.90	8.43	18.00	9.90	18.00	9.90	0.00	Pressurized	17.50	16.81	
PIPE 20	13.73	7.77	14.69	6.54	11.47	8.50	1.65	Pressurized	10.10	59.63	
STM-1 L2 PIPE 19	90.23	9.38	42.00	11.09	42.00	11.09	0.00	Pressurized	106.70	93.14	
STM-1 L3 PIPE 17	90.23	9.38	42.00	9.45	42.00	9.45	0.00	Pressurized	90.90	94.79	
LAT-2 L18 PIPE 16	32.08	10.21	16.11	6.20	11.04	9.85	2.06	Supercritical	13.90	0.00	
STM-1 L4 PIPE 15	90.23	9.38	33.00	9.53	29.93	10.54	1.22	Pressurized	77.30	368.17	
STM-1 L5 PIPE 15	71.33	7.41	42.00	8.03	42.00	8.03	0.00	Pressurized	77.30	278.55	
STM-1 L7 PIPE 8	66.88	9.46	26.88	8.36	22.35	10.26	1.44	Pressurized	47.30	84.52	
LAT-3 L19 PIPE 7	14.52	8.22	12.02	5.34	8.59	8.05	1.90	Pressurized	6.70	5.67	
STM-1 PIPE 5	61.48	8.70	20.42	6.69	16.94	8.47	1.43	Pressurized	27.70	369.56	
FIL 2 PIPE 3	86.94	12.30	18.57	6.28	12.67	10.40	2.08	Pressurized	23.10	125.71	
LAT FIL 2 PIPE 2	20.85	6.64	13.58	5.46	11.71	6.57	1.33	Pressurized	10.00	5.68	
LAT FIL 2 PIPE 1	20.85	6.64	16.52	6.33	14.80	7.18	1.24	Pressurized	14.60	26.95	
FIL 2 PIPE 4	13.69	7.75	15.46	7.06	12.55	8.67	1.56	Pressurized	11.40	29.86	
LAT-3 L 20 PIPE 6	22.68	7.22	16.23	6.24	13.70	7.61	1.39	Pressurized	14.10	24.67	
STM-2 L9 PIPE 14	52.02	10.60	22.62	7.71	16.54	11.03	1.84	Pressurized	30.60	249.88	
STM-2 L10 PIPE 11	29.58	9.41	14.54	5.73	10.34	8.80	1.92	Supercritical Jump	11.40	140.07	
STM-2 L11 PIPE 11	22.68	7.22	14.54	5.73	12.04	7.23	1.43	Supercritical	11.40	0.00	

Per ECM Section 3.3.1.J.8 pipe exceeds max velocity of 18 fps

LAT-5 L15 PIPE 9	10.53	5.96	14.94	6.70	14.70	6.79	1.04	Supercritical	10.50	0.00	
LAT-5 L14 PIPE 10	10.53	5.96	5.12	3.14	4.27	4.05	1.42	Supercritical	1.30	0.00	
LAT-4 L13 PIPE 13	11.05	6.25	10.85	4.94	8.98	6.24	1.44	Supercritical	5.50	0.00	
LAT-4 L12 PIPE 12	22.68	7.22	16.52	6.33	14.01	7.67	1.38	Supercritical	14.60	0.00	
LAT-1 L17 PIPE 18	64.96	20.68	17.36	6.62	8.14	17.15	4.29	Pressurized	16.10	24.38	

- 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 22	121.50	CIRCULAR	48.00 in	48.00 in	48.00 in	48.00 in	48.00 in	48.00 in	12.57	
PIPE 21	17.50	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
PIPE 20	10.10	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
STM-1 L2 PIPE 19	106.70	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 17	90.90	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
LAT-2 L18 PIPE 16	13.90	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 15	77.30	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
STM-1 L5 PIPE 15	77.30	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 L7 PIPE 8	47.30	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
LAT-3 L19 PIPE 7	6.70	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
STM-1 PIPE 5	27.70	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	
FIL 2 PIPE 3	23.10	CIRCULAR	36.00 in	36.00 in	24.00 in	24.00 in	36.00 in	36.00 in	7.07	
LAT FIL 2 PIPE 2	10.00	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
LAT FIL 2 PIPE 1	14.60	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
FIL 2 PIPE 4	11.40	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
LAT-3 L 20 PIPE 6	14.10	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 14	30.60	CIRCULAR	30.00 in	30.00 in	27.00 in	27.00 in	30.00 in	30.00 in	4.91	
STM-2 L10 PIPE 11	11.40	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
STM-2 L11 PIPE 11	11.40	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
LAT-5 L15 PIPE 9	10.50	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.
LAT-5 L14 PIPE 10	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 13	5.50	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 12	14.60	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 18	16.10	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): 7097.60

	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 22	7094.50	7095.13	0.00	0.00	7097.60	7098.45	7099.70	0.59	7100.29
PIPE 21	7101.80	7102.14	0.44	0.00	7103.30	7103.77	7104.83	0.46	7105.29
PIPE 20	7102.46	7103.47	0.51	0.00	7105.29	7105.84	7105.80	0.55	7106.35
STM-1 L2 PIPE 19	7099.80	7100.55	0.19	0.97	7103.30	7104.35	7105.21	1.04	7106.26
STM-1 L3 PIPE 17	7100.65	7101.41	0.07	1.56	7106.50	7107.27	7107.89	0.77	7108.66
LAT-2 L18 PIPE 16	7107.27	7107.76	0.30	0.00	7108.19	7109.10	7109.69	0.01	7109.70
STM-1 L4 PIPE 15	7101.75	7104.70	0.05	1.14	7108.84	7111.00	7109.84	2.16	7112.01
STM-1 L5 PIPE 15	7104.81	7106.20	0.05	0.00	7111.05	7112.69	7112.06	1.64	7113.69
STM-1 L7 PIPE 8	7106.69	7107.54	0.03	0.83	7113.86	7114.28	7114.56	0.42	7114.98
LAT-3 L19 PIPE 7	7113.06	7113.17	0.22	0.00	7114.98	7115.00	7115.20	0.02	7115.22
STM-1 PIPE 5	7107.64	7109.49	0.01	0.64	7115.39	7115.76	7115.63	0.38	7116.00
FIL 2 PIPE 3	7109.56	7110.82	0.01	0.20	7116.04	7116.13	7116.21	0.09	7116.29
LAT FIL 2 PIPE 2	7112.86	7112.89	0.16	0.00	7116.30	7116.30	7116.45	0.01	7116.46
LAT FIL 2 PIPE 1	7112.86	7112.99	0.16	0.00	7116.29	7116.36	7116.63	0.07	7116.69
FIL 2 PIPE 4	7112.73	7113.03	0.03	0.00	7115.79	7116.00	7116.44	0.21	7116.65
LAT-3 L 20 PIPE 6	7112.55	7112.80	0.31	0.00	7114.98	7115.07	7115.29	0.10	7115.39
STM-2 L9 PIPE 14	7106.86	7110.86	0.60	0.00	7113.69	7115.08	7114.30	1.38	7115.68

STM-2 L10 PIPE 11	7112.01	7120.35	0.01	0.55	7116.04	7121.56	7116.24	5.83	7122.07
STM-2 L11 PIPE 11	7120.65	7121.13	0.20	0.00	7121.77	7122.34	7122.46	0.39	7122.85
LAT-5 L15 PIPE 9	7121.64	7121.90	0.16	0.00	7122.86	7123.15	7123.58	0.26	7123.84
LAT-5 L14 PIPE 10	7121.63	7121.73	0.00	0.00	7122.84	7122.84	7122.85	0.00	7122.86
LAT-4 L13 PIPE 13	7115.61	7115.67	0.15	0.00	7116.42	7116.57	7116.91	0.04	7116.95
LAT-4 L12 PIPE 12	7115.11	7115.36	0.34	0.00	7116.28	7116.74	7117.19	0.17	7117.36
LAT-1 L17 PIPE 18	7102.06	7104.06	0.41	0.00	7106.26	7106.38	7106.66	0.12	7106.79

- 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.

DETENTION & STORMWATER QUALITY POND

(CONSTRUCTED WITH SF2236)

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator
LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

Designer: dlg
Company: Classic Consulting
Date: August 17, 2020
Project: Foursquare at Sterling Ranch East Filing No. 1 & Sterling Ranch East Filing No. 2
Location: FSD Pond 16 TRIBUTARY INTERIM

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52	
Max Intensity for Optional User Defined Storm	2.51496		

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**FIL 2**	**FSQ**												
Receiving Pervious Area Soil Type	Sand	Sand												
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	8.600	35.420												
Directly Connected Impervious Area (DCIA, acres)	2.543	5.703												
Unconnected Impervious Area (UIA, acres)	3.355	9.417												
Receiving Pervious Area (RPA, acres)	2.702	6.738												
Separate Pervious Area (SPA, acres)	0.000	13.562												
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C												

Need to provide an exhibit showing these receiving pervious areas.

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	8.600	35.420												
Directly Connected Impervious Area (DCIA, %)	29.6%	16.1%												
Unconnected Impervious Area (UIA, %)	39.0%	26.6%												
Receiving Pervious Area (RPA, %)	31.4%	19.0%												
Separate Pervious Area (SPA, %)	0.0%	38.3%												
A_R (RPA / UIA)	0.805	0.716												
I_a Check	0.550	0.580												
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	0.65												
IRF for 5-Year Event:	0.87	0.87												
IRF for 100-Year Event:	0.88	0.89												
IRF for Optional User Defined Storm CUHP:	0.88	0.89												
Total Site Imperviousness: I_{total}	68.6%	42.7%												
Effective Imperviousness for WQCV Event:	54.3%	33.4%												
Effective Imperviousness for 5-Year Event:	63.4%	39.3%												
Effective Imperviousness for 100-Year Event:	63.9%	39.7%												
Effective Imperviousness for Optional User Defined Storm CUHP:	63.9%	39.7%												

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	18.7%	13.5%	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:	6.5%	7.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:	8.4%	5.8%												

Total Site Imperviousness:	**47.7%**
Total Site Effective Imperviousness for WQCV Event:	**37.5%**
Total Site Effective Imperviousness for 5-Year Event:	**44.0%**
Total Site Effective Imperviousness for 100-Year Event:	**44.4%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**44.4%**

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

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: **DLG**
Company: **CLASSIC CONSULTING**
Date: **March 16, 2023**
Project: **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**
Location: **POND FSD 16 INTERIM CONDITION (FILING 2 & FOURSQUARE ONLY)**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 44.4 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.444

C) Contributing Watershed Area — Area = 44.020 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.43 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}= ac-ft

G) For Watersheds Outside of the Denver Region,
Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)
— $V_{DESIGN\ OTHER}$= 0.702 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) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = 100 %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = 0 %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = 0 %

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: $EURV_{C/D} = 1.20 * i^{1.08}$
— $EURV_{DESIGN}$ = 2.180 ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired)
— $EURV_{DESIGN\ USER}$= 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:

5. Forebay

A) Minimum Forebay Volume
(V_{FMIN} = 3% of the WQCV)
— V_{FMIN} = 0.021 ac-ft

B) Actual Forebay Volume — V_F = 0.021 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} = 121.50 cfs

ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)
— Q_F = 2.43 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 = 11.2 in

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 2 of 3

Designer: DLG
Company: CLASSIC CONSULTING
Date: March 16, 2023
Project: STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
Location: POND FSD 16 INTERIM CONDITION (FILING 2 & FOURSQUARE ONLY)

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) — $D_{orifice}$ = 1.75 inches

E) Total Outlet Area — A_{ot} = 48.50 square inches

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} = 92 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 = 1,581 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} = 2227 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) — $W_{opening}$ = 15.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 3

Designer: DLG
Company: CLASSIC CONSULTING
Date: March 16, 2023
Project: STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1
Location: POND FSD 16 INTERIM CONDITION (FILING 2 & FOURSQUARE ONLY)

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)	Ze = 4.00 ft / ft
11. Vegetation	Choose One ○ Irrigated ○ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	

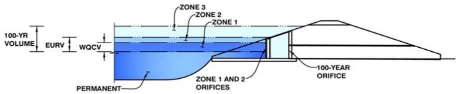
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

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

Basin ID: **POND FSD 16 INTERIM CONDITION (STERLING RANCH EAST FILING NO.2 & FOURSQUARE AT STERLING RACNH EAST FILING 1 ONLY)**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type = **EDB**
Watershed Area = 44.02 acres
Watershed Length = 1,800 ft
Watershed Length to Centroid = 900 ft
Watershed Slope = 0.040 ft/ft
Watershed Imperviousness = 44.40% 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

Should not be using reduced % impervious for low impact development as project is very dense, urban development.

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) =	0.702	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.180	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.642	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.196	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.638	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.403	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.148	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.111	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	6.695	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	1.395	acre-feet		
Approximate 5-yr Detention Volume =	1.841	acre-feet		
Approximate 10-yr Detention Volume =	2.260	acre-feet		
Approximate 25-yr Detention Volume =	2.785	acre-feet		
Approximate 50-yr Detention Volume =	3.130	acre-feet		
Approximate 100-yr Detention Volume =	3.581	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) = 0.702 acre-feet
Zone 2 Volume (EURV - Zone 1) = 1.478 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) = 1.401 acre-feet
Total Detention Basin Volume = 3.581 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 = 2.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	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	--	--	--	53,295	1.223	91,412	2.099
[illegible]	[illegible]	[illegible]	--	--	--	89,516	2.055	234,223	5.377
[illegible]	[illegible]	[illegible]	--	--	--	106,783	2.451	430,522	9.883
[illegible]	[illegible]	[illegible]	--	--	--	185,108	4.249	722,413	16.584
[illegible]	[illegible]	[illegible]	--	--	--	263,928	6.059	1,171,449	26.893
[illegible]	[illegible]	[illegible]	--	--	--	343,298	7.881	1,778,675	40.833
[illegible]	[illegible]		--	--	--				
[illegible]	[illegible]		--	--	--				
[illegible]	[illegible]		--	--	--				
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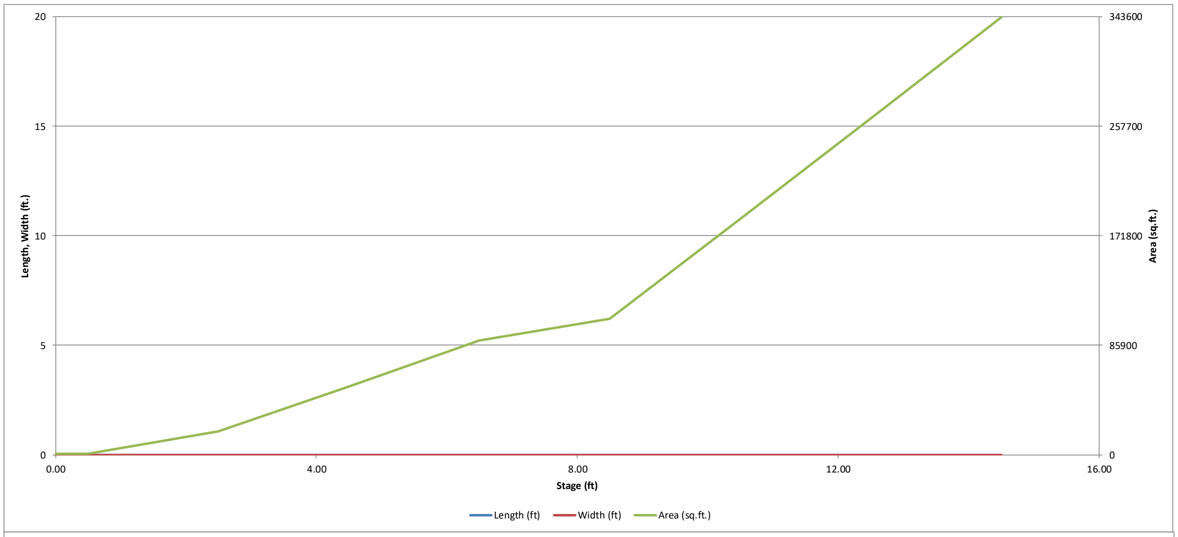
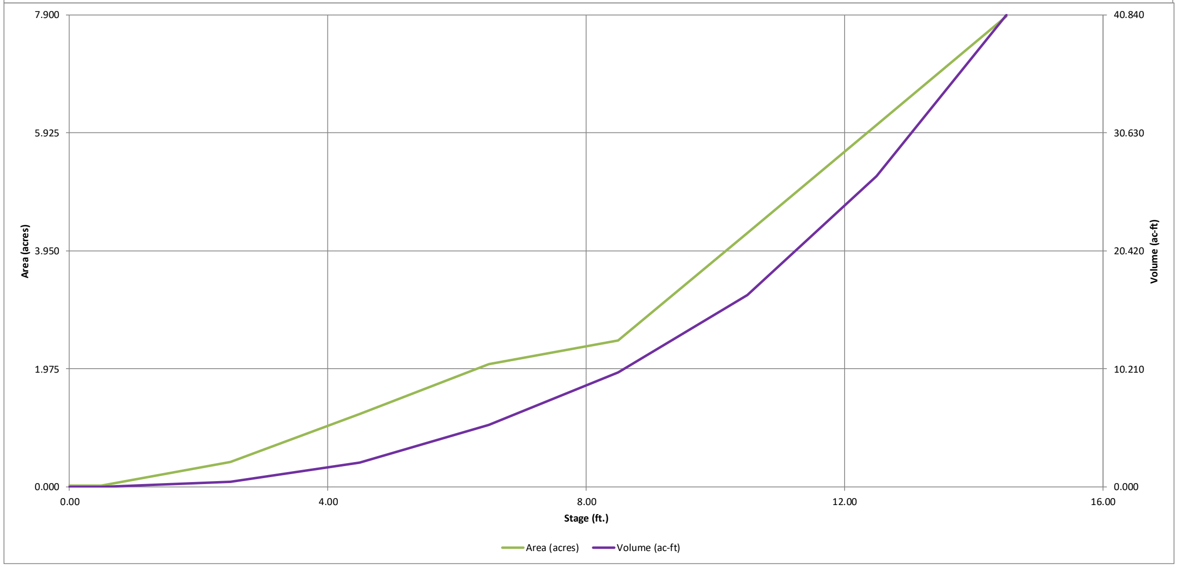
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

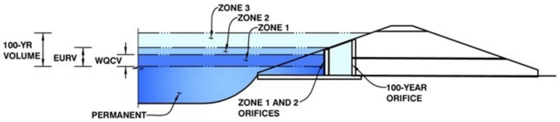




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **STERLING RANCH EAST FILING NO. 2 & FOURSQUARE AT STERLING RANCH EAST FILING NO. 1**
Basin ID: **POND FSD 16 INTERIM CONDITION (STERLING RANCH EAST FILING NO.2 & FOURSQUARE AT STERLING RACNH EAST FILING 1 ONLY)**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.98	0.702	Orifice Plate
Zone 2 (EURV)	4.57	1.478	Orifice Plate
Zone 3 (100-year)	5.54	1.401	Weir&Pipe (Restrict)
	Total (all zones)	3.581	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

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

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	10.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	30.00	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

Calculated Parameters for Plate

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

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.50	5.00	7.50				
Orifice Area (sq. inches)	3.50	9.00	16.00	16.00				

	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	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	10.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	20.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	10.00	N/A	feet
Overflow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.01	N/A	
Overflow Grate Open Area w/o Debris =	55.68	N/A	ft^2
Overflow Grate Open Area w/ Debris =	27.84	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	26.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	6.95	N/A	ft^2
Outlet Orifice Centroid =	1.24	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.65	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	12.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	170.00	feet
Spillway End Slopes =	6.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.32	feet
Stage at Top of Freeboard =	13.82	feet
Basin Area at Top of Freeboard =	7.26	acres
Basin Volume at Top of Freeboard =	35.68	acre-ft

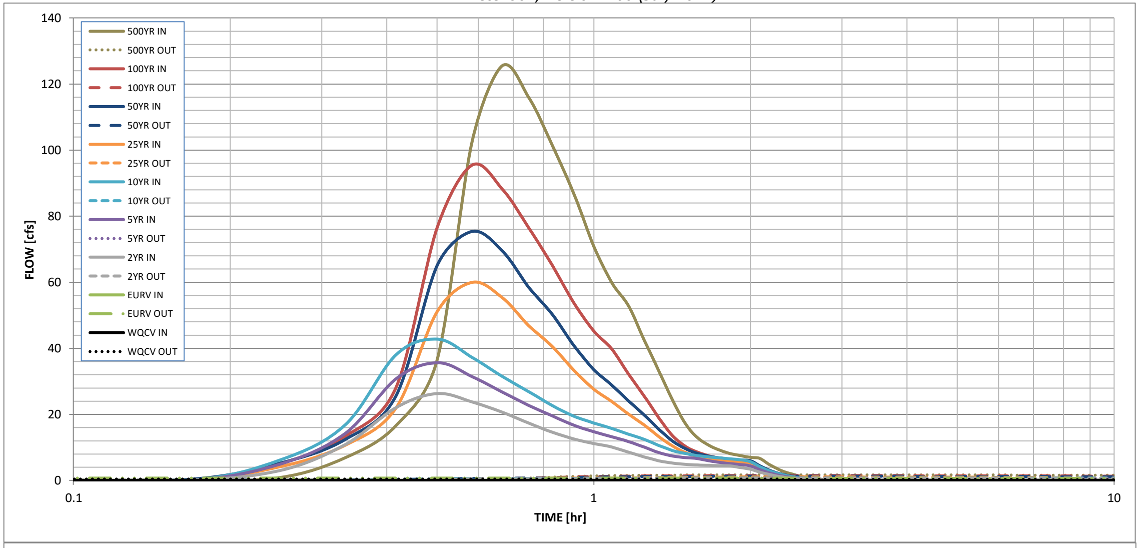
Routed Hydrograph Results

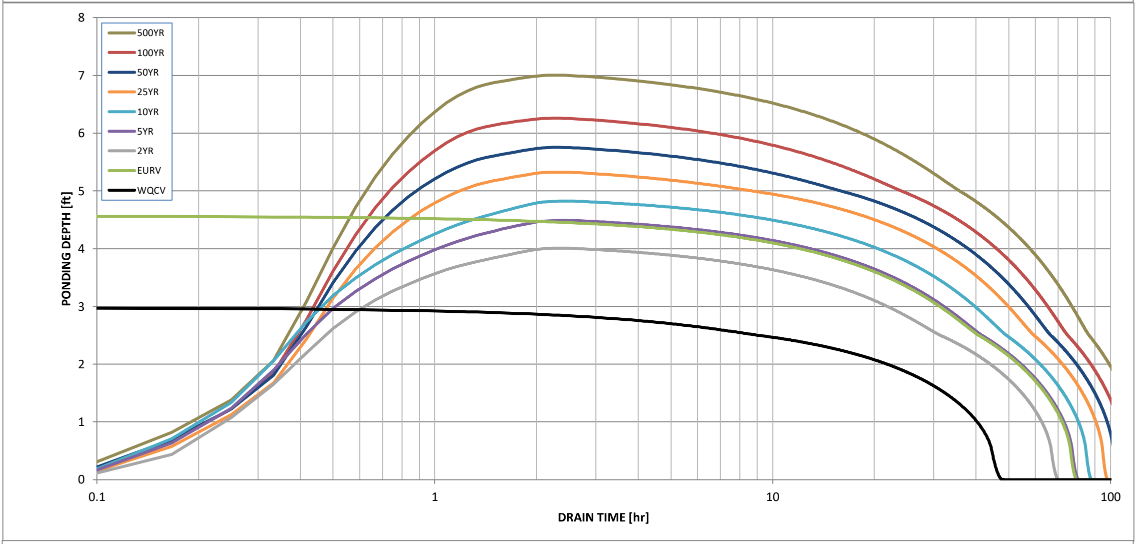
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

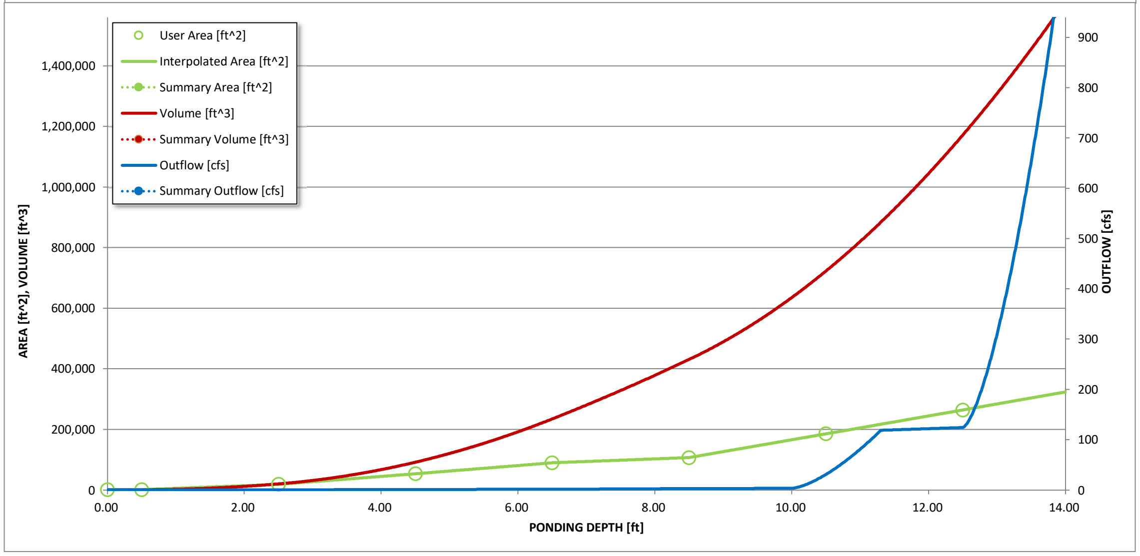
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.702	2.180	1.642	2.196	2.638	3.403	4.148	5.111	6.695
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.642	2.196	2.638	3.403	4.148	5.111	6.695
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	0.8	1.1	9.9	19.7	32.2	51.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.23	0.45	0.73	1.17
Peak Inflow Q (cfs) =	N/A	N/A	26.3	35.7	42.8	60.0	75.4	95.4	125.4
Peak Outflow Q (cfs) =	0.4	0.7	0.6	0.7	0.7	1.1	1.3	1.5	1.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	0.7	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	63	71	77	86	91	97	104
Time to Drain 99% of Inflow Volume (hours) =	**45**	75	66	76	83	92	99	106	116
Maximum Ponding Depth (ft) =	2.98	4.57	4.01	4.49	4.82	5.33	5.75	6.26	7.00
Area at Maximum Ponding Depth (acres) =	0.61	1.25	1.02	1.22	1.36	1.56	1.74	1.95	2.15
Maximum Volume Stored (acre-ft) =	0.703	2.185	1.537	2.074	2.511	3.242	3.953	4.876	6.429

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.04	0.89
	0:15:00	0.00	0.00	3.08	5.00	6.23	4.21	5.27	5.17	6.92
	0:20:00	0.00	0.00	10.93	14.32	16.91	10.70	12.49	13.43	16.59
	0:25:00	0.00	0.00	22.05	30.77	38.04	21.96	25.67	28.12	36.37
	0:30:00	0.00	0.00	26.31	35.66	42.78	51.06	64.95	76.41	102.35
	0:35:00	0.00	0.00	23.80	31.49	37.29	59.96	75.39	95.43	125.45
	0:40:00	0.00	0.00	20.70	26.77	31.51	55.39	69.59	88.30	116.03
	0:45:00	0.00	0.00	17.36	22.76	26.89	46.87	58.53	76.50	101.28
	0:50:00	0.00	0.00	14.60	19.50	22.64	40.51	50.16	64.95	86.62
	0:55:00	0.00	0.00	12.57	16.67	19.47	33.30	40.76	53.65	71.03
	1:00:00	0.00	0.00	11.20	14.76	17.42	27.68	33.61	45.27	59.90
	1:05:00	0.00	0.00	10.12	13.24	15.72	23.86	28.85	39.76	52.91
	1:10:00	0.00	0.00	8.57	11.77	14.03	20.11	24.10	32.26	42.54
	1:15:00	0.00	0.00	7.13	10.07	12.46	16.76	19.86	25.57	33.28
	1:20:00	0.00	0.00	5.98	8.46	10.65	13.33	15.57	19.06	24.48
	1:25:00	0.00	0.00	5.26	7.44	9.08	10.49	11.99	13.60	17.16
	1:30:00	0.00	0.00	4.88	6.93	8.15	8.45	9.59	10.33	12.94
	1:35:00	0.00	0.00	4.68	6.63	7.54	7.25	8.19	8.55	10.60
	1:40:00	0.00	0.00	4.57	5.98	7.10	6.52	7.35	7.45	9.11
	1:45:00	0.00	0.00	4.49	5.45	6.79	6.03	6.79	6.72	8.13
	1:50:00	0.00	0.00	4.43	5.07	6.57	5.71	6.42	6.22	7.47
	1:55:00	0.00	0.00	3.88	4.78	6.25	5.49	6.17	5.86	6.99
	2:00:00	0.00	0.00	3.40	4.44	5.68	5.33	5.99	5.64	6.70
	2:05:00	0.00	0.00	2.55	3.33	4.23	4.01	4.49	4.23	5.02
	2:10:00	0.00	0.00	1.85	2.40	3.04	2.87	3.21	3.03	3.58
	2:15:00	0.00	0.00	1.33	1.73	2.18	2.06	2.31	2.19	2.58
	2:20:00	0.00	0.00	0.95	1.23	1.56	1.47	1.64	1.56	1.84
	2:25:00	0.00	0.00	0.66	0.84	1.08	1.02	1.14	1.08	1.27
	2:30:00	0.00	0.00	0.45	0.57	0.75	0.71	0.78	0.74	0.87
	2:35:00	0.00	0.00	0.29	0.39	0.50	0.48	0.53	0.50	0.58
	2:40:00	0.00	0.00	0.17	0.24	0.30	0.30	0.32	0.30	0.35
	2:45:00	0.00	0.00	0.08	0.13	0.15	0.16	0.17	0.15	0.17
	2:50:00	0.00	0.00	0.03	0.05	0.06	0.06	0.06	0.05	0.06
	2:55:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52	
Max Intensity for Optional User Defined Storm	2.51496		

Designer: dlg
Company: Classic Consulting
Date: August 17, 2020
Project: Foursquare at Sterling Ranch East Filing No. 1 & Sterling Ranch East Filing No. 2
Location: FSD Pond 16 TRIBUTARY ULTIMATE

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)	8.600	35.420	176.880											
Directly Connected Impervious Area (DCIA, acres)	2.543	5.703	25.942											
Unconnected Impervious Area (UIA, acres)	3.355	9.417	71.984											
Receiving Pervious Area (RPA, acres)	2.702	6.738	57.953											
Separate Pervious Area (SPA, acres)	0.000	13.562	21.001											
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C											

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	8.600	35.420	176.880											
Directly Connected Impervious Area (DCIA, %)	29.6%	16.1%	14.7%											
Unconnected Impervious Area (UIA, %)	39.0%	26.6%	40.7%											
Receiving Pervious Area (RPA, %)	31.4%	19.0%	32.8%											
Separate Pervious Area (SPA, %)	0.0%	38.3%	11.9%											
A_R (RPA / UIA)	0.805	0.716	0.805											
I_a Check	0.550	0.580	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	0.65	0.63											
IRF for 5-Year Event:	0.87	0.87	0.87											
IRF for 100-Year Event:	0.88	0.89	0.88											
IRF for Optional User Defined Storm CUHP:	0.88	0.89	0.88											
Total Site Imperviousness: I_{total}	68.6%	42.7%	55.4%											
Effective Imperviousness for WQCV Event:	54.3%	33.4%	40.5%											
Effective Imperviousness for 5-Year Event:	63.4%	39.3%	50.0%											
Effective Imperviousness for 100-Year Event:	63.9%	39.7%	50.5%											
Effective Imperviousness for Optional User Defined Storm CUHP:	63.9%	39.7%	50.5%											

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	18.7%	13.5%	18.2%	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:	6.5%	7.1%	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:	8.4%	5.8%	8.6%											

Total Site Imperviousness:	**53.8%**
Total Site Effective Imperviousness for WQCV Event:	**39.9%**
Total Site Effective Imperviousness for 5-Year Event:	**48.8%**
Total Site Effective Imperviousness for 100-Year Event:	**49.3%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**49.3%**

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.

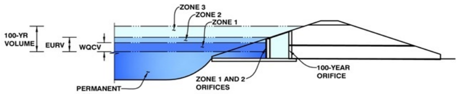
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

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

Basin ID: POND FSD 16 ULTIMATE (STERLING RANCH EAST FILING NO. 2, FOURSQUIRE AT STERLING RANCH EAST FILING NO.1 & PLANNED FUTURE DEVELOPMENT)



Example Zone Configuration (Retention Pond)

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 = 49.30% 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) =	3.762	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	12.288	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	9.710	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	12.839	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	15.865	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	20.998	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	25.112	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	30.660	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	39.447	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	8.219	acre-feet		
Approximate 5-yr Detention Volume =	10.945	acre-feet		
Approximate 10-yr Detention Volume =	13.685	acre-feet		
Approximate 25-yr Detention Volume =	16.244	acre-feet		
Approximate 50-yr Detention Volume =	17.832	acre-feet		
Approximate 100-yr Detention Volume =	20.079	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) = 3.762 acre-feet
Zone 2 Volume (EURV - Zone 1) = 8.526 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) = 7.791 acre-feet
Total Detention Basin Volume = 20.079 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	--	--	--	53,295	1.223	91,411	2.099
7098	--	6.50	--	--	--	89,516	2.055	234,222	5.377
7100	--	8.50	--	--	--	106,783	2.451	430,521	9.883
7102	--	10.50	--	--	--	185,108	4.249	722,412	16.584
7104	--	12.50	--	--	--	263,928	6.059	1,171,448	26.893
7106	--	14.50	--	--	--	343,298	7.881	1,778,674	40.833
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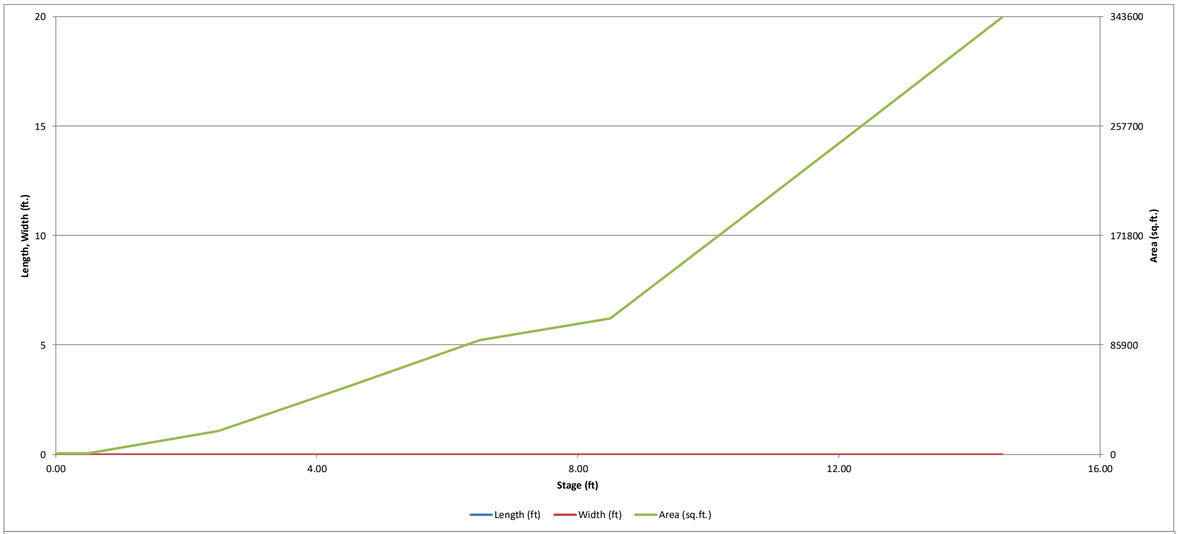
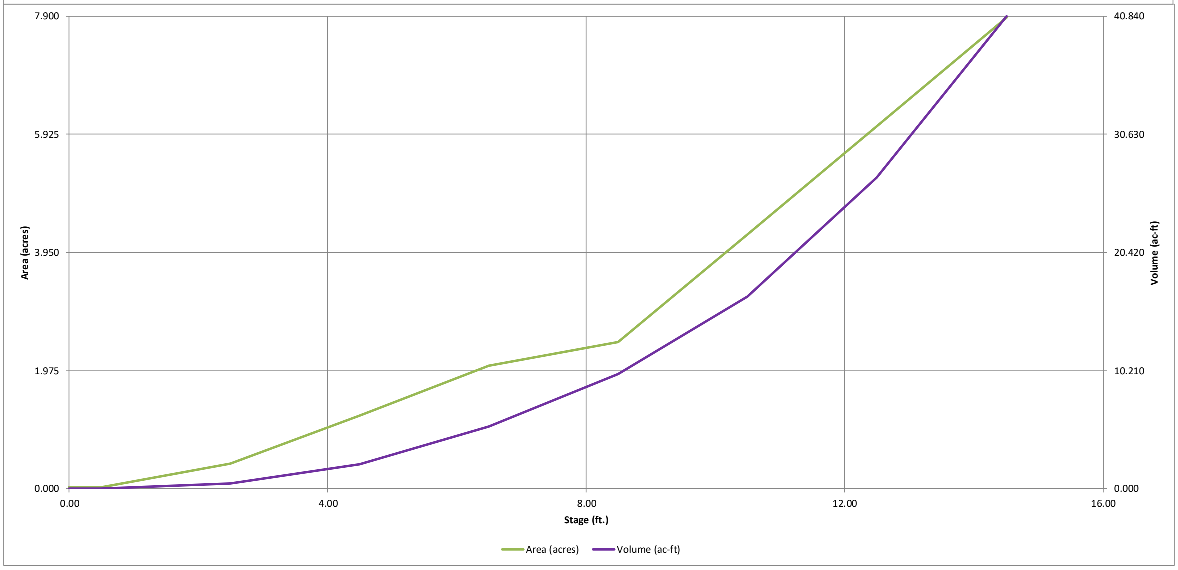
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





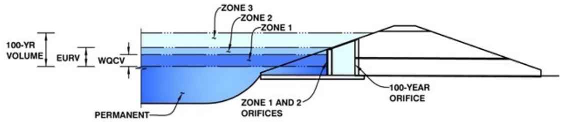
Include sizing of forebay for ultimate condition

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

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

Basin ID: **POND FSD 16 ULTIMATE (STERLING RANCH EAST FILING NO. 2, FOURSQUIRE AT STERLING RANCH EAST FILING NO.1 & PLANNED FUTURE DEVELOPMENT)**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	5.64	3.762	Orifice Plate
Zone 2 (EURV)	9.35	8.526	Orifice Plate
Zone 3 (100-year)	11.27	7.791	Weir&Pipe (Restrict)
Total (all zones)		20.079	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

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

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	10.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	30.00	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

Calculated Parameters for Plate

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

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.50	5.00	7.50				
Orifice Area (sq. inches)	10.00	14.00	16.00	16.00				

	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	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	10.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	20.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	10.00	N/A	feet
Overflow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.01	N/A	
Overflow Grate Open Area w/o Debris =	55.68	N/A	ft^2
Overflow Grate Open Area w/ Debris =	27.84	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	26.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	6.95	N/A	ft^2
Outlet Orifice Centroid =	1.24	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.65	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	12.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	170.00	feet
Spillway End Slopes =	6.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.00	feet
Stage at Top of Freeboard =	14.50	feet
Basin Area at Top of Freeboard =	7.88	acres
Basin Volume at Top of Freeboard =	40.83	acre-ft

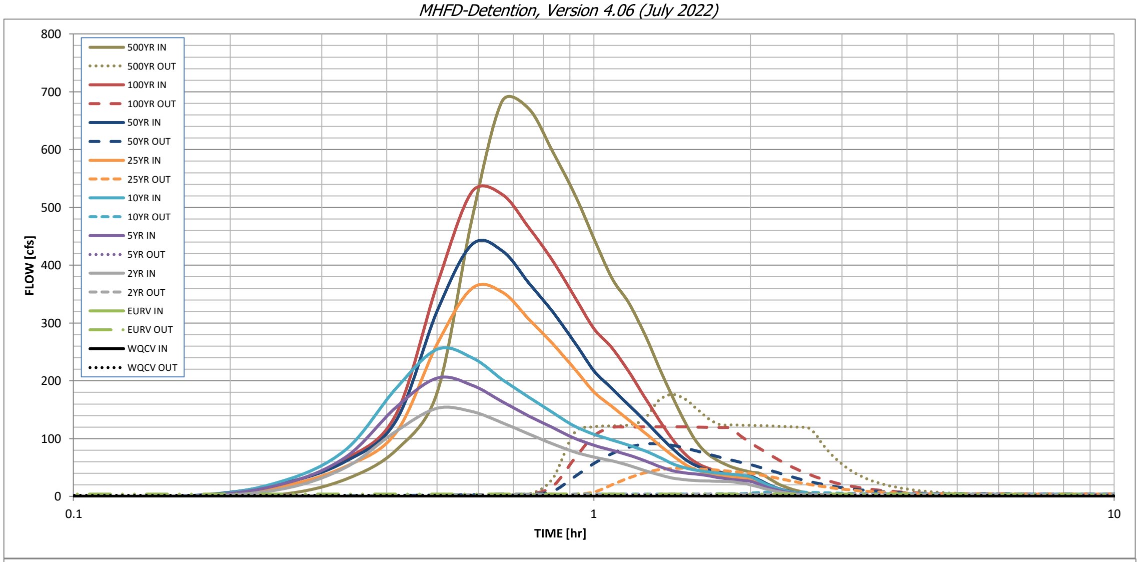
Routed Hydrograph Results

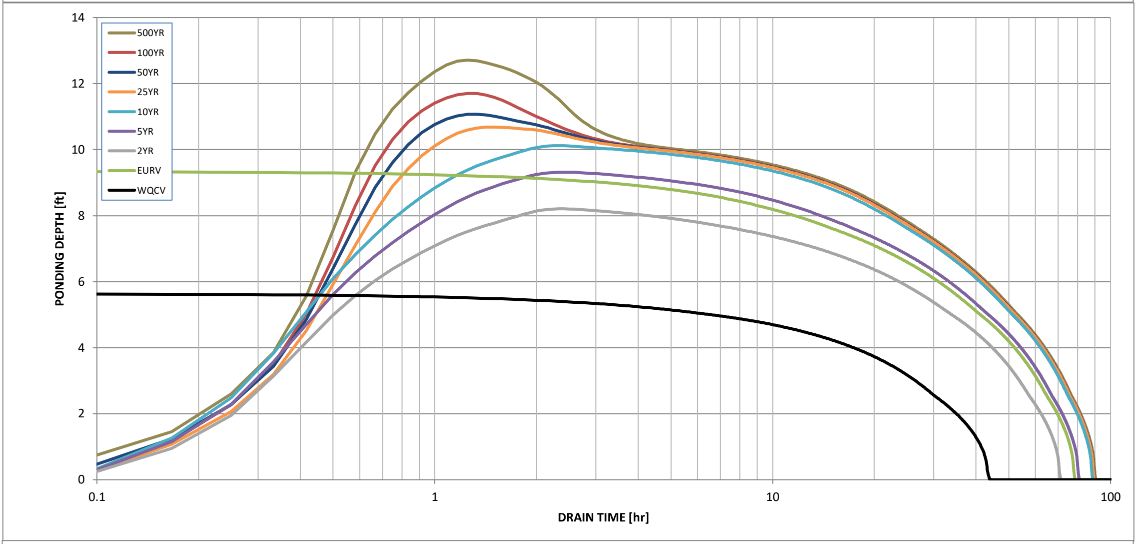
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

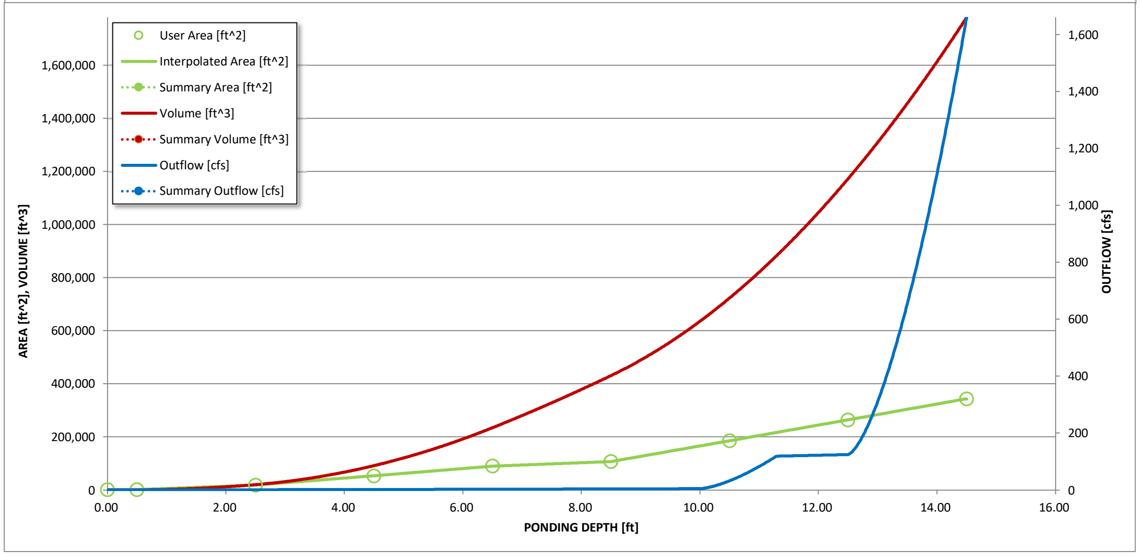
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	3.762	12.288	9.710	12.839	15.865	20.998	25.112	30.660	39.447
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	9.710	12.839	15.865	20.998	25.112	30.660	39.447
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.7	4.5	23.4	95.7	140.7	204.0	304.3
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	0.11	0.43	0.64	0.92	1.38
Peak Inflow Q (cfs) =	N/A	N/A	152.5	204.8	254.6	360.0	435.8	526.8	683.4
Peak Outflow Q (cfs) =	2.0	4.1	3.5	4.1	7.7	48.7	91.2	120.5	176.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	0.3	0.5	0.6	0.6	0.6
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	0.1	0.8	1.6	2.1	2.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	67	62	69	75	73	72	70	68
Time to Drain 99% of Inflow Volume (hours) =	**42**	74	67	76	83	82	81	80	79
Maximum Ponding Depth (ft) =	5.64	9.35	8.21	9.32	10.12	10.69	11.08	11.71	12.72
Area at Maximum Ponding Depth (acres) =	1.70	3.22	2.39	3.18	3.91	4.41	4.77	5.34	6.25
Maximum Volume Stored (acre-ft) =	3.763	12.292	9.157	12.164	15.034	17.364	19.153	22.335	28.185

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	0.14	3.62
	0:15:00	0.00	0.00	12.44	20.45	25.45	17.15	22.10	21.06	29.79
	0:20:00	0.00	0.00	49.95	67.93	80.76	51.54	60.65	64.31	80.17
	0:25:00	0.00	0.00	112.89	154.25	186.90	110.26	130.88	142.02	179.25
	0:30:00	0.00	0.00	152.50	204.77	254.63	263.28	320.19	366.16	479.40
	0:35:00	0.00	0.00	146.91	192.55	240.26	359.97	435.83	526.76	683.43
	0:40:00	0.00	0.00	127.54	163.96	202.57	353.47	425.20	522.87	671.00
	0:45:00	0.00	0.00	108.38	139.47	171.92	307.02	369.68	465.38	596.64
	0:50:00	0.00	0.00	90.99	119.22	145.25	264.20	319.64	408.08	524.81
	0:55:00	0.00	0.00	77.23	101.13	122.03	221.74	268.00	346.70	447.50
	1:00:00	0.00	0.00	68.05	88.70	107.64	181.24	218.13	291.22	377.73
	1:05:00	0.00	0.00	61.61	79.80	97.82	155.65	186.70	257.42	335.71
	1:10:00	0.00	0.00	53.69	71.64	88.57	132.77	158.60	216.83	282.60
	1:15:00	0.00	0.00	45.18	62.25	79.43	111.19	132.27	173.26	225.06
	1:20:00	0.00	0.00	37.74	52.41	68.53	90.05	106.35	133.89	172.81
	1:25:00	0.00	0.00	32.01	44.58	56.81	71.10	83.09	99.27	126.82
	1:30:00	0.00	0.00	28.84	40.63	49.29	55.04	63.81	72.61	92.09
	1:35:00	0.00	0.00	27.37	38.65	45.08	45.30	52.21	57.01	71.87
	1:40:00	0.00	0.00	26.56	35.49	42.11	39.66	45.39	48.11	60.03
	1:45:00	0.00	0.00	26.06	32.15	39.96	36.16	41.11	42.04	51.84
	1:50:00	0.00	0.00	25.68	29.76	38.50	33.76	38.23	38.03	46.36
	1:55:00	0.00	0.00	23.31	28.01	36.80	32.20	36.37	35.22	42.49
	2:00:00	0.00	0.00	20.32	26.12	33.83	31.11	35.07	33.29	39.85
	2:05:00	0.00	0.00	16.11	20.97	26.83	25.36	28.54	26.84	32.00
	2:10:00	0.00	0.00	11.81	15.19	19.29	18.23	20.47	19.27	22.90
	2:15:00	0.00	0.00	8.60	11.01	13.88	13.14	14.73	13.92	16.51
	2:20:00	0.00	0.00	6.21	7.91	10.00	9.50	10.65	10.13	12.00
	2:25:00	0.00	0.00	4.43	5.51	7.06	6.69	7.48	7.15	8.46
	2:30:00	0.00	0.00	3.05	3.75	4.90	4.63	5.18	4.94	5.84
	2:35:00	0.00	0.00	2.06	2.58	3.40	3.27	3.65	3.48	4.09
	2:40:00	0.00	0.00	1.29	1.70	2.17	2.15	2.39	2.27	2.66
	2:45:00	0.00	0.00	0.70	1.00	1.23	1.26	1.39	1.31	1.53
	2:50:00	0.00	0.00	0.31	0.48	0.56	0.60	0.66	0.62	0.71
	2:55:00	0.00	0.00	0.11	0.15	0.16	0.19	0.20	0.18	0.20
	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

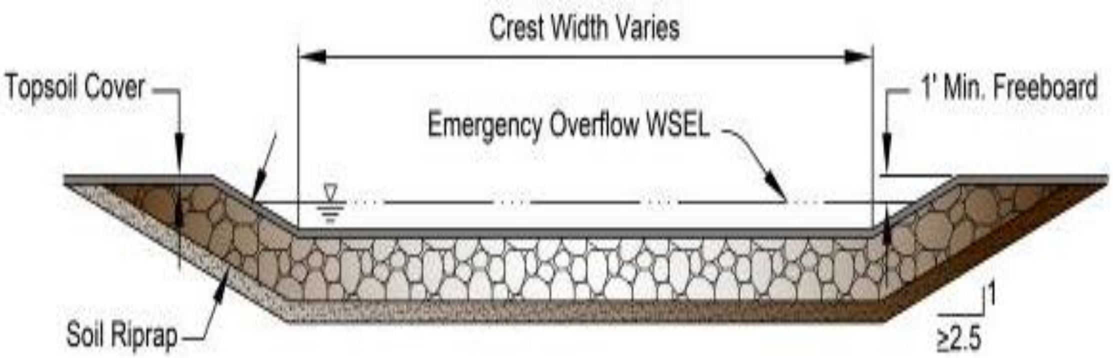
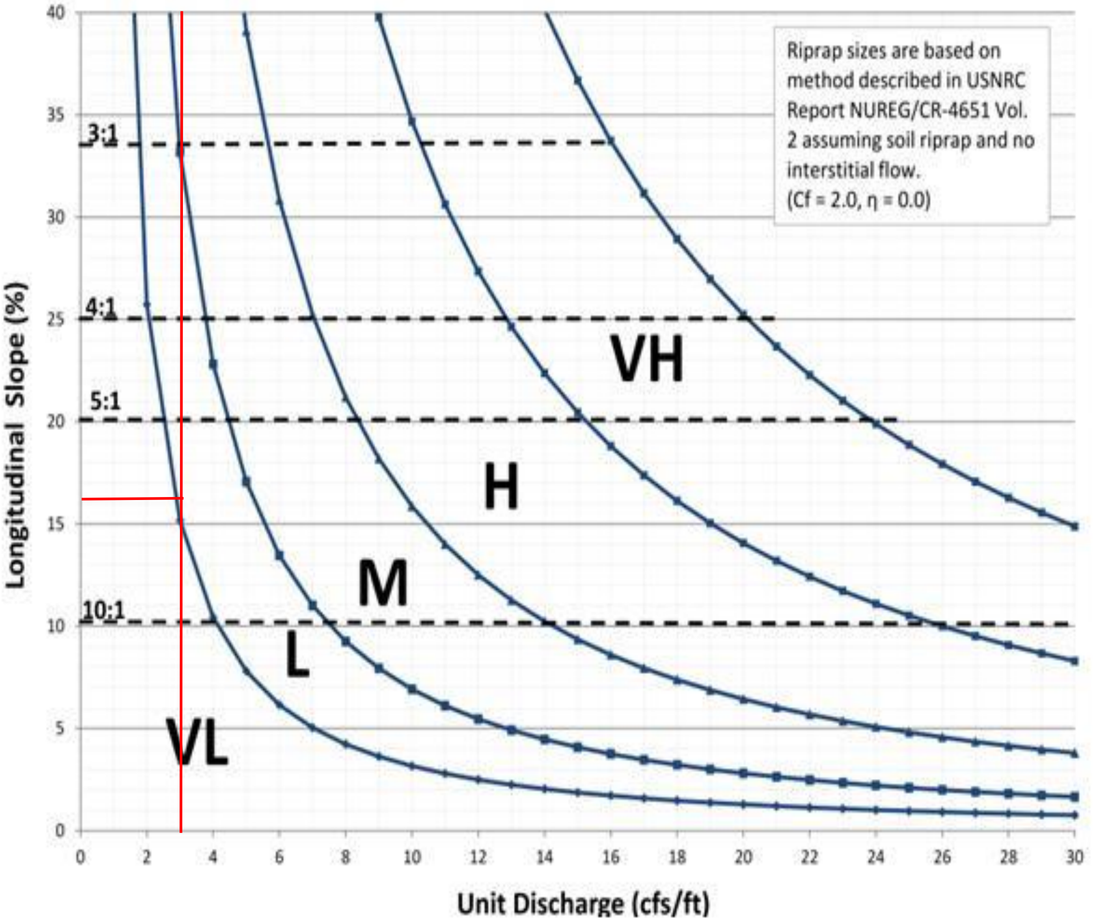


Figure 13-12d. Riprap Types for Emergency Spillway Protection



ULTIMATE &
INTERIM
CONDITION

Include sizing of trickle channel for ultimate condition

Worksheet for TRICKLE CHANNEL

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Bottom Width	3.00 ft
Discharge	4.86 cfs

Results	
Normal Depth	5.1 in
Flow Area	1.3 ft²
Wetted Perimeter	3.8 ft
Hydraulic Radius	3.9 in
Top Width	3.00 ft
Critical Depth	5.2 in
Critical Slope	0.005 ft/ft
Velocity	3.85 ft/s
Velocity Head	0.23 ft
Specific Energy	0.65 ft
Froude Number	1.045
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
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	5.1 in
Critical Depth	5.2 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

REFERENCE MATERIALS FROM PREVIOUS REPORTS

EPA- 600/R-14/413b
Revisied September 2015

Storm Water Management Model User's Manual Version 5.1

by

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U.S. Environmental Protection Agency
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September 2015

SWMM MODEL RAIN GAGE INPUT PARAMETERS
(PER DCM CPT. 6)

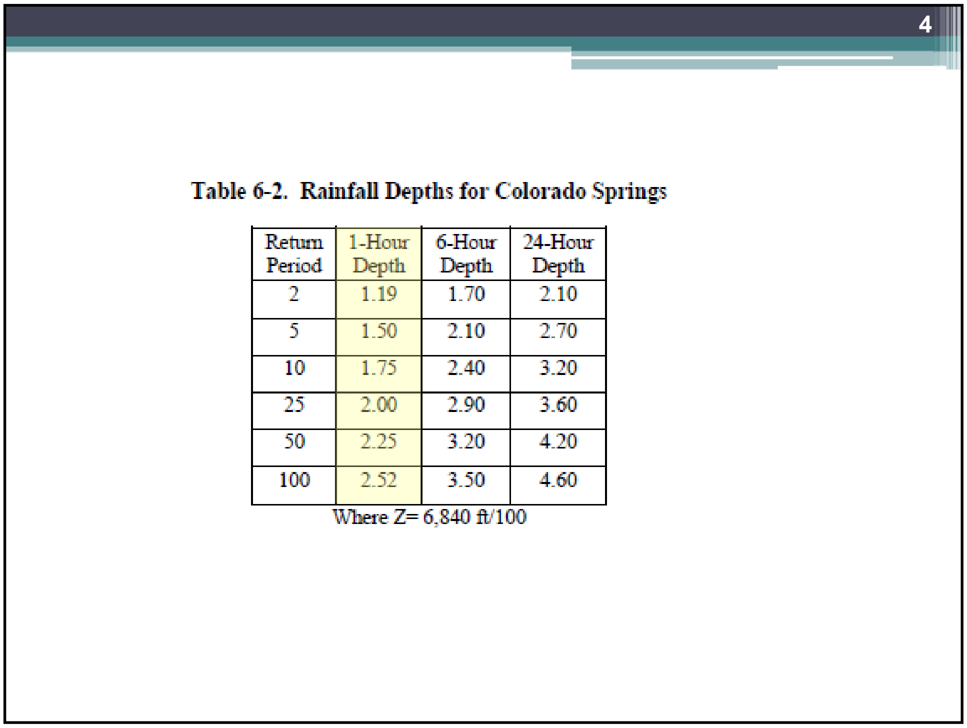
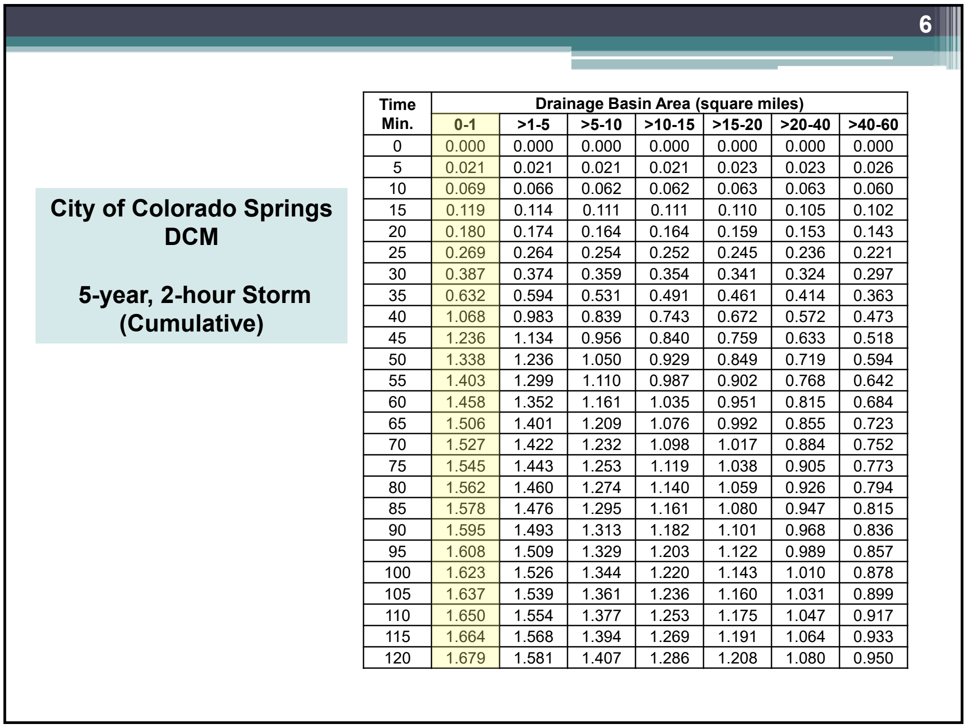


Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100



City of Colorado Springs DCM

5-year, 2-hour Storm (Cumulative)

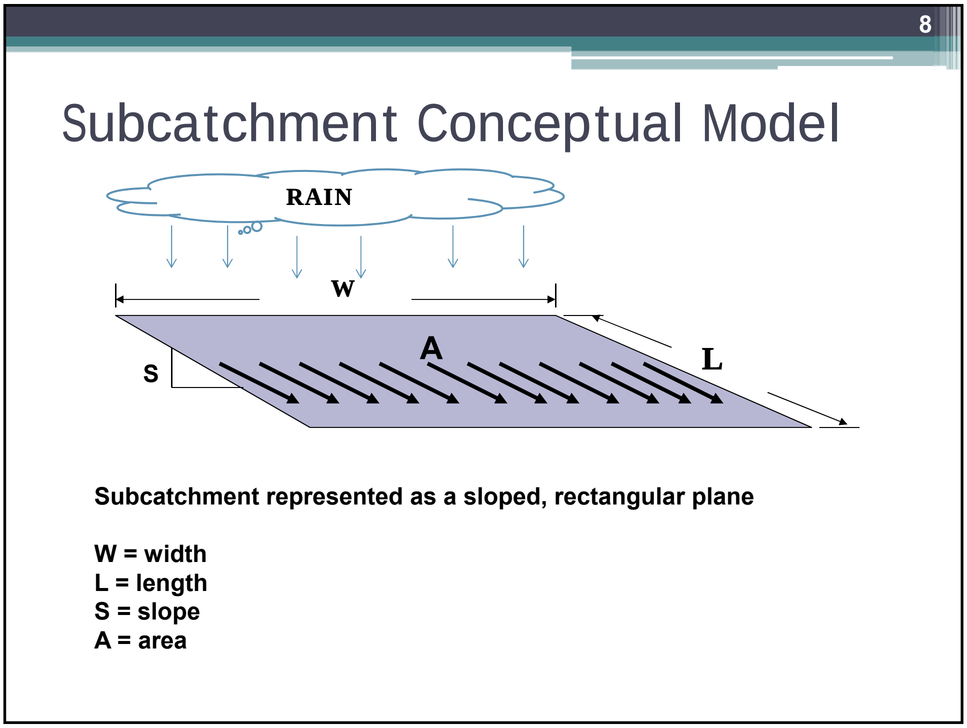
Time Min.	Drainage Basin Area (square miles)						
	0-1	**>1-5**	**>5-10**	**>10-15**	**>15-20**	**>20-40**	**>40-60**
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.021	0.021	0.021	0.021	0.023	0.023	0.026
10	0.069	0.066	0.062	0.062	0.063	0.063	0.060
15	0.119	0.114	0.111	0.111	0.110	0.105	0.102
20	0.180	0.174	0.164	0.164	0.159	0.153	0.143
25	0.269	0.264	0.254	0.252	0.245	0.236	0.221
30	0.387	0.374	0.359	0.354	0.341	0.324	0.297
35	0.632	0.594	0.531	0.491	0.461	0.414	0.363
40	1.068	0.983	0.839	0.743	0.672	0.572	0.473
45	1.236	1.134	0.956	0.840	0.759	0.633	0.518
50	1.338	1.236	1.050	0.929	0.849	0.719	0.594
55	1.403	1.299	1.110	0.987	0.902	0.768	0.642
60	1.458	1.352	1.161	1.035	0.951	0.815	0.684
65	1.506	1.401	1.209	1.076	0.992	0.855	0.723
70	1.527	1.422	1.232	1.098	1.017	0.884	0.752
75	1.545	1.443	1.253	1.119	1.038	0.905	0.773
80	1.562	1.460	1.274	1.140	1.059	0.926	0.794
85	1.578	1.476	1.295	1.161	1.080	0.947	0.815
90	1.595	1.493	1.313	1.182	1.101	0.968	0.836
95	1.608	1.509	1.329	1.203	1.122	0.989	0.857
100	1.623	1.526	1.344	1.220	1.143	1.010	0.878
105	1.637	1.539	1.361	1.236	1.160	1.031	0.899
110	1.650	1.554	1.377	1.253	1.175	1.047	0.917
115	1.664	1.568	1.394	1.269	1.191	1.064	0.933
120	1.679	1.581	1.407	1.286	1.208	1.080	0.950

City of Colorado Springs DCM

100-year, 2-hour Storm (Cumulative)

Time Min.	Drainage Basin Area (square miles)						
	0-1	>1-5	>5-10	>10-15	>15-20	>20-40	>40-60
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.035	0.035	0.035	0.035	0.038	0.038	0.043
10	0.116	0.111	0.103	0.103	0.106	0.106	0.101
15	0.199	0.192	0.186	0.186	0.184	0.176	0.171
20	0.302	0.292	0.275	0.275	0.267	0.257	0.239
25	0.451	0.444	0.426	0.423	0.411	0.396	0.370
30	0.650	0.627	0.602	0.595	0.572	0.544	0.499
35	1.061	0.998	0.892	0.824	0.774	0.696	0.610
40	1.794	1.651	1.409	1.247	1.129	0.960	0.794
45	2.076	1.905	1.605	1.411	1.275	1.063	0.869
50	2.248	2.076	1.764	1.560	1.426	1.207	0.998
55	2.356	2.182	1.865	1.658	1.515	1.290	1.079
60	2.449	2.271	1.950	1.739	1.598	1.368	1.149
65	2.530	2.354	2.031	1.807	1.666	1.436	1.215
70	2.565	2.389	2.069	1.845	1.709	1.484	1.263
75	2.596	2.424	2.104	1.880	1.744	1.520	1.298
80	2.623	2.452	2.139	1.915	1.779	1.555	1.333
85	2.651	2.480	2.175	1.950	1.814	1.590	1.368
90	2.679	2.507	2.205	1.986	1.850	1.625	1.404
95	2.701	2.535	2.233	2.021	1.885	1.661	1.439
100	2.727	2.563	2.258	2.049	1.920	1.696	1.474
105	2.749	2.586	2.286	2.076	1.948	1.731	1.509
110	2.772	2.611	2.313	2.104	1.973	1.759	1.540
115	2.795	2.633	2.341	2.132	2.001	1.787	1.567
120	2.820	2.656	2.364	2.160	2.029	1.814	1.595

SWMM MODEL SUBCATCHMENT INPUT PARAMETERS

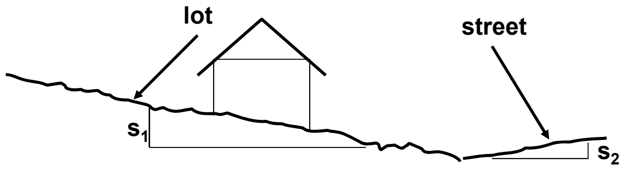


Subcatchment Conceptual Model

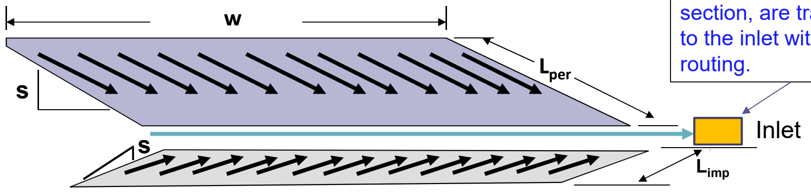
Subcatchment represented as a sloped, rectangular plane

W = width
L = length
S = slope
A = area

Subcatchment Conceptual Model



Pervious and Impervious areas are processed independently and are then combined.
Both have the same tributary width (W).



Flows calculated at edge for rectangular section, are transferred to the inlet without flow routing.

You can set them up as separate subcatchments.

Width Parameter

NEVER use default value

Approx. Width = (Area) ÷ (Length)

Length = average overland sheet flow length of runoff

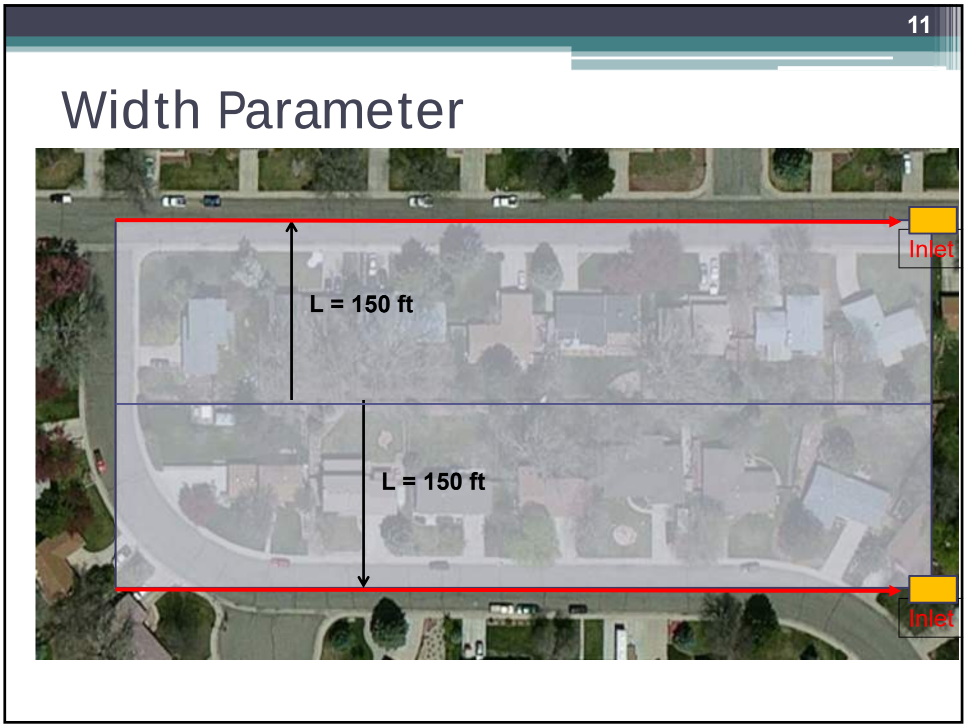
Suggested Rules of Thumb:

Undeveloped:

- **Maximum length = 100- to 500-feet**

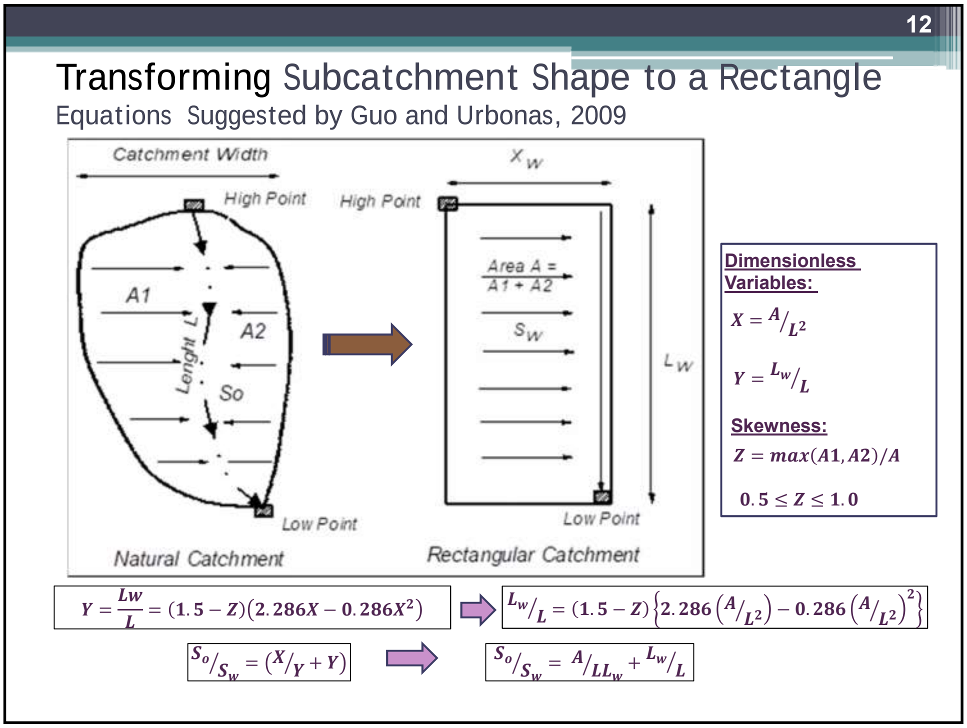
Residential Catchments:

- **Maximum length = 100 to 300 feet**
- **back of lot to street gutter (100-175 ft)**



Width Parameter

11



Transforming Subcatchment Shape to a Rectangle

Equations Suggested by Guo and Urbonas, 2009

Dimensionless Variables:

$X = A/L^2$

$Y = L_w/L$

Skewness:

$Z = max(A1, A2)/A$

$0.5 \leq Z \leq 1.0$

$$Y = \frac{Lw}{L} = (1.5 - Z)(2.286X - 0.286X^2) \Rightarrow L_w/L = (1.5 - Z)\left\{2.286\left(A/L^2\right) - 0.286\left(A/L^2\right)^2\right\}$$

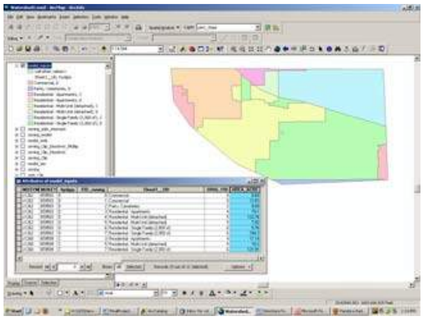
$$S_o/S_w = (X/Y + Y) \Rightarrow S_o/S_w = A/LL_w + L_w/L$$

12

Percent Impervious

Estimating/Measuring Percent Impervious:

- **If site-specific information is not available, use land use classification**
- **Sometimes, site-specific impervious GIS layers are available**



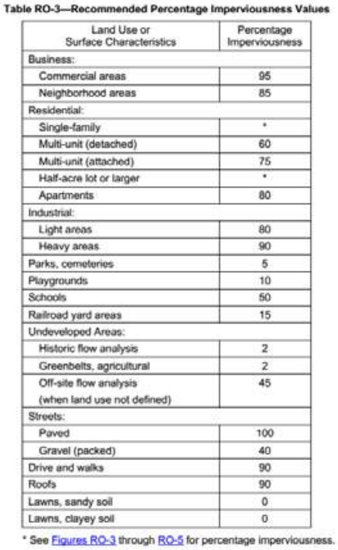


Table RO-3—Recommended Percentage Imperviousness Values

Land Use or Surface Characteristics	Percentage Imperviousness
Business:	
Commercial areas	95
Neighborhood areas	85
Residential:	
Single-family	*
Multi-unit (detached)	60
Multi-unit (attached)	75
Half-acre lot or larger	*
Apartments	80
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	5
Playgrounds	10
Schools	50
Railroad yard areas	15
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	0
Lawns, clayey soil	0

* See Figures RO-3 through RO-5 for percentage imperviousness.

Source: UDFCD Storm Drainage Criteria Manual

City of Colorado Springs DCM - Manning's n

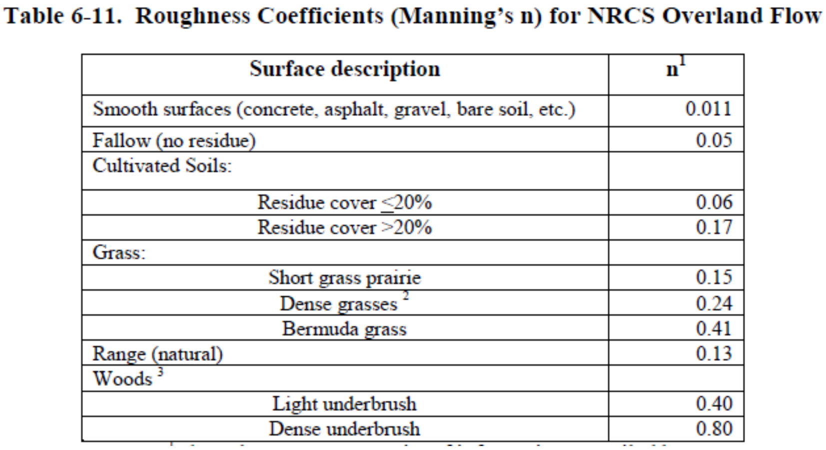


Table 6-11. Roughness Coefficients (Manning's n) for NRCS Overland Flow

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, bare soil, etc.)	0.011
Fallow (no residue)	0.05
Cultivated Soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses[2]	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods[3]	
Light underbrush	0.40
Dense underbrush	0.80

Table 3-1 Impervious area as a percentage of land use.

Land Use	Percent Impervious Area
Commercial	56
Industrial	76
High density residential	51
Medium density residential	38
Low density residential	19
Institutional	34
Agricultural	2
Forest	1.9
Open Urban Land	11

As mentioned earlier, impervious areas in SWMM are hydraulically (directly) connected to the drainage system – called directly connected impervious areas (DCIA). For instance, if rooftops drain onto adjacent pervious lawn areas, they should not be treated as a hydraulically effective impervious area. Such areas are non-effective impervious areas (Doyle and Miller, 1980). On the other hand, if a driveway drains to a street and then to a stormwater inlet, the driveway would be considered hydraulically connected. Rooftops with downspouts connected directly to a sewer are clearly hydraulically connected. An example of careful measurements and statistics on imperviousness may be found in Field et al. (2000), Lee (2003), and Roy and Shuster (2007). Lee and Heaney (2003) provide detailed comparisons of imperviousness computations and their implications for modeling.

Should rooftops be treated as “pervious,” the real surrounding pervious area is subject to more incoming water than rainfall alone and thus might produce runoff sooner than if rainfall alone were considered. In the possible event that this effect is important (a judgment based on infiltration parameters) it can be modeled using the overland flow re-routing option discussed earlier in Section 3.7. For example, if disconnected rooftops comprised 25 percent of the total impervious area of a subcatchment (as opposed to the total DCIA) then one could tell SWMM that this percentage of impervious area should be internally routed onto the pervious sub-area of the subcatchment.

Another method of estimating the effective impervious area given measured data is to plot the runoff (in. or mm) vs. rainfall (in. or mm) for small storms. The slope of the regression line is a good estimate of the effective impervious area (Doyle and Miller, 1980).

Table 3-5 Estimates of Manning's roughness coefficient for overland flow

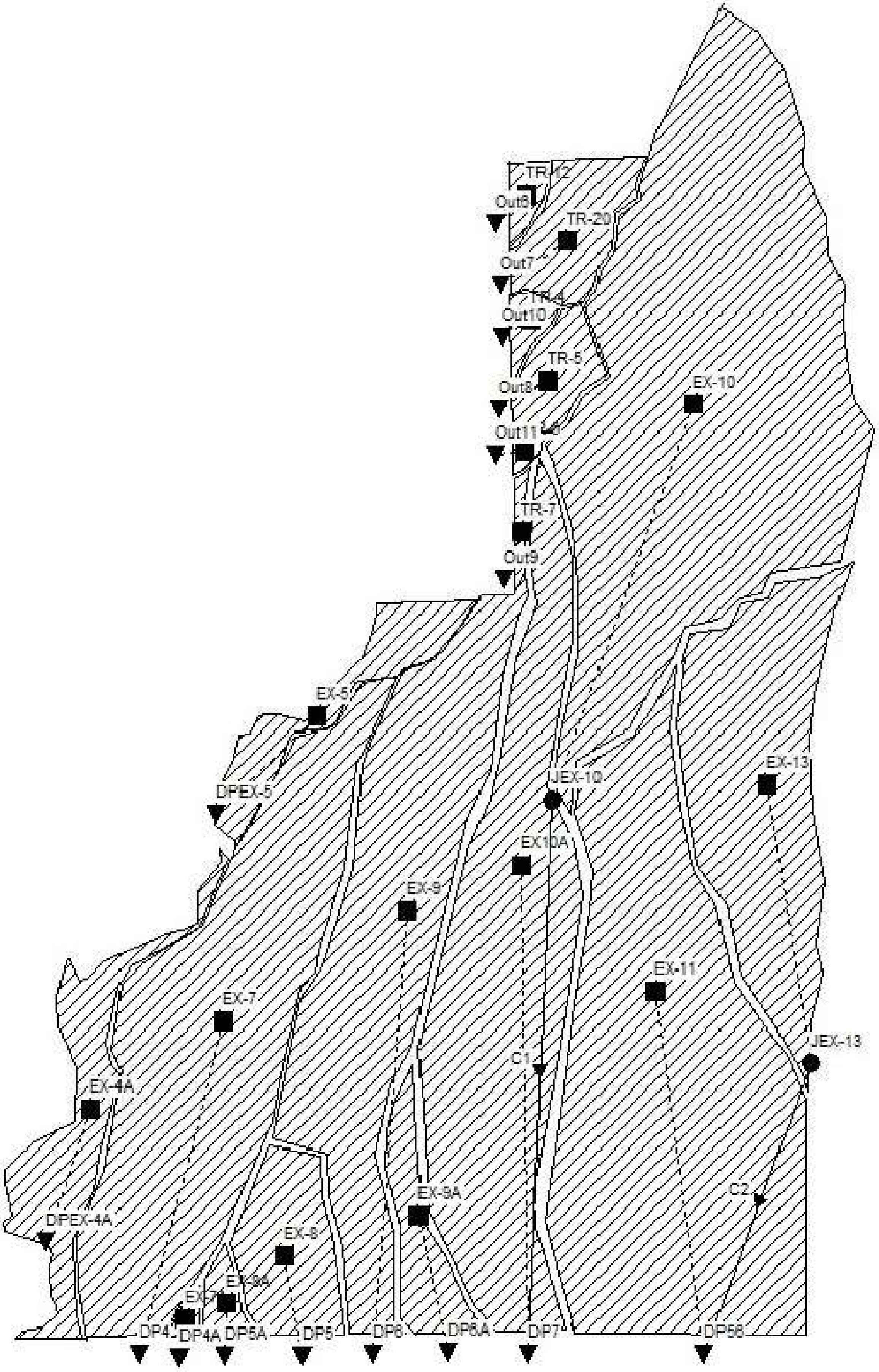
Source	Ground Cover	n	Range
Crawford and Linsley (1966)[a]	Smooth asphalt	0.01	
	Asphalt of concrete paving	0.014	
	Packed clay	0.03	
	Light turf	0.20	
	Dense turf	0.35	
	Dense shrubbery and forest litter	0.4	
Engman (1986)[b]	Concrete or asphalt	0.011	0.010-0.013
	Bare sand	0.010	0.01-0.016
	Graveled surface	0.02	0.012-0.03
	Bare clay-loam (eroded)	0.02	0.012-0.033
	Range (natural)	0.13	0.01-0.32
	Bluegrass sod	0.45	0.39-0.63
	Short grass prairie	0.15	0.10-0.20
	Bermuda grass	0.41	0.30-0.48
Yen (2001)[c]	Smooth asphalt pavement	0.012	0.010-0.015
	Smooth impervious surface	0.013	0.011-0.015
	Tar and sand pavement	0.014	0.012-0.016
	Concrete pavement	0.017	0.014-0.020
	Rough impervious surface	0.019	0.015-0.023
	Smooth bare packed soil	0.021	0.017-0.025
	Moderate bare packed soil	0.030	0.025-0.035
	Rough bare packed soil	0.038	0.032-0.045
	Gravel soil	0.032	0.025-0.045
	Mowed poor grass	0.038	0.030-0.045
	Average grass, closely clipped sod	0.050	0.040-0.060
	Pasture	0.055	0.040-0.070
	Timberland	0.090	0.060-0.120
	Dense grass	0.090	0.060-0.120
	Shrubs and bushes	0.120	0.080-0.180
	Business land use	0.022	0.014-0.035
	Semi-business land use	0.035	0.022-0.050
	Industrial land use	0.035	0.020-0.050
	Dense residential land use	0.040	0.025-0.060
	Suburban residential land use	0.055	0.030-0.080
	Parks and lawns	0.075	0.040-0.120

[a] Obtained by calibration of Stanford Watershed Model.

[b] Computed by Engman (1986) by kinematic wave and storage analysis of measured rainfall-runoff data.

[c] Computed on basis of kinematic wave analysis.

EXISTING CONDITIONS SWMM MODEL MAP



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

Design Point (South Bndy.)	Peak Runoff 5 yr. (CFS)	Peak Runoff 100 yr. (CFS)
4	46	105
4A	1	5
5	5	23
5A	2	9
6	59	122
6A	7	19
7	110	249
56	60	160

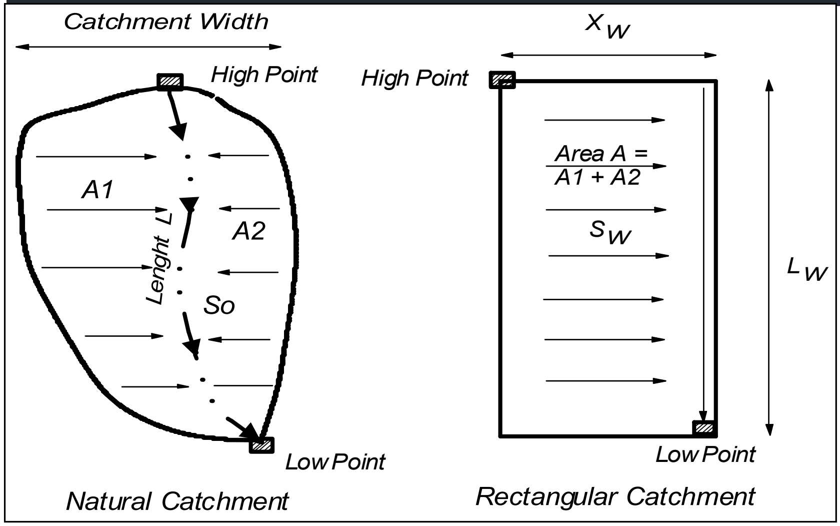
STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Pre-Developed Subcatchment Runoff

Subcatchment	Area (Ac.)	SWMM Imperv. (%)	*SWMM Width (Lw) (ft.)	*SWMM Slope (Sw) (%)	Peak Runoff 5 yr. (CFS)	Peak Runoff 100 yr. (CFS)
EX-10	265.9	7%	3365	3.41%	105	222
EX10A	153.5	5%	1857	4.05%	46	103
EX-11 +	214.3	4%	3255	3.01%	54	129
EX-13 +	94.8	6%	1877	3.97%	36	85
EX-4A	44.2	8%	3355	1.09%	19	50
EX-5	26.2	8%	1959	1.65%	12	32
EX-7	152.8	5%	2234	3.13%	46	105
EX-7A	2.4	2%	416	2.70%	1	5
EX-8	32.2	2%	1679	1.47%	5	23
EX-8A	6.6	2%	698	1.80%	2	9
EX-9	139.3	8%	1837	3.19%	59	122
EX-9A	21.8	5%	786	3.01%	7	19
TR-12 +	4.7	5%	544	4.13%	2	9
TR-20 +	23.2	7%	1388	3.21%	10	32
TR-4 +	4.4	5%	645	2.76%	2	9
TR-5 +	13.7	5%	990	2.70%	5	17
TR-6 +	1.5	5%	519	1.55%	1	4
TR-7 +	2.6	5%	233	5.84%	1	5

* Reference SWMM Catchment Shape Parameter Finder for calculations

CATCHMENT SHAPE PARAMETER FINDER

Convert Natural Catchment to a Rectangular Shape



Subcatchment Center	Z=0.5
Side Collector	Z=1
Skewed Location	0.5<Z<1

Dimensionless Variables

$$Y = \frac{L}{L_W}; \qquad X = \frac{A}{L^2}$$

$$Y = (1.5 - Z)(2.286X - 0.286X^2)$$

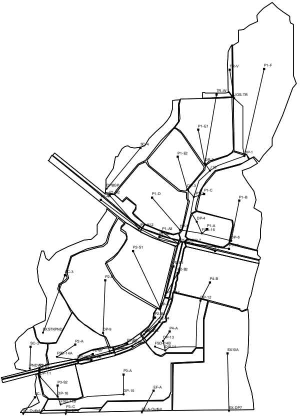
$$\frac{Lw}{L} = (1.5 - Z)[2.286(\frac{A}{L^2}) - 0.286(\frac{A}{L^2})^2]$$

$$S_o/S_w = A/(LL_w) + L_w/L$$

$$X_w = A/L_w$$

Subarea ID	Area acre	A1 acre	A2 acre	L ft	High Pt Elev. ft	Low Pt Elev. ft	Z=Am/A	$X=A/L^2$	Y=Lw/L	Lw ft	Xw ft	So %	So/Sw	Sw %
EX-7	152.80	82.00	70.80	6,430	7160.0	6997.0	0.54	0.16	0.35	2,234	2,980	2.53	0.81	3.13
EX-9	139.30	65.00	74.30	7,190	7190.0	7026.0	0.53	0.12	0.26	1,837	3,302	2.28	0.71	3.19
EX10A	153.50	75.00	78.50	8,030	7,236	7,015	0.51	0.10	0.23	1,857	3,600	2.75	0.68	4.05
EX10	265.90	120.00	145.90	7,280	7,380	7,148	0.55	0.22	0.46	3,365	3,442	3.19	0.94	3.41
EX-11	214.30	100.00	114.30	6,140	7,192	7,008	0.53	0.25	0.53	3,255	2,867	3.00	1.00	3.01
EX-13	94.80	47.00	47.80	4,900	7,232	7,070	0.50	0.17	0.38	1,877	2,200	3.31	0.83	3.97
TR-4	4.40	2.20	2.20	640	7,270	7,244	0.50	0.47	1.01	645	297	4.06	1.47	2.76
TR-5	13.70	7.50	6.20	1,250	7,273	7,230	0.55	0.38	0.79	990	603	3.44	1.27	2.70
TR-6	1.50	0.75	0.75	250	7,238	7,228	0.50	1.05	2.08	519	126	4.00	2.58	1.55
TR-7	2.60	1.30	1.30	1,100	7,234	7,192	0.50	0.09	0.21	233	487	3.82	0.65	5.84
TR-12	4.70	2.50	2.20	800	7,300	7,262	0.53	0.32	0.68	544	377	4.75	1.15	4.13
TR-20	23.20	12.00	11.20	1,550	7,314	7,246	0.52	0.42	0.90	1,388	728	4.39	1.37	3.21
EX-4A	44.20	22.10	22.10	750	7,044	7,001	0.50	3.42	4.47	3,355	574	5.73	5.24	1.09
EX-5	26.20	13.10	13.10	1,200	7,186	7,144	0.50	0.79	1.63	1,959	583	3.50	2.12	1.65
EX-7A	2.40	1.20	1.20	550	7,039	7,021	0.50	0.35	0.76	416	251	3.27	1.21	2.70
EX-8A	6.60	3.30	3.30	900	7,045	7,025	0.50	0.35	0.78	698	412	2.22	1.23	1.80
EX-8A	32.20	17.00	15.20	1,750	7,062	7,025	0.53	0.46	0.96	1,679	835	2.11	1.44	1.47
EX-9A	21.80	11.80	10.00	2,600	7,082	7,022	0.54	0.14	0.30	786	1,208	2.31	0.77	3.01

DEVELOPED CONDITIONS SWMM MODEL MAP



STERLING RANCH EAST PRELIMINARY PLAN NO. 1

Developed Subcatchment Runoff

Subcatchment	Area (Ac.)	SWWM Imperv. (%)	*SWMM Width (Lw) (ft.)	*SWMM Slope (Sw) (%)	Peak Runoff 5 yr. (CFS)	Peak Runoff 100 yr. (CFS)
EF-A	8.2	15%	1064	1.57%	**7**	**20**
EX10A +	60.4	5%	2452	1.79%	**18**	**50**
EX-9 +	6.0	5%	578	1.70%	**2**	**8**
EX-9A +	12.7	5%	1080	1.94%	**4**	**16**
P1-A	12.7	8%	1276	1.29%	**6**	**19**
P1-A1	5.0	45%	258	1.66%	**11**	**21**
P1-A2	6.4	45%	258	0.77%	**12**	**23**
P1-A3	1.8	50%	196	1.17%	**5**	**9**
P1-A4	2.0	50%	208	1.12%	**5**	**10**
P1-A5	5.7	45%	417	1.38%	**13**	**25**
P1-A6	2.8	50%	205	1.75%	**7**	**14**
P1-B (Dev.)	35.5	38%	873	1.36%	**55**	**108**
P1-B (Un-dev.)	35.5	5%	873	1.36%	**10**	**23**
P1-C	8.9	50%	581	3.69%	**23**	**46**
P1-D	31.4	38%	1033	1.27%	**53**	**102**
P1-E1	30.4	35%	1148	1.56%	**50**	**97**
P1-E2	21.8	40%	1048	1.23%	**41**	**80**
P1-F (Dev.)	76.7	30%	2322	2.18%	**111**	**215**
P1-F (Un-dev.)	76.7	5%	2322	2.18%	**22**	**59**
P2-A	24.4	10%	2164	2.11%	**15**	**43**
P2-B	57.8	38%	1215	1.64%	**88**	**173**
P2-B1	2.5	50%	201	3.37%	**7**	**13**
P2-B10	1.7	50%	187	3.43%	**5**	**10**
P2-B2	1.9	50%	148	3.54%	**5**	**10**
P2-B3	2.8	45%	245	2.15%	**7**	**13**
P2-B4	1.6	50%	138	2.49%	**4**	**8**
P2-B5	1.9	45%	230	1.86%	**5**	**9**
P2-B6	1.1	50%	141	2.28%	**3**	**6**
P2-B7	2.5	45%	272	1.78%	**6**	**12**
P2-B8	1.2	50%	141	2.34%	**3**	**7**
P2-B9	2.0	50%	226	3.27%	**5**	**11**
P2-S1	35.6	40%	1756	1.44%	**68**	**133**
P3-A	52.6	40%	1290	1.37%	**85**	**166**
P3-C	1.7	11%	446	1.31%	**1**	**5**
P3-S2	11.9	40%	1103	1.27%	**25**	**50**
P4-A	25.8	35%	920	1.21%	**41**	**80**
P4-B	37.3	35%	1773	1.34%	**63**	**123**
SC-1 +	3.6	8%	306	2.20%	**2**	**6**
SC-2 +	10.8	8%	1211	2.44%	**6**	**20**
SC-3 +	27.2	8%	616	2.68%	**12**	**26**
SC-4 +	16.4	8%	1918	1.48%	**8**	**27**
TR-V	2.1	19%	162	4.13%	**2**	**6**
TR-W	1.4	38%	90	1.30%	**3**	**5**

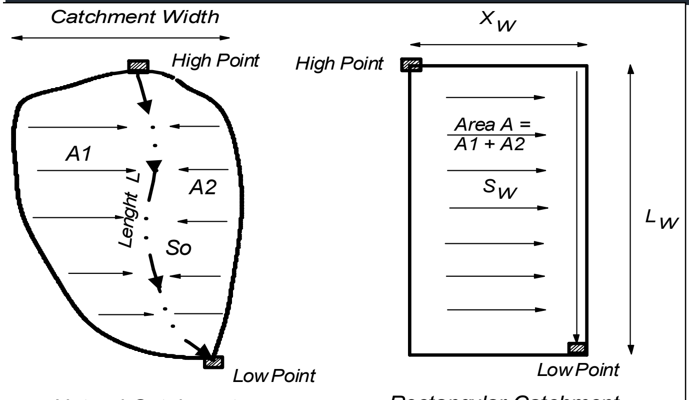
*** Reference SWMM Catchment Shape Parameter Finder for calculations**

+ Basin not changed from pre-development conditions

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Developed Surface Routing

Design Point (On-Site)	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	68	133
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
Pond FSD-11B	115	227
Pond FSD-14A	234	486
Pond FSD-14B	97	189
Pond FSD-16 (Ultimate)	323	499
Pond FSD-16 (Interim)	197	410
Design Point (South Bndy.)	**Peak Runoff 5 yr. (CFS)**	**Peak Runoff 100 yr. (CFS)**
4	0.5	3.5
4A	0.5	3.5
5	4	10
5A	2	7
6	2.0	48.9
6A	4	16
7	18	50

Convert Natural Catchment to a Rectangular Shape



Natural Catchment

Rectangular Catchment

Subcatchment Center	Z=0.5
Side Collector	Z=1
Skewed Location	0.5<Z<1

Dimensionless Variables

$Y = \frac{L}{L_w}; \qquad X = \frac{A}{L^2}$

$$Y = (1.5 - Z)(2.286X - 0.286X^2)$$

$$\frac{Lw}{L} = (1.5 - Z)[2.286(\frac{A}{L^2}) - 0.286(\frac{A}{L^2})^2]$$

$$S_o/S_w = A/(LL_w) + L_w/L$$

$$X_w = A/L_w$$

Subarea ID	Area acre	A1 acre	A2 acre	L ft	High Pt Elev. ft	Low Pt Elev. ft	Z=Am/A	X=A/L ^{2}	Y=Lw/L	Lw ft	Xw ft	So %	So/Sw	Sw %
EF-A	8.20	4.10	4.10	260	7050.0	7028.0	0.50	5.28	4.09	1,064	336	8.46	5.38	1.57
P3-C	1.70	0.50	1.20	260	7027.0	7019.0	0.71	1.10	1.72	446	166	3.08	2.35	1.31
P1-A	12.70	7.00	5.70	850	7,124	7,102	0.55	0.77	1.50	1,276	433	2.59	2.01	1.29
P1-B	35.50	10.00	25.50	3,100	7,160	7,124	0.72	0.16	0.28	873	1,770	1.16	0.85	1.36
P1-C	8.90	4.50	4.40	1,700	7,158	7,122	0.51	0.13	0.30	510	761	2.12	0.75	2.83
P1-D	31.40	14.00	17.40	2,800	7,136	7,106	0.55	0.17	0.37	1,033	1,324	1.07	0.84	1.27
P1-E1	30.40	16.00	14.40	2,500	7,188	7,152	0.53	0.21	0.46	1,148	1,154	1.44	0.92	1.56
P1-E2	21.80	11.00	10.80	2,000	7,158	7,134	0.50	0.24	0.52	1,048	906	1.20	0.98	1.23
P1-F	76.70	35.00	41.70	3,000	7,240	7,158	0.54	0.37	0.77	2,322	1,439	2.73	1.25	2.18
TR-W	1.40	0.70	0.70	90	7,192	7,182	0.50	7.53	1.00	90	678	11.11	8.53	1.30
TR-V	2.10	1.50	0.60	1,000	7,220	7,190	0.71	0.09	0.16	162	563	3.00	0.73	4.13
P1-A1	5.00	3.10	1.90	2,400	7,134	7,112	0.62	0.04	0.08	182	1,199	0.92	0.58	1.59
P1-A2	6.40	3.20	3.20	2,400	7,134	7,110	0.50	0.05	0.11	264	1,056	1.00	0.55	1.82
P1-A3	1.80	0.70	1.10	800	7,110	7,103	0.61	0.12	0.25	196	400	0.88	0.74	1.17
P1-A4	2.00	1.30	0.70	800	7,112	7,105	0.65	0.14	0.26	208	419	0.88	0.78	1.12
P1-A5	5.70	3.00	2.70	1,300	7,114	7,100	0.53	0.15	0.32	417	595	1.08	0.78	1.38
P1-A6	2.80	1.30	1.50	1,300	7,114	7,100	0.54	0.07	0.16	205	595	1.08	0.62	1.75
P2-A	24.40	13.20	11.20	900	7,056	7,000	0.54	1.31	2.40	2,164	491	6.22	2.95	2.11
P2-B	57.80	18.50	39.30	3,800	7,106	7,052	0.68	0.17	0.32	1,215	2,072	1.42	0.87	1.64
P2-S1	35.60	18.00	17.60	1,900	7,110	7,072	0.51	0.43	0.92	1,756	883	2.00	1.39	1.44
P2-B1	2.50	1.50	1.00	1,100	7,102	7,077	0.60	0.09	0.18	201	541	2.27	0.67	3.37
P2-B2	1.90	1.20	0.70	1,100	7,102	7,077	0.63	0.07	0.13	148	559	2.27	0.64	3.54
P2-B3	2.80	1.70	1.10	1,000	7,077	7,061	0.61	0.12	0.25	245	498	1.60	0.74	2.15
P2-B4	1.60	1.00	0.60	1,000	7,077	7,061	0.63	0.07	0.14	138	504	1.60	0.64	2.49
P2-B5	1.90	1.20	0.70	700	7,061	7,050	0.63	0.17	0.33	230	360	1.57	0.84	1.86
P2-B6	1.10	0.65	0.45	700	7,061	7,050	0.59	0.10	0.20	141	341	1.57	0.69	2.28
P2-B7	2.50	1.60	0.90	770	7,050	7,038	0.64	0.18	0.35	272	401	1.56	0.87	1.78
P2-B8	1.20	0.70	0.50	770	7,050	7,038	0.58	0.09	0.18	141	372	1.56	0.67	2.34
P2-B9	2.00	1.00	1.00	870	7,038	7,018	0.50	0.12	0.26	226	386	2.30	0.70	3.27
P2-B10	1.70	0.90	0.80	870	7,038	7,018	0.53	0.10	0.21	187	397	2.30	0.67	3.43
P3-A	1.70	0.90	0.80	870	7,038	7,018	0.53	0.10	0.21	187	397	2.30	0.67	3.43
P3-S2	11.90	6.00	5.90	1,000	7,036	7,016	0.50	0.52	1.10	1,103	470	2.00	1.57	1.27
P4-A	25.80	20.00	5.80	1,950	7,078	7,052	0.78	0.30	0.47	920	1,222	1.33	1.10	1.21
P4-B	37.30	25.00	12.30	1,600	7,116	7,080	0.67	0.63	1.11	1,773	916	2.25	1.68	1.34
SC-1	3.60	1.80	1.80	150	7,014	6,996	0.50	6.97	2.04	306	512	12.00	5.46	2.20
SC-2	10.80	5.00	5.80	770	7040.0	7001.0	0.54	0.79	1.57	1,211	388	5.06	2.08	2.44
SC-3	27.20	14.00	13.20	4,300	7100.0	7032.0	0.51	0.06	0.14	616	1,925	1.58	0.59	2.68
SC-4	16.40	8.20	8.20	420	7,136	7,102	0.50	4.05	4.57	1,918	372	8.10	5.45	1.48
EX-9	6.00	3.00	3.00	1,000	7,050	7,030	0.50	0.26	0.58	578	452	2.00	1.03	1.94
EX-9A	12.70	6.30	6.40	1,100	7,049	7,022	0.50	0.46	0.98	1,080	512	2.45	1.45	1.70

PROPOSED PONDS
EFFECTIVE IMPERVIOUS AREA CALCULATIONS

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

(Full Build Out)

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%**

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

(Prelim. Plan 1 & Foursquare PUD Only)

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P1-A	12.7	N/A	15%
P1-B	35.5	Un dev.	2%
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	Un dev.	2%
TR-V	2.1	17,500	27%
TR-W	1.4	13,500	32%
TOTAL	**220.9**		**26%**

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Pond FSD-14A Tributary Area

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P1-A1	5.0	N/A	70%
P1-A2	6.4	N/A	70%
P1-A3	1.8	N/A	70%
P1-A4	2.0	N/A	70%
P1-A5	5.7	N/A	70%
P1-A6	2.8	N/A	70%
P2-S1	35.6	School	50%
P2-A	24.4	Park	7%
P2-B	57.8	7,000	57%
P2-B1	2.5	N/A	50%
P2-B2	1.9	N/A	70%
P2-B3	2.8	N/A	50%
P2-B4	1.6	N/A	70%
P2-B5	1.9	N/A	50%
P2-B6	1.1	N/A	70%
P2-B7	2.5	N/A	25%
P2-B8	1.2	N/A	70%
TOTAL	**157.0**		**49%**

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Pond FSD-14B Tributary Area

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P4-A	25.8	6,500	60%
P4-B	37.3	6,500	60%
TOTAL	**63.1**		**60%**

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Pond FSD-11B Tributary Area

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P2-B9	2.0	N/A	70%
P2-B10	1.7	N/A	70%
P3-S2	11.9	School	65%
P3-A	52.6	7,000	57%
TOTAL	**68.2**		**59%**

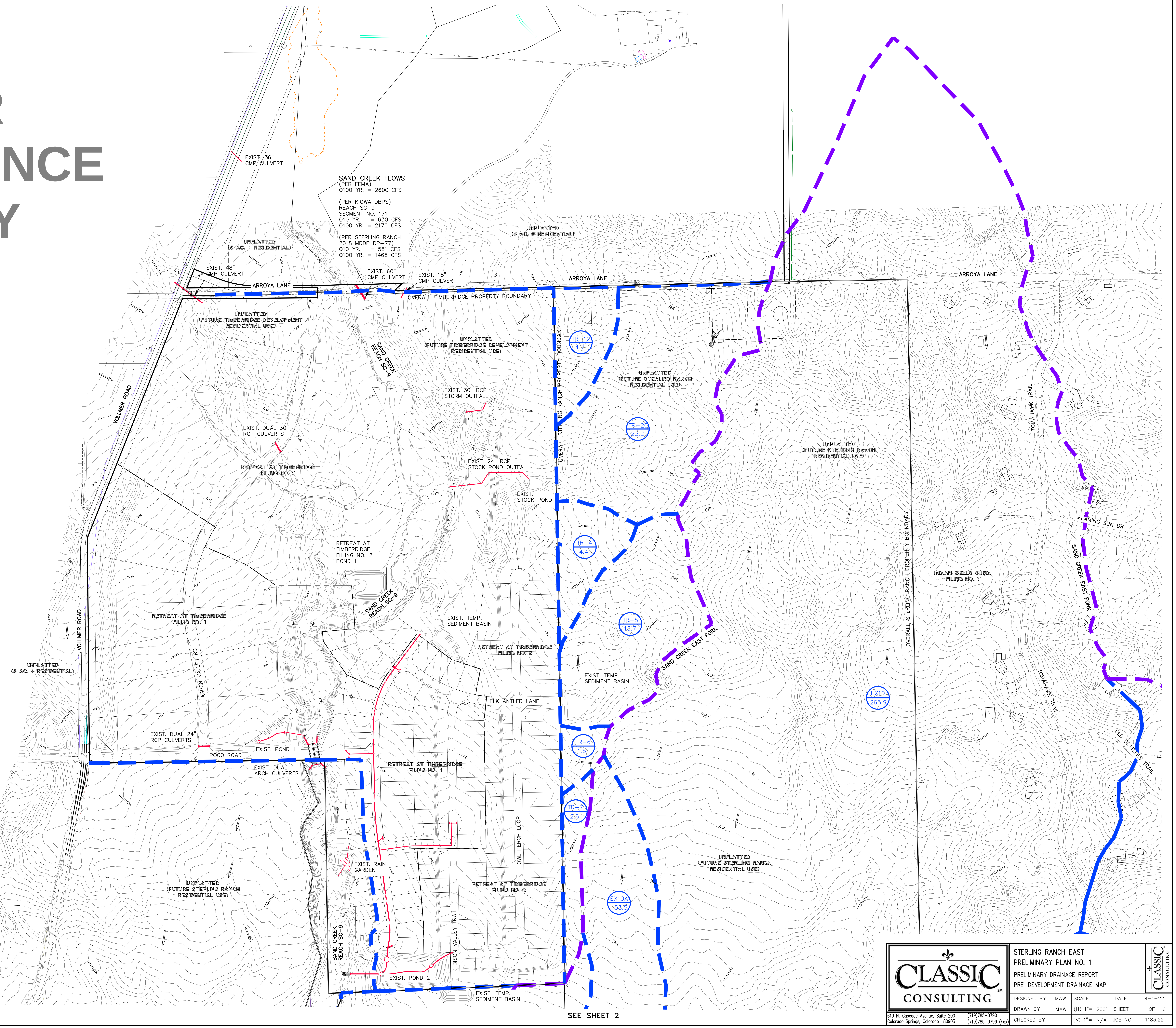
STERLING RANCH EAST PRELIMINARY PLAN NO. 1

Flow Comparison along South Boundary

	This Report (SWMM 5.1) Pre-Dev. Conditions		This Report (SWMM 5.1) Developed Conditions		2018 SR MDDP (HEC-HMS) Pre-Dev. Conditions	
Design Point (South Bndy.)	**Peak Runoff 5 yr. (CFS)**	**Peak Runoff 100 yr. (CFS)**	**Peak Runoff 5 yr. (CFS)**	**Peak Runoff 100 yr. (CFS)**	**Peak Runoff 5 yr. (CFS)**	**Peak Runoff 100 yr. (CFS)**
4	**46**	**105**	**0.5**	**3.5**	**21.5**	**107.4**
4A	**1**	**5**	**0.5**	**3.5**		
5	**5**	**23**	**4**	**10**	**1.7**	**20.5**
5A	**2**	**9**	**2**	**7**		
6	**59**	**122**	**2.0**	**48.9**	**23.9**	**125.2**
6A	**7**	**19**	**4**	**11**		
7	**110**	**249**	**18**	**50**	**57.1**	**277.9**
56	**60**	**160**	**60**	**160**	**42.5**	**202.9**

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**



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200 100 0 200 400

SCALE: 1" = 200'

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	▬

CLASSIC CONSULTING
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Colorado Springs, Colorado 80903
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(719)785-0799 (Fax)

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

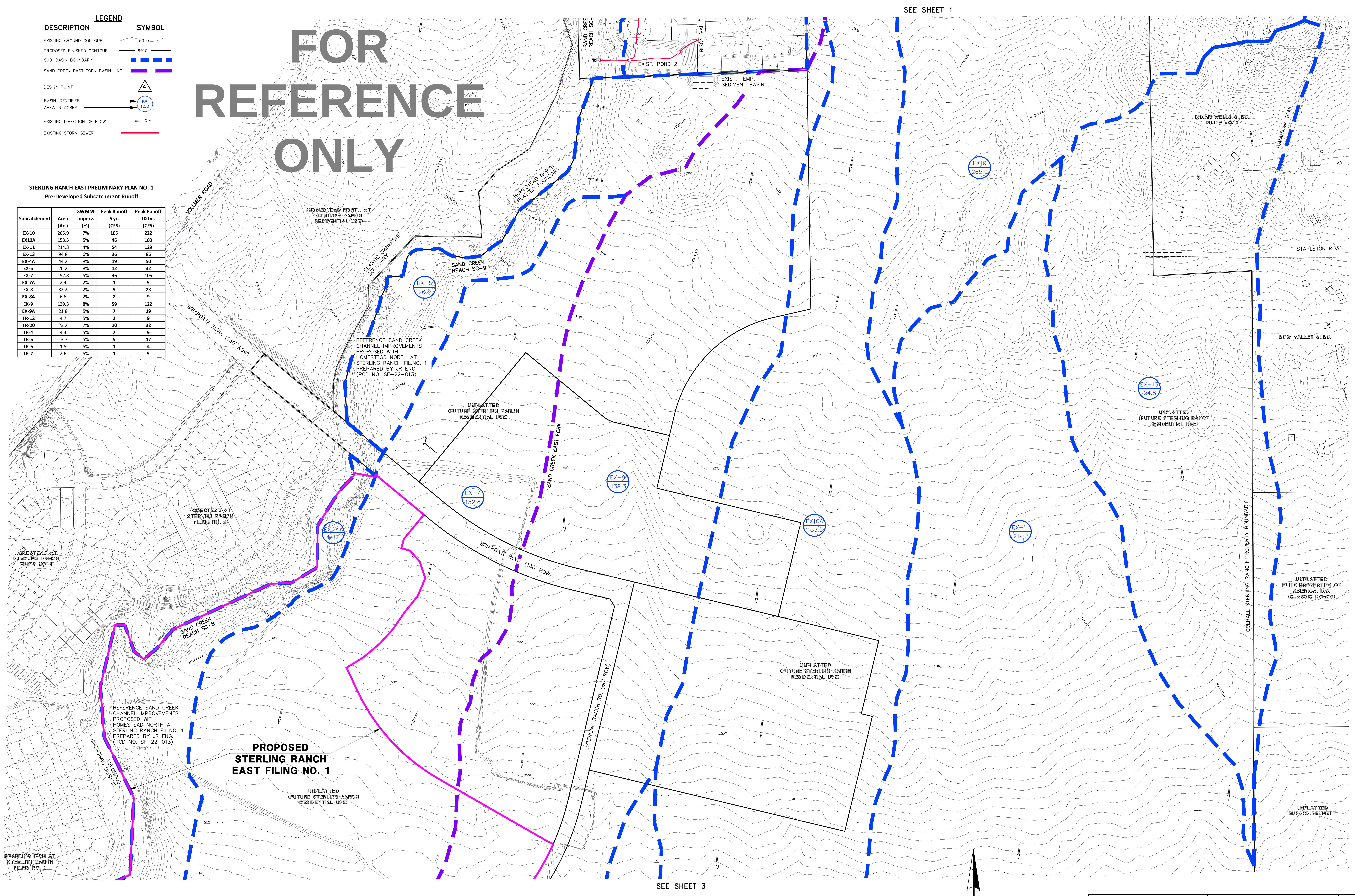
DESIGNED BY	MAW	SCALE	DATE 4-1-22
DRAWN BY	MAW	(H) 1"= 200'	SHEET 1 OF 6
CHECKED BY		(V) 1"= N/A	JOB NO. 1183.22

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**



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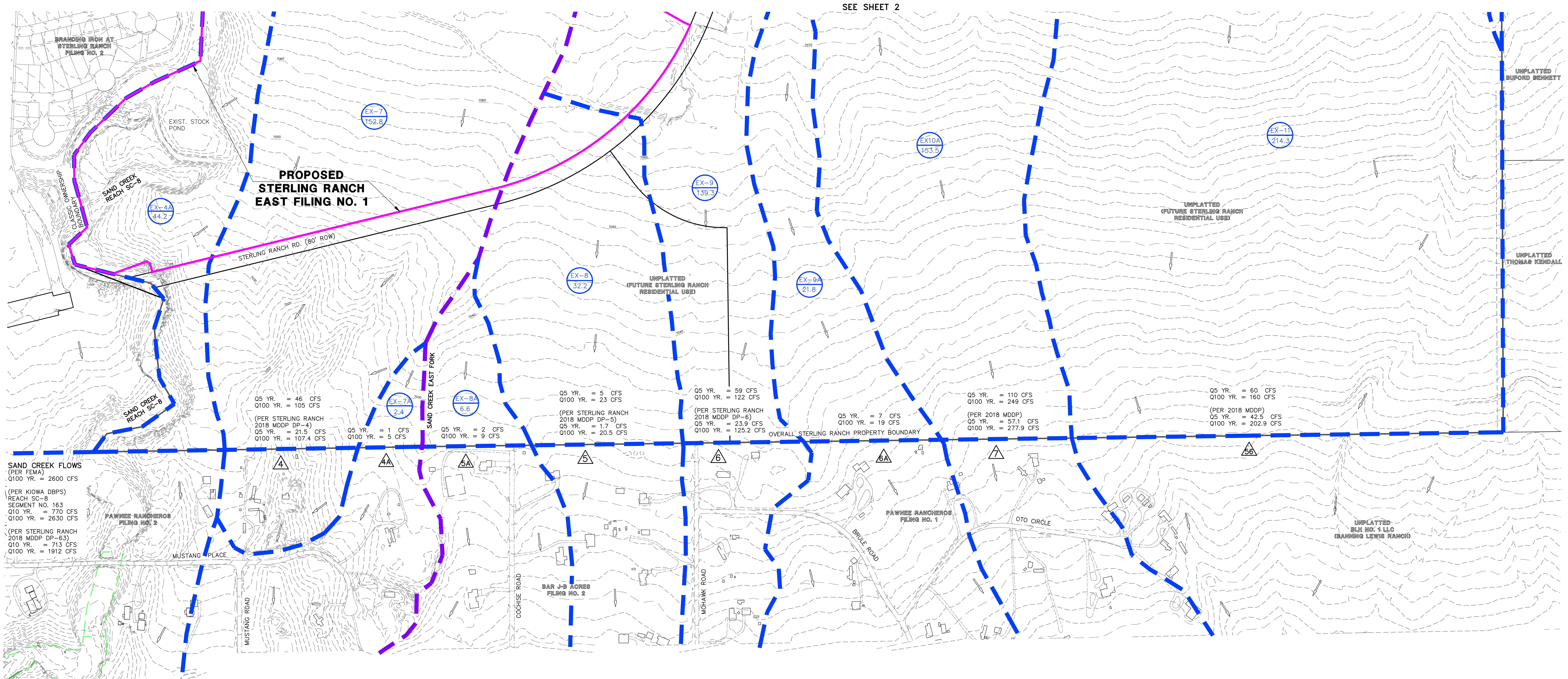
STERLING RANCH EAST
PRELIMINARY PLAN NO. 1
PRELIMINARY DRAINAGE REPORT
PRE-DEVELOPMENT DRAINAGE MAP

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



MUSTANG ROAD

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	BB
AREA IN ACRES	10.0
EXISTING DIRECTION OF FLOW	⇒
EXISTING STORM SEWER	▬

N

200 100 0 200 400

SCALE: 1" = 200'

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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

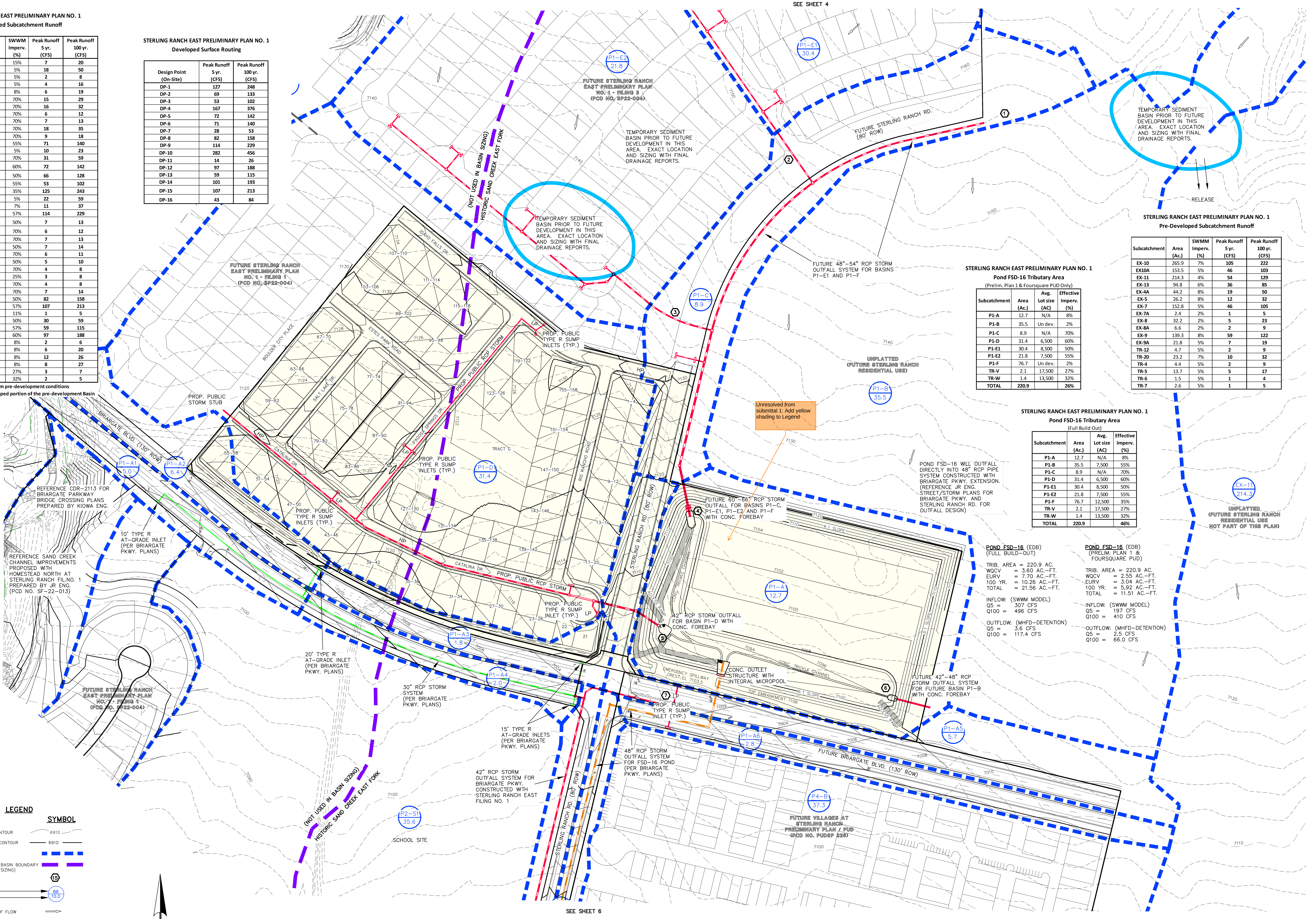
Subcatchment	Area (Ac.)	SWWM Imperv. (%)	Peak Runoff 5 yr. (CFS)	Peak Runoff 100 yr. (CFS)
EF-A	8.2	15%	7	20
EX10A ++	60.4	5%	18	50
EX-9 ++	6.0	5%	2	8
EX-9A ++	12.7	5%	4	16
P1-A	12.7	8%	6	19
P1-A1	5.0	70%	15	29
P1-A2	6.4	70%	16	32
P1-A3	1.8	70%	6	12
P1-A4	2.0	70%	7	13
P1-A5	5.7	70%	18	35
P1-A6	2.8	70%	9	18
P1-B (Dev.)	35.5	55%	71	140
P1-B (Un-dev.)	35.5	5%	10	23
P1-C	8.9	70%	31	59
P1-D	31.4	60%	72	142
P1-E1	30.4	50%	66	128
P1-E2	21.8	55%	53	102
P1-F (Dev.)	76.7	35%	125	243
P1-F (Un-dev.)	76.7	5%	22	59
P2-A	24.4	7%	11	37
P2-B	57.8	57%	114	229
P2-B1	2.5	50%	7	13
P2-B10	1.7	70%	6	12
P2-B2	1.9	70%	7	13
P2-B3	2.8	50%	7	14
P2-B4	1.6	70%	6	11
P2-B5	1.9	50%	5	10
P2-B6	1.1	70%	4	8
P2-B7	2.5	25%	3	8
P2-B8	1.2	70%	4	8
P2-B9	2.0	70%	7	14
P2-S1	35.6	50%	82	158
P3-A	52.6	57%	107	213
P3-C	1.7	11%	1	5
P3-S2	11.9	50%	30	59
P4-A	25.8	57%	59	115
P4-B	37.3	60%	97	188
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	27%	3	7
TR-W	1.4	32%	2	5

\+ Basin not changed from pre-development conditions

++ Remaining undeveloped portion of the pre-development Basin

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Developed Surface Routing

Design Point (On-Site)	Peak Runoff 5 yr. (CFS)	Peak Runoff 100 yr. (CFS)
DP-1	127	248
DP-2	69	133
DP-3	53	102
DP-4	167	376
DP-5	72	142
DP-6	71	140
DP-7	28	53
DP-8	82	158
DP-9	114	229
DP-10	282	456
DP-11	14	26
DP-12	97	188
DP-13	59	115
DP-14	101	193
DP-15	107	213
DP-16	43	84



Unresolved from submittal 1: Add yellow shading to Legend

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)

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
(Prelim. Plan 1 & Foursquare PUD Only)

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P1-A	12.7	N/A	8%
P1-B	35.5	Un dev.	2%
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	Un dev.	2%
TR-V	2.1	17,500	27%
TR-W	1.4	13,500	32%
TOTAL	220.9		26%

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Pond FSD-16 Tributary Area
(Full Build Out)

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P1-A	12.7	N/A	8%
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%

POND FSD-16 (EDB)
(FULL BUILD-OUT)

TRIB. AREA = 220.9 AC.
WQCV = 3.60 AC.-FT.
EURV = 7.70 AC.-FT.
100 YR. = 10.26 AC.-FT.
TOTAL = 21.56 AC.-FT.

INFLOW: (SWWM MODEL)
Q5 = 307 CFS
Q100 = 496 CFS

OUTFLOW: (MHFD-DETENTION)
Q5 = 3.6 CFS
Q100 = 117.4 CFS

POND FSD-16 (EDB)
(PRELIM. PLAN 1 & FOURSQUARE PUD)

TRIB. AREA = 220.9 AC.
WQCV = 2.55 AC.-FT.
EURV = 3.04 AC.-FT.
100 YR. = 5,92 AC.-FT.
TOTAL = 11.51 AC.-FT.

INFLOW: (SWWM MODEL)
Q5 = 197 CFS
Q100 = 410 CFS

OUTFLOW: (MHFD-DETENTION)
Q5 = 2.5 CFS
Q100 = 66.0 CFS

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	— 6910 —
BASIN BOUNDARY	▬ ▬ ▬ ▬
HISTORIC EAST FORK BASIN BOUNDARY (NOT USED IN BASIN SIZING)	▬ ▬
DESIGN POINT	⑮
BASIN IDENTIFIER	BB
AREA IN ACRES	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	🟧

N

100 50 0 100 200

SCALE: 1" = 100'

SEE SHEET 6

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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

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	🟧
STERLING RANCH EAST PRELIMINARY PLAN NO. 1 AREA	🟨

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
EX-9 ++	6.0	5%	2	8
EX-9A ++	12.7	5%	4	16
P1-A	12.7	8%	6	19
P1-A1	5.0	70%	15	29
P1-A2	6.4	70%	16	32
P1-A3	1.8	70%	6	12
P1-A4	2.0	70%	7	13
P1-A5	5.7	70%	18	35
P1-A6	2.8	70%	9	18
P1-B (Dev.)	35.5	55%	71	140
P1-B (Un-dev.)	35.5	5%	10	23
P1-C	8.9	70%	31	59
P1-D	31.4	60%	72	142
P1-E1	30.4	50%	66	128
P1-E2	21.8	55%	53	102
P1-F (Dev.)	76.7	35%	125	243
P1-F (Un-dev.)	76.7	5%	22	59
P2-A	24.4	7%	11	37
P2-B	57.8	57%	114	229
P2-B1	2.5	50%	7	13
P2-B10	1.7	70%	6	12
P2-B2	1.9	70%	7	13
P2-B3	2.8	50%	7	14
P2-B4	1.6	70%	6	11
P2-B5	1.9	50%	5	10
P2-B6	1.1	70%	4	8
P2-B7	2.5	25%	3	8
P2-B8	1.2	70%	4	8
P2-B9	2.0	70%	7	14
P2-S1	35.6	50%	82	158
P3-A	52.6	57%	107	213
P3-C	1.7	11%	1	5
P3-S2	11.9	50%	30	59
P4-A	25.8	57%	59	115
P4-B	37.3	60%	97	188
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	27%	3	7
TR-W	1.4	32%	2	5

+ Basin not changed from pre-development conditions

++ Remaining undeveloped portion of the pre-development Basin

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Pond FSD-14A Tributary Area

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P1-A1	5.0	N/A	70%
P1-A2	6.4	N/A	70%
P1-A3	1.8	N/A	70%
P1-A4	2.0	N/A	70%
P1-A5	5.7	N/A	70%
P1-A6	2.8	N/A	70%
P2-S1	35.6	School	50%
P2-A	24.4	Park	7%
P2-B	57.8	7,000	57%
P2-B1	2.5	N/A	50%
P2-B2	1.9	N/A	70%
P2-B3	2.8	N/A	50%
P2-B4	1.6	N/A	70%
P2-B5	1.9	N/A	50%
P2-B6	1.1	N/A	70%
P2-B7	2.5	N/A	25%
P2-B8	1.2	N/A	70%
TOTAL	157.0		49%

POND FSD-14A (EDB)

TRIB. AREA = 157.0 AC.
WQCV = 2.67 AC.-FT.
EURV = 6.10 AC.-FT.
100 YR. = 5.59 AC.-FT.
TOTAL = 14.36 AC.-FT.

INFLOW: (SWWM MODEL)
Q5 = 307 CFS
Q100 = 496 CFS

OUTFLOW: (MHFD-DETENTION)
Q5 = 3.3 CFS
Q100 = 119.0 CFS

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Developed Surface Routing

Design Point (On-Site)	Peak Runoff 5 yr. (CFS)	Peak Runoff 100 yr. (CFS)
DP-1	127	248
DP-2	69	133
DP-3	53	102
DP-4	167	376
DP-5	72	142
DP-6	71	140
DP-7	28	53
DP-8	82	158
DP-9	114	229
DP-10	282	456
DP-11	14	26
DP-12	97	188
DP-13	59	115
DP-14	101	193
DP-15	107	213
DP-16	43	84
Pond FSD-11B	144	236
Pond FSD-14A	290	488
Pond FSD-14B	101	193
Pond FSD-16 (Ultimate)	307	496
Pond FSD-16 (Interim)	197	410

POND FSD-16 (EDB)
(FULL BUILD-OUT)

TRIB. AREA = 220.9 AC.
WQCV = 3.60 AC.-FT.
EURV = 7.70 AC.-FT.
100 YR. = 10.26 AC.-FT.
TOTAL = 21.56 AC.-FT.

INFLOW: (SWWM MODEL)
Q5 = 307 CFS
Q100 = 496 CFS

OUTFLOW: (MHFD-DETENTION)
Q5 = 3.6 CFS
Q100 = 117.4 CFS

POND FSD-16 (EDB)
(PRELIM. PLAN 1 & FOURSQUARE PUD DEVELOPMENTS ONLY
BASINS P1-B & P1-F UNDEVELOPED)

TRIB. AREA = 220.9 AC.
WQCV = 2.55 AC.-FT.
EURV = 3.04 AC.-FT.
100 YR. = 5.92 AC.-FT.
TOTAL = 11.51 AC.-FT.

INFLOW: (SWWM MODEL)
Q5 = 197 CFS
Q100 = 410 CFS

OUTFLOW: (MHFD-DETENTION)
Q5 = 2.5 CFS
Q100 = 66.0 CFS

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

(Full Build Out)

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P1-A	12.7	N/A	8%
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%

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

(Prelim. Plan 1 & Foursquare PUD Only)

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P1-A	12.7	N/A	8%
P1-B	35.5	Un dev.	2%
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	Un dev.	2%
TR-V	2.1	17,500	27%
TR-W	1.4	13,500	32%
TOTAL	220.9		26%

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

* Basins with no change upon developed condition

POND FSD-14B (EDB)

TRIB. AREA = 63.1 AC.
WQCV = 1.23 AC.-FT.
EURV = 3.27 AC.-FT.
100 YR. = 1.93 AC.-FT.
TOTAL = 6.43 AC.-FT.

INFLOW: (SWWM MODEL)
Q5 = 101 CFS
Q100 = 193 CFS

OUTFLOW: (MHFD-DETENTION)
Q5 = 2.0 CFS
Q100 = 48.1 CFS

STERLING RANCH EAST PRELIMINARY PLAN NO. 1
Pond FSD-14B Tributary Area

Subcatchment	Area (Ac.)	Avg. Lot size (AC)	Effective Imperv. (%)
P4-A	25.8	7,000	57%
P4-B	37.3	6,500	60%
TOTAL	63.1		59%

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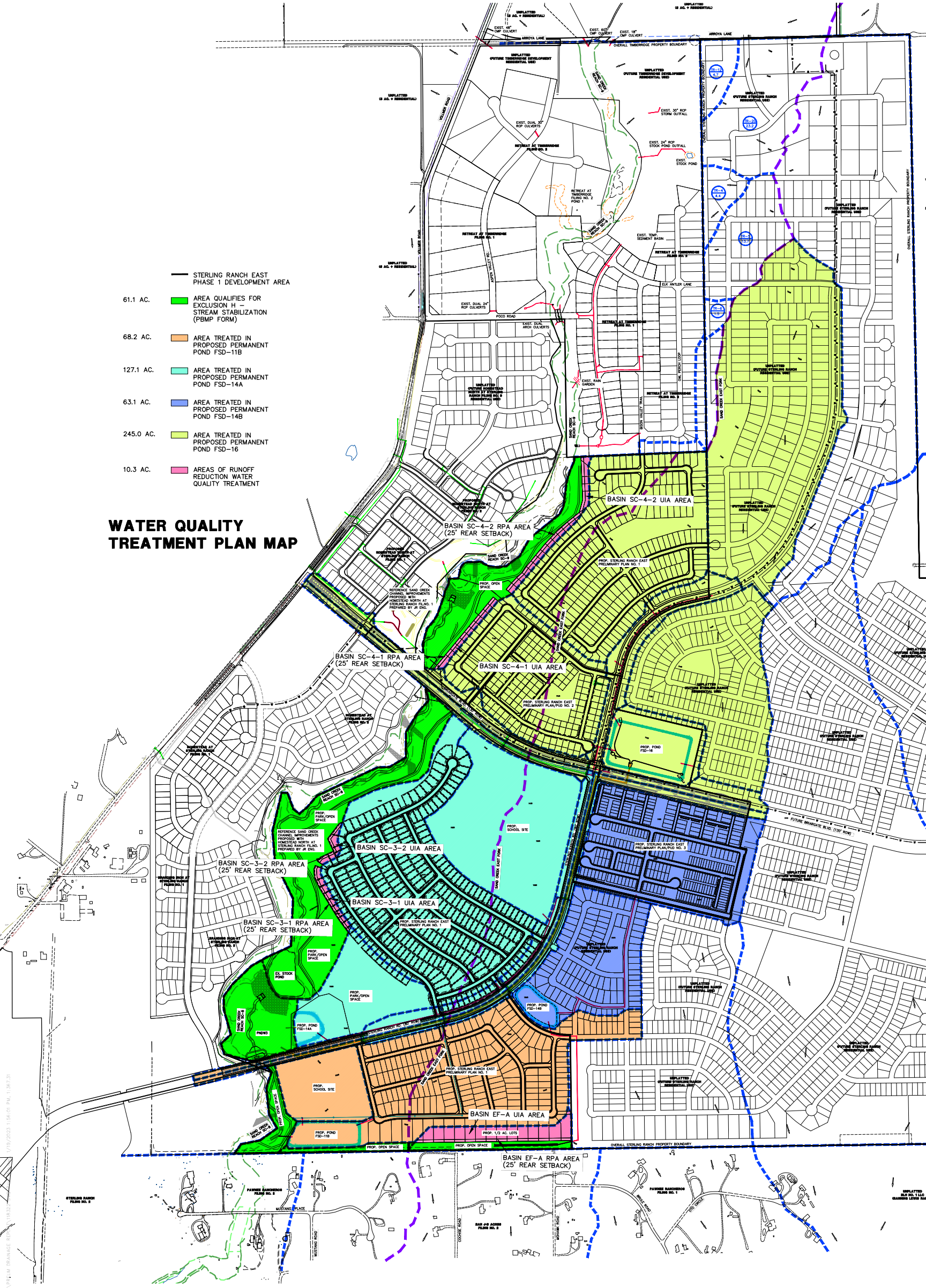
(719)785-0790
(719)785-0799 (Fax)

STERLING RANCH EAST
PRELIMINARY PLAN NO. 1
PRELIMINARY DRAINAGE REPORT
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 4-1-22
DRAWN BY	MAW	(H) 1"= 200'	SHEET 5 OF 6
CHECKED BY		(V) 1"= N/A	JOB NO. 1183.22

WATER QUALITY TREATMENT PLAN MAP

	━	STERLING RANCH EAST PHASE 1 DEVELOPMENT AREA
61.1 AC.	🟩	AREA QUALIFIES FOR EXCLUSION H – STREAM STABILIZATION (PBMP FORM)
68.2 AC.	🟧	AREA TREATED IN PROPOSED PERMANENT POND FSD–11B
127.1 AC.	▨	AREA TREATED IN PROPOSED PERMANENT POND FSD–14A
63.1 AC.	🟦	AREA TREATED IN PROPOSED PERMANENT POND FSD–14B
245.0 AC.	🟨	AREA TREATED IN PROPOSED PERMANENT POND FSD–16
10.3 AC.	🟪	AREAS OF RUNOFF REDUCTION WATER QUALITY TREATMENT



Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Designer: **Marc A. Whorton, P.E.**
Company: **Classic Consulting**
Date: **May 31, 2022**
Project: **Sterling Ranch East Preliminary Plan No. 1**
Location: **BASINS NOT TRIBUTARY TO PERMANENT SWQ FACILITY**

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth 0.53 inches
Depth of Average Runoff Producing Storm, d_6 = 0.42 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA							
Area ID	EF-A	SC-3-1	SC-3-2	SC-4-1	SC-4-2							
Downstream Design Point ID	SC	SC	SC	SC	SC							
Downstream BMP Type	None	None	None	None	None							
DCIA (ft^2)	--	--	--	--	--							
UIA (ft^2)	40,000	26,790	19,924	30,053	48,697							
RPA (ft^2)	37,188	17,918	12,924	21,985	28,692							
SPA (ft^2)	--	--	--	--	--							
HSG A (%)	0%	0%	0%	0%	0%							
HSG B (%)	100%	100%	100%	100%	100%							
HSG C/D (%)	0%	0%	0%	0%	0%							
Average Slope of RPA (ft/ft)	0.020	0.040	0.030	0.040	0.040							
UIA:RPA Interface Width (ft)	800.00	700.00	400.00	800.00	1000.00							

CALCULATED RUNOFF RESULTS

Area ID	EF-A	SC-3-1	SC-3-2	SC-4-1	SC-4-2							
UIA:RPA Area (ft^2)	77,188	44,708	32,848	52,038	77,389							
L / W Ratio	0.12	0.09	0.21	0.08	0.08							
UIA / Area	0.5182	0.5992	0.6066	0.5775	0.6292							
Runoff (in)	0.00	0.00	0.00	0.00	0.00							
Runoff (ft^3)	0	0	0	0	0							
Runoff Reduction (ft^3)	1433	960	714	1077	1745							

CALCULATED WQCV RESULTS

Area ID	EF-A	SC-3-1	SC-3-2	SC-4-1	SC-4-2							
WQCV (ft^3)	1628	1090	811	1223	1982							
WQCV Reduction (ft^3)	1628	1090	811	1223	1982							
WQCV Reduction (%)	100%	100%	100%	100%	100%							
Untreated WQCV (ft^3)	0	0	0	0	0							

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

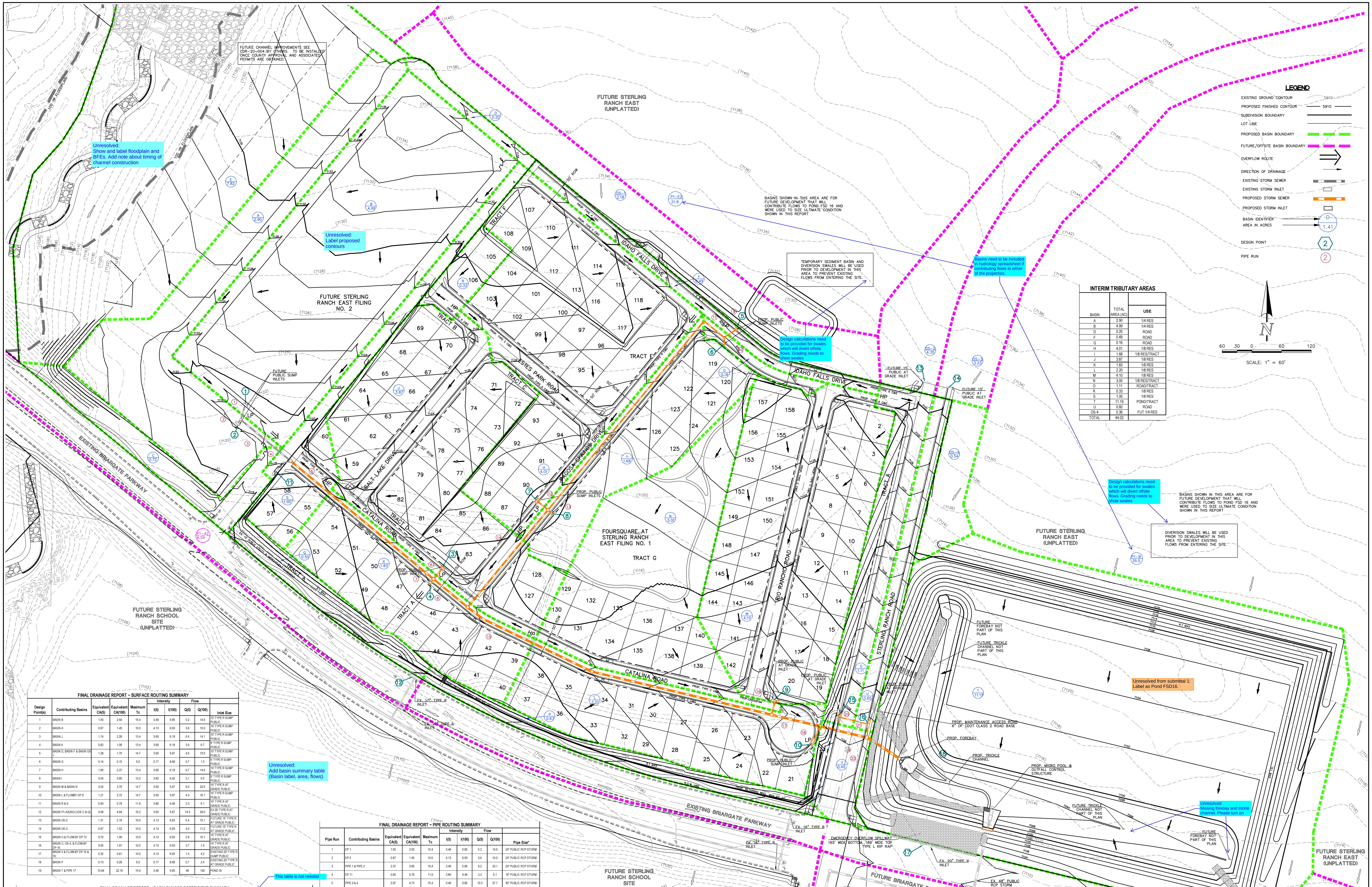
Downstream Design Point ID	SC											
DCIA (ft^2)	0											
UIA (ft^2)	165,464											
RPA (ft^2)	118,707											
SPA (ft^2)	0											
Total Area (ft^2)	284,171											
Total Impervious Area (ft^2)	165,464											
WQCV (ft^3)	6,734											
WQCV Reduction (ft^3)	6,734											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	284,171
Total Impervious Area (ft^2)	165,464
WQCV (ft^3)	6,734
WQCV Reduction (ft^3)	6,734
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

DRAINAGE MAPS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS



FUTURE CHANNEL IMPROVEMENTS SEE CDR-20-004 BY OTHERS. TO BE INSTALLED ONCE COUNTY APPROVAL AND ASSOCIATED PERMITS ARE OBTAINED.

Unresolved:
Show and label floodplain and BFEs. Add note about timing of channel construction

Unresolved:
Label proposed contours

BASINS SHOWN IN THIS AREA ARE FOR FUTURE DEVELOPMENT THAT WILL CONTRIBUTE FLOWS TO POND FSD 16 AND WERE USED TO SIZE ULTIMATE CONDITION SHOWN IN THIS REPORT

TEMPORARY SEDIMENT BASIN AND DIVERISION SWALES WILL BE USED PRIOR TO DEVELOPMENT IN THIS AREA TO PREVENT EXISTING FLOWS FROM ENTERING THE SITE.

Basins need to be included in hydrology spreadsheet if contributing flows to either of the properties.

Design calculations need to be provided for swales which will divert offsite flows. Grading needs to show swales

Design calculations need to be provided for swales which will divert offsite flows. Grading needs to show swales

BASINS SHOWN IN THIS AREA ARE FOR FUTURE DEVELOPMENT THAT WILL CONTRIBUTE FLOWS TO POND FSD 16 AND WERE USED TO SIZE ULTIMATE CONDITION SHOWN IN THIS REPORT

DIVERISION SWALES WILL BE USED PRIOR TO DEVELOPMENT IN THIS AREA TO PREVENT EXISTING FLOWS FROM ENTERING THE SITE.

Unresolved from submittal 1:
Label as Pond FSD16.

Unresolved:
Missing forebay and trickle channel. Please turn on

Unresolved:
Add basin summary table (Basin label, area, flows)

LEGEND

EXISTING GROUND CONTOUR	5910
PROPOSED FINISHED CONTOUR	5910
SUBDIVISION BOUNDARY	
LOT LINE	
PROPOSED BASIN BOUNDARY	🟩
FUTURE/OFFSITE 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

INTERIM TRIBUTARY AREAS

BASIN	TOTAL AREA (AC)	USE
A	2.90	1/4 RES
B	4.99	1/4 RES
D	0.20	ROAD
F	0.49	ROAD
G	0.16	ROAD
H	4.01	1/8 RES
I	1.68	1/8 RES/TRACT
J	3.87	1/8 RES
K	1.83	1/8 RES
L	2.20	1/8 RES
M	4.10	1/8 RES
N	3.00	1/8 RES/TRACT
O	1.11	ROAD/TRACT
R	0.33	1/8 RES
S	1.00	1/8 RES
T	11.19	POND/TRACT
U	0.60	ROAD
OS-4	0.36	FUT 1/4 RES
TOTAL	44.02	

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1	BASIN B	1.50	2.50	15.4	3.48	5.85	5.2	14.6	10' TYPE R SUMP PUBLIC
2	BASIN A	0.87	1.45	10.0	4.13	6.93	3.6	10.0	10' TYPE R SUMP PUBLIC
3	BASIN J	1.74	2.28	13.4	3.69	6.19	6.4	14.1	10' TYPE R SUMP PUBLIC
4	BASIN K	0.82	1.08	13.4	3.69	6.19	3.0	6.7	5' TYPE R SUMP PUBLIC
5	BASIN D, BASIN F & BASIN OS-1	1.28	1.75	14.7	3.56	5.97	4.5	10.5	10' TYPE R SUMP PUBLIC
6	BASIN G	0.14	0.15	5.0	5.17	8.68	0.7	1.3	5' TYPE R SUMP PUBLIC
7	BASIN H	1.80	2.37	13.4	3.69	6.19	6.7	14.6	10' TYPE R SUMP PUBLIC
8	BASIN I	0.54	0.85	12.2	3.83	6.42	2.1	5.5	5' TYPE R SUMP PUBLIC
9	BASIN M & BASIN N	2.54	3.76	14.7	3.56	5.97	9.0	22.5	15' TYPE R AT GRADE PUBLIC
10	BASIN L & FLOWBY DP 9	1.21	2.70	14.7	3.56	5.97	4.3	16.1	15' TYPE R SUMP PUBLIC
11	BASIN R & S	0.60	0.78	11.9	3.86	6.48	2.3	5.1	15' TYPE R AT GRADE PUBLIC
12	BASIN P1-A2(INCLUDE C & Q)	4.09	4.94	15.2	3.50	5.87	14.3	29.0	EX 20' TYPE R AT GRADE PUBLIC
13	BASIN OS-2	1.31	2.18	10.0	4.13	6.93	5.4	15.1	FUTURE 15' TYPE R AT GRADE PUBLIC
14	BASIN OS-3	0.97	1.62	10.0	4.13	6.93	4.0	11.2	FUTURE 15' TYPE R AT GRADE PUBLIC
15	BASIN O & FLOW-BY DP 13	0.70	1.46	10.0	4.13	6.93	2.9	10.1	15' TYPE R AT GRADE PUBLIC
16	BASIN U, OS-4, & FLOW-BY DP 15	0.65	1.07	10.0	4.13	6.93	2.7	7.4	15' TYPE R AT GRADE PUBLIC
17	BASIN V & FLOW-BY DP 15 & 16	0.32	0.61	10.0	4.13	6.93	1.3	4.2	EXISTING 20' TYPE R SUMP PUBLIC
18	BASIN P	0.13	0.28	5.0	5.17	8.68	0.7	2.4	EXISTING 20' TYPE R AT GRADE PUBLIC
19	BASIN T & PIPE 17	13.84	22.16	15.4	3.48	5.85	48	130	POND IN

This table is not needed

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	DEVELOPED AREA (LOTS/ROADS)				LANDSCAPE TRACTS/UNDEVELOPED AREA				WEIGHTED				WEIGHTED CA		
		AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	USE	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**
A	2.90	2.90	0.23	0.30	0.50	0.00	0.02	0.08	0.35	1/4 RES	0.23	0.30	0.50	**0.67**	**0.87**	**1.45**
B	4.99	4.99	0.23	0.30	0.50	0.00	0.02	0.08	0.35	1/4 RES	0.23	0.30	0.50	**1.15**	**1.50**	**2.50**
C	0.72	0.19	0.89	0.90	0.96	0.53	0.02	0.08	0.35	ROAD/TRACT	0.25	0.30	0.51	**0.18**	**0.21**	**0.37**
D	0.20	0.20	0.89	0.90	0.96	0.00	0.02	0.08	0.35	ROAD	0.89	0.90	0.96	**0.18**	**0.18**	**0.19**
E	7.82	1.70	0.89	0.90	0.96	6.12	0.02	0.08	0.35	LANDSCAPE/TRACT	0.21	0.26	0.48	**1.64**	**2.02**	**3.77**
F	0.49	0.49	0.89	0.90	0.96	0.00	0.02	0.08	0.35	ROAD	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	ROAD	0.89	0.90	0.96	**0.14**	**0.14**	**0.15**
H	4.01	4.01	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**1.64**	**1.80**	**2.37**
I	1.68	1.09	0.41	0.45	0.59	0.59	0.02	0.08	0.35	1/8 RES/TRACT	0.27	0.32	0.51	**0.46**	**0.54**	**0.85**
J	3.87	3.87	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**1.59**	**1.74**	**2.28**
K	1.83	1.83	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**0.75**	**0.82**	**1.08**
L	2.20	2.20	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**0.90**	**0.99**	**1.30**
M	4.10	4.10	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**1.68**	**1.85**	**2.42**
N	3.00	1.23	0.41	0.45	0.59	1.77	0.02	0.08	0.35	1/8 RES/TRACT	0.18	0.23	0.45	**0.54**	**0.70**	**1.35**
O	1.11	0.74	0.89	0.90	0.96	0.37	0.02	0.08	0.35	ROAD/TRACT	0.60	0.63	0.76	**0.67**	**0.70**	**0.84**
P	0.63	0.10	0.89	0.90	0.96	0.53	0.02	0.08	0.35	LANDSCAPE TRACT	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	LANDSCAPE TRACT	0.19	0.24	0.47	**0.10**	**0.12**	**0.24**
R	0.33	0.33	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**0.14**	**0.15**	**0.19**
S	1.00	1.00	0.41	0.45	0.59	0.00	0.02	0.08	0.35	1/8 RES	0.41	0.45	0.59	**0.41**	**0.45**	**0.59**
T	11.19	0.00	0.89	0.90	0.96	11.19	0.02	0.08	0.35	POND/TRACT	0.02	0.08	0.35	**0.22**	**0.90**	**3.92**
U	0.60	0.60	0.89	0.90	0.96	0.00	0.02	0.08	0.35	ROAD	0.89	0.90	0.96	**0.53**	**0.54**	**0.58**
V	0.45	0.35	0.89	0.90	0.96	0.10	0.02	0.08	0.35	ROAD/TRACT	0.70	0.72	0.82	**0.31**	**0.32**	**0.37**
P1-A2	6.59	4.20	0.89	0.90	0.96	2.39	0.02	0.08	0.35	TRACT/ROAD	0.57	0.62	0.75	**3.79**	**4.09**	**4.94**
OS-1	2.18	2.18	0.23	0.30	0.50	0.00	0.02	0.08	0.35	FUT 1/4 RES	0.23	0.30	0.50	**0.50**	**0.65**	**1.09**
OS-2	4.35	4.35	0.23	0.30	0.50	0.00	0.02	0.08	0.35	FUT 1/4 RES	0.23	0.30	0.50	**1.00**	**1.31**	**2.18**
OS-3	3.23	3.23	0.23	0.30	0.50	0.00	0.02	0.08	0.35	FUT 1/4 RES	0.23	0.30	0.50	**0.74**	**0.97**	**1.62**
OS-4	0.36	0.36	0.23	0.30	0.50	0.00	0.02	0.08	0.35	FUT 1/4 RES	0.23	0.30	0.50	**0.08**	**0.11**	**0.18**

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

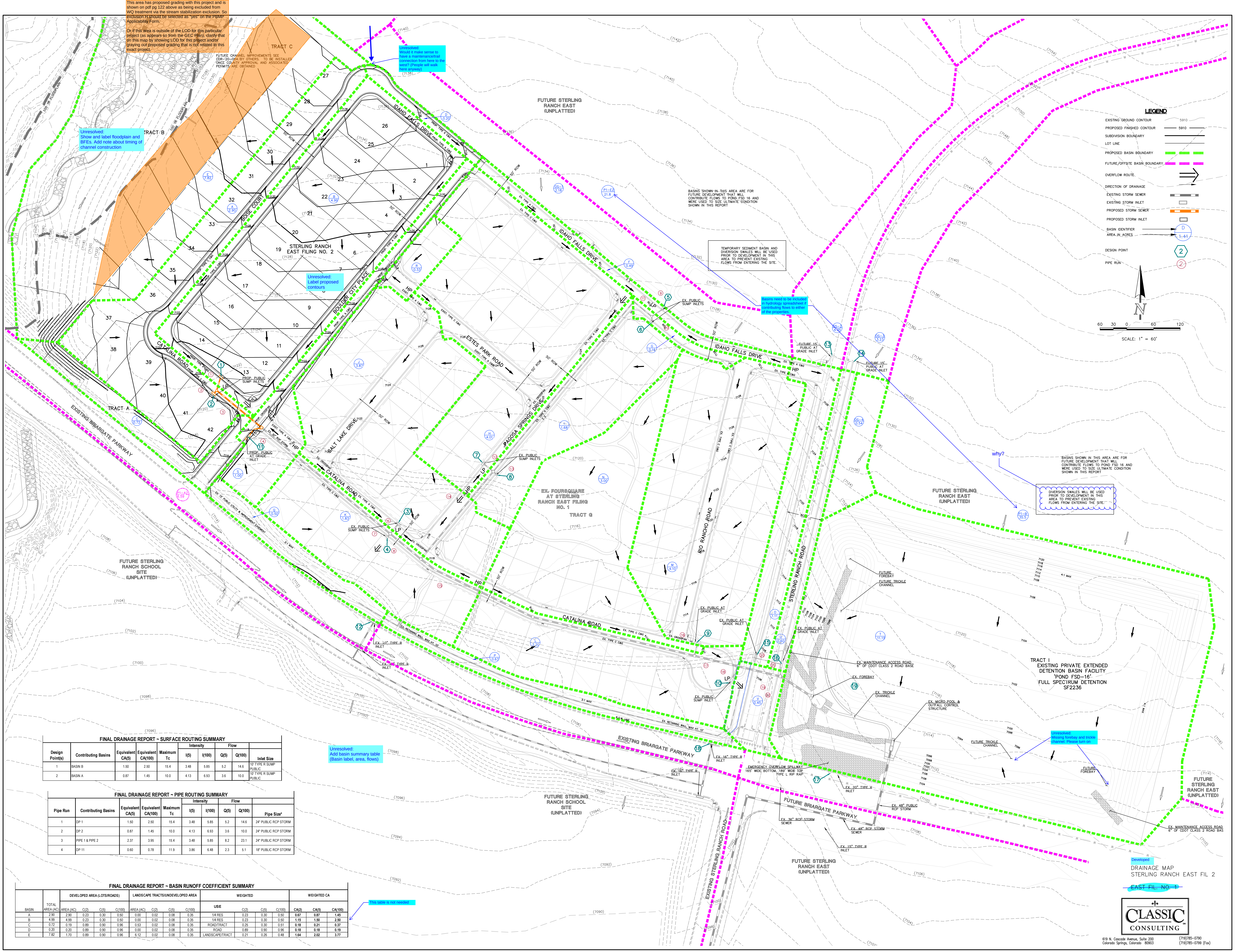
Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
1	DP 1	1.50	2.50	15.4	3.48	5.85	5.2	14.6	24" PUBLIC RCP STORM
2	DP 2	0.87	1.45	10.0	4.13	6.93	3.6	10.0	24" PUBLIC RCP STORM
3	PIPE 1 & PIPE 2	2.37	3.95	15.4	3.48	5.85	8.2	23.1	24" PUBLIC RCP STORM
4	DP 11	0.60	0.78	11.9	3.86	6.48	2.3	5.1	18" PUBLIC RCP STORM
5	PIPE 3 & 4	2.97	4.73	15.4	3.48	5.85	10.3	27.7	30" PUBLIC RCP STORM
6	DP 3	1.74	2.28	13.4	3.69	6.19	6.4	14.1	24" PUBLIC RCP STORM
7	DP 4	0.82	1.08	13.4	3.69	6.19	3.0	6.7	18" PUBLIC RCP STORM
8	PIPE 5, PIPE 6 & PIPE 7	5.53	8.09	15.4	3.48	5.85	19.3	47.3	36" PUBLIC RCP STORM
9	DP 5	1.28	1.75	14.7	3.56	5.97	4.5	10.5	18" PUBLIC RCP STORM
10	DP 6	0.14	0.15	5.0	5.17	8.68	0.7	1.3	18" PUBLIC RCP STORM
11	PIPE 9 & PIPE 10	1.42	1.91	14.7	3.56	5.97	5.0	11.4	24" PUBLIC RCP STORM
12	DP 7	1.80	2.37	13.4	3.69	6.19	6.7	14.6	24" PUBLIC RCP STORM
13	DP 8	0.54	0.85	12.2	3.83	6.42	2.1	5.5	18" PUBLIC RCP STORM
14	PIPE 11, PIPE 12, PIPE 13	3.76	5.12	14.7	3.56	5.97	13.4	30.6	24" PUBLIC RCP STORM
15	PIPE 8 & PIPE 14	9.29	13.21	15.4	3.48	5.85	32.4	77.3	42" PUBLIC RCP STORM
16	DP 9 INTERCEPTED	2.44	2.33	14.7	3.56	5.97	8.7	13.9	24" PUBLIC RCP STORM
17	PIPE 15 & PIPE 16	11.73	15.55	15.4	3.48	5.85	40.9	90.9	42" PUBLIC RCP STORM
18	DP 10	1.21	2.70	14.7	3.56	5.97	4.3	16.1	24" PUBLIC RCP STORM
19	PIPE 17 & PIPE 18	12.94	18.25	15.4	3.48	5.85	45.1	106.7	42" PUBLIC RCP STORM
20	DP 15 INTERCEPTED	0.70	1.46	10.0	4.13	6.93	2.9	10.1	42" PUBLIC RCP STORM
21	DP 16 INTERCEPTED & PIPE 20	1.34	2.53	10.0	4.13	6.93	5.5	17.5	42" PUBLIC RCP STORM
22	PIPE 19 & PIPE 21	14.29	20.77	15.4	3.48	5.85	49.8	121.5	48" PUBLIC RCP STORM

Developed

DRAINAGE MAP
FOURSQUARE AT STERLING RANCH
FILING NO. 1
~~EAST FIL. NO. 1~~

CLASSIC CONSULTING

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



This area has proposed grading with this project and is shown on pdf pg 122 above as being excluded from WQ treatment via the stream stabilization exclusion. So exclusion H should be selected as "yes" on the PBMP Applicability Form.

Or if this area is outside of the LOD for this particular project (as appears so from the GEC Plan), clarify that on this map by showing LOD for this project and/or graying out proposed grading that is not related to this exact project.

Unresolved:
Would it make sense to have a maintenance/trail connection from here to the west? (People will walk here anyway)

Unresolved:
Show and label floodplain and BFEs. Add note about timing of channel construction

Unresolved:
Label proposed contours

BASINS SHOWN IN THIS AREA ARE FOR FUTURE DEVELOPMENT THAT WILL CONTRIBUTE FLOWS TO POND FSD 16 AND WERE USED TO SIZE ULTIMATE CONDITION SHOWN IN THIS REPORT

TEMPORARY SEDIMENT BASIN AND DIVERISION SWALES WILL BE USED PRIOR TO DEVELOPMENT IN THIS AREA TO PREVENT EXISTING FLOWS FROM ENTERING THE SITE.

Basins need to be included in hydrology spreadsheet if contributing flows to either of the properties.

BASINS SHOWN IN THIS AREA ARE FOR FUTURE DEVELOPMENT THAT WILL CONTRIBUTE FLOWS TO POND FSD 16 AND WERE USED TO SIZE ULTIMATE CONDITION SHOWN IN THIS REPORT

DIVERSION SWALES WILL BE USED PRIOR TO DEVELOPMENT IN THIS AREA TO PREVENT EXISTING FLOWS FROM ENTERING THE SITE.

Unresolved:
Missing forebay and trickle channel. Please turn on

LEGEND

EXISTING GROUND CONTOUR	5910
PROPOSED FINISHED CONTOUR	5910
SUBDIVISION BOUNDARY	
LOT LINE	
PROPOSED BASIN BOUNDARY	
FUTURE/OFFSITE 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

60 30 0 60 120

SCALE: 1" = 60'

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	1.50	2.50	15.4	3.48	5.85	5.2	14.6	10' TYPE R SUMP PUBLIC
2	BASIN A	0.87	1.45	10.0	4.13	6.93	3.6	10.0	10' TYPE R SUMP PUBLIC

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	1.50	2.50	15.4	3.48	5.85	5.2	14.6	24" PUBLIC RCP STORM
2	DP 2	0.87	1.45	10.0	4.13	6.93	3.6	10.0	24" PUBLIC RCP STORM
3	PIPE 1 & PIPE 2	2.37	3.95	15.4	3.48	5.85	8.2	23.1	24" PUBLIC RCP STORM
4	DP 11	0.60	0.78	11.9	3.86	6.48	2.3	5.1	18" PUBLIC RCP STORM

Unresolved:
Add basin summary table (Basin label, area, flows)

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

		DEVELOPED AREA (LOTS/ROADS)				LANDSCAPE TRACTS/UNDEVELOPED AREA				WEIGHTED				WEIGHTED CA		
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	USE	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)
A	2.90	2.90	0.23	0.30	0.50	0.00	0.02	0.08	0.35	1/4 RES	0.23	0.30	0.50	**0.67**	**0.87**	**1.45**
B	4.99	4.99	0.23	0.30	0.50	0.00	0.02	0.08	0.35	1/4 RES	0.23	0.30	0.50	**1.15**	**1.50**	**2.50**
C	0.72	0.19	0.89	0.90	0.96	0.53	0.02	0.08	0.35	ROAD/TRACT	0.25	0.30	0.51	**0.18**	**0.21**	**0.37**
D	0.20	0.20	0.89	0.90	0.96	0.00	0.02	0.08	0.35	ROAD	0.89	0.90	0.96	**0.18**	**0.18**	**0.19**
E	7.82	1.70	0.89	0.90	0.96	6.12	0.02	0.08	0.35	LANDSCAPE/TRACT	0.21	0.26	0.48	**1.64**	**2.02**	**3.77**

This table is not needed

Developed

DRAINAGE MAP
STERLING RANCH EAST FIL 2

~~EAST FIL. NO. 1~~

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