

**PRELIMINARY DRAINAGE REPORT  
FOR  
STERLING RANCH PHASE 2 PRELIMINARY PLAN**

**Prepared For:**

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**May, 2021  
Project No. 25188.02  
SP-20-003**

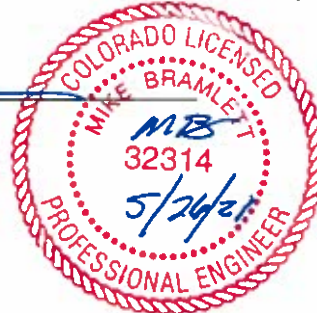
**Prepared By:  
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5475 Tech Center Drive, Suite 235  
Colorado Springs, CO 80919  
719-593-2593**

**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 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.



Mike Bramlett, Colorado P.E. 38861  
For and On Behalf of JR Engineering, LLC

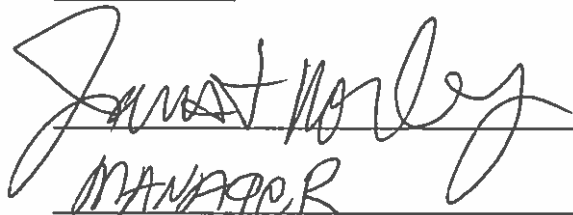


**DEVELOPER'S STATEMENT:**

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

Business Name: SR Land, LLC

By:



Title:

MANAGER

Address:

20 Boulder Crescent, Suite 200  
Colorado Springs, CO 80903

**El Paso County:**

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

\_\_\_\_\_  
Jennifer Irvine, P.E.  
County Engineer/ ECM Administrator

\_\_\_\_\_  
Date

Conditions:





## Table of Contents

Purpose .....	1
General Site Description .....	1
General Location.....	1
Description of Property .....	1
Floodplain Statement .....	1
Existing Drainage Conditions .....	2
Major Basin Descriptions .....	2
Existing Sub-basin Drainage .....	2
Proposed Drainage Conditions.....	4
Proposed Sub-basin Drainage.....	4
Interim Condition Proposed Sub-basin Drainage.....	7
Drainage Design Criteria .....	7
Development Criteria Reference .....	7
Hydrologic Criteria.....	7
Hydraulic Criteria.....	8
Drainage Facility Design .....	8
General Concept.....	8
Four Step Process to Minimize Adverse Impacts of Urbanization .....	8
Water Quality.....	9
Erosion Control Plan .....	9
Operation & Maintenance.....	10
Drainage and Bridge Fees.....	10
Summary .....	10
References.....	11

## APPENDIX

- Appendix A – Vicinity Map, Soil Descriptions, FEMA Floodplain Map
- Appendix B – Hydrologic and Hydraulic Calculations
- Appendix C – Reference Material
- Appendix D – Drainage Maps



## **PURPOSE**

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This document is the Preliminary Drainage Report for Sterling Ranch Phase 2. The purpose of this report is to identify on-site and off-site drainage patterns, storm sewer, culvert and inlet locations, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities.

## **GENERAL SITE DESCRIPTION**

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### **GENERAL LOCATION**

Sterling Ranch Phase 2 (hereby referred to as the “site”) is a proposed development within the Sterling Ranch master planned community with a total area of approximately 75 acres that are presently undeveloped.

The site is located in portions of Section 4, 5 & 33, Township 12 & 13 South, Range 65 West of the Sixth Principal Meridian in El Paso County, State of Colorado. The site is bounded by Un-platted land to the southwest, the Barbarick Subdivision to the north, Sterling Ranch Road cuts through the site, and Sand Creek borders the site to east. The parcels are planned to be platted after approval of the Preliminary Plan. Refer to the vicinity map in Appendix A for additional information.

### **DESCRIPTION OF PROPERTY**

The property will be primarily be single-family residential development (approximately 42 acres), Open space and drainage tracts (approximately 28 acres, and an approximate 5 acre tract in the southwest corner where the Sterling Ranch Lift Station is located. The site is comprised of variable sloping grasslands that generally slope(s) downward to the southeast at 3 to 8% towards the Sand Creek tributary basin.

Soil characteristics are comprised of Type A and B hydrologic Soil groups. Refer to the soil survey map in Appendix A for additional information.

There are no major drainage ways running through the site, although a tributary to the Sand Creek basin is immediately to the east of the site. Currently, Kiowa Engineering Corp. is performing studies and plans to address Sand Creek stabilization.

There are no known irrigation facilities located on the project site.

### **FLOODPLAIN STATEMENT**

Based on the FEMA FIRM Maps number 08041C0533G, dated December 7, 2018, the far eastern portion of the project site that is adjacent to the existing drainage way lies within Zone AE. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event. The majority of

the proposed development lies within Zone X. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. No grading operations are proposed within the Zone AE at this time. FIRM Maps have been presented in Appendix A.

## EXISTING DRAINAGE CONDITIONS

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### MAJOR BASIN DESCRIPTIONS

The site lies within the Sand Creek Drainage Basin based on the "Sand Creek Drainage Basin Planning Study" (DBPS) completed by Kiowa Engineering Corporation in January 1993, revised March 1996. The Sand Creek Drainage Basin covers approximately 54 square miles and is divided into major sub-basins. The site is within the respective sub-basin is shown in Appendix E.

The Sand Creek DBPS assumed the Sterling Ranch Phase 2 property to have a "large lot residential" use for the majority of the site. The Sterling Ranch MDDP assumed a mix of commercial and single family residential lots ranging in size from 0.2 to 0.3 acres for the Sterling Ranch Phase 2 site. The proposed Sterling Ranch master plan is a mix of; school, multi-family, single-family, and commercial land uses, resulting in higher runoff. Any additional runoff will be provided for with the extended detention basin located at the southern edge of the site. The site generally drains from north to south consisting of rolling hills. Currently, the site is used as pasture land for cattle. Sand Creek is located east of the site running north to south. This reach of drainage conveyance is not currently improved. There are a few stock ponds within the creek channel used for cattle watering. Currently, Kiowa is performing studies and plans to address Sand Creek stabilization adjacent to the site.

The proposed drainage on the site closely follows the approved "Master Development Drainage Plan for Sterling Ranch", (MDDP) prepared by M&S Civil Consultants, Inc., dated October 24, 2018. The site is tributary to Pond W5 and full-spectrum detention for the site was previously analyzed and can be found in the Final Drainage Report for Sterling Ranch Filing 2.

### EXISTING SUB-BASIN DRAINAGE

The existing / predeveloped condition of the site was broken into two major basins: Basin A (western portion) and Basin B (Eastern Portion), as well as several offsite basins. The basin and sub-basin delineation is shown in the existing drainage map in Appendix E and is described as follows:

Sub-basin A1( $Q_5 = 1.1\text{cfs}$ ,  $Q_{100} = 8.0\text{cfs}$ ) is 5.17 acres and 0 percent impervious consists of the eastern portion of Sterling Ranch phase 2. Runoff from this basin drains to the south west into the assumed existing storm sewer built with Filing 2 just east of Marksheffel Road located at design point 1.

Collected runoff is piped south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

Sub-basin A2 ( $Q_5 = 4.6\text{cfs}$ ,  $Q_{100} = 33.6\text{cfs}$ ) is 27.48 acres and 0 percent impervious and consists the central portion of Sterling Ranch Phase 2. Runoff from this basin drains south onsite into the assumed existing storm sewer built with Filing 2 located at design point 2. Collected runoff is piped south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

Sub-basin A3 ( $Q_5 = 2.9\text{cfs}$ ,  $Q_{100} = 21.5\text{cfs}$ ) is 11.68 acres and 0 percent impervious and is located onsite in the northern part of Sterling Ranch Phase 2. Runoff from this basin drains to the assumed existing storm sewer built with Filing 2 just north of Sterling Ranch Road located at design point 5. Design Point 5.1 is a confluence of flows from basins A3, OS6 and OS7. Collected runoff is piped south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

Sub-basin B1 ( $Q_5 = 2.6\text{cfs}$ ,  $Q_{100} = 19.0\text{cfs}$ ) is 11.78 and is 0 percent impervious and is located on the eastern portion of the site portion of the site. Runoff from this basin drains to the southeast into Sand Creek at design point 6.

Sub-basin OS1 ( $Q_5 = 13.4\text{cfs}$ ,  $Q_{100} = 29.8\text{cfs}$ ) is 9.27 acres is 30.7 percent impervious and is located to the east of the site. Runoff from this basin drains into the Sterling Ranch Filing 2 detention Pond in confluence with upstream flows from the eastern portion of Sub-basin A2. Collected runoff is piped south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

Sub-basin OS2 ( $Q_5 = 6.3\text{cfs}$ ,  $Q_{100} = 11.2\text{cfs}$ ) is 5.00 acres and 100 percent impervious and is comprised of the southern half street of Sterling Ranch Road. Runoff from this basin drains into the assumed existing storm sewer built with Filing 2 located at design point 7. Collected runoff is piped south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

Sub-basin OS3 ( $Q_5 = 8.1\text{cfs}$ ,  $Q_{100} = 14.6\text{cfs}$ ) is 2.36 acres and 100 percent impervious and is comprised of the northern half street of Sterling Ranch Road. Runoff from this basin drains into the assumed existing storm sewer built with Filing 2 located at design point 8. Collected runoff is piped south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

Sub-basin OS4 ( $Q_5 = 2.8\text{cfs}$ ,  $Q_{100} = 16.9\text{cfs}$ ) is 11.71 acres and 3.6 percent impervious and is located immediately north of Sterling Ranch Road and the eastern portion of the site. Runoff from this basin drains south into assumed existing storm sewer built with Filing 2 located at design point 9. Collected runoff is piped south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

Sub-basin OS5 ( $Q_5 = 0.7\text{cfs}$ ,  $Q_{100} = 5.0\text{cfs}$ ) is 3.46 acres and 0 percent impervious and is located to the east of the northern portion of the site. Runoff from this basin drains to a low point just north of

Sterling Ranch Road located at Design Point 4 and will be collected in the assumed existing storm sewer built with Filing 2 and piped to the Filing 2 detention pond located south of the site and outfalls to Sand Creek.

Sub-basin OS6 ( $Q_5 = 35.4\text{cfs}$ ,  $Q_{100} = 72.2\text{cfs}$ ) is 18.38 acres and 11.3 percent impervious as is located northwest of the site in the Barbarick subdivision. Historic runoff from this basins drains south onto the site at design point 10. Detained flow from this basin will be piped through the site to the detention pond and will outfall to Sand Creek.

Sub-basin OS7( $Q_5 = 20.6\text{cfs}$ ,  $Q_{100} = 60.4\text{cfs}$ ) is 33.07 Acres and 19.1 percent impervious and is located directly north of the site in the Barbarick subdivision. Historic runoff from this site drains south onto the site at design point 11. Detained flow from this basin will be piped through the site to the detention pond and will outfall to Sand Creek.

## PROPOSED DRAINAGE CONDITIONS

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### PROPOSED SUB-BASIN DRAINAGE

The proposed site was broken into three major basins: Basin A (lower-portion), Basin B (mid and eastern –portion) and Basin C (upper-portion) of the site. The proposed basin (and sub-basin) delineation is shown on the drainage basin map within Appendix E and is described as follows.

**Basin A1** ( $Q_5 = 8.1\text{cfs}$ ,  $Q_{100} = 17.4\text{cfs}$ ) is 4.31 acres and 63 percent impervious and is comprised of single-family residential lots, and a local road. Runoff from this basin drains to design point 15, a type R on grade inlet at the southwest corner of the basin.

**Basin A2** ( $Q_5 = 1.4\text{cfs}$ ,  $Q_{100} = 4.0\text{cfs}$ ) is 1.41 acres and 31 percent impervious is comprised of single-family residential lots, open space, several trails, and a local road. Runoff from this basin drains to design point 17, a type R on grade inlet on the southwest corner of the basin, in confluence with upstream by-pass flows from basin A1.

**Basin A3** ( $Q_5 = 6.8\text{cfs}$ ,  $Q_{100} = 14.6\text{cfs}$ ) is 3.68 acres and 65 percent impervious is comprised of single-family residential lots and a local road. Runoff from this basin drains to an on grade inlet located at design point 20.

**Basin A4** ( $Q_5 = 5.7\text{cfs}$ ,  $Q_{100} = 13.4\text{cfs}$ ) is 3.94 acres and 52 percent impervious is comprised of single-family residential lots, open space a local road and two urban knuckles. Runoff from this basin drains to a sump type R inlet located at design point 22 in confluence with upstream bypass flows from basins A1, A2, and A3.

**Basin A5** ( $Q_5 = 1.4\text{cfs}$ ,  $Q_{100} = 2.9\text{cfs}$ ) is 0.45 acres and 78 percent impervious is comprised of single-family residential lots and a local road. Runoff from this basin drains to an on grade inlet at design point 16.

**Basin A6** ( $Q_5 = 15.3\text{cfs}$ ,  $Q_{100} = 31.4\text{cfs}$ ) is 7.60 acres and 73 percent impervious is comprised of single-family residential lots, local roads. Runoff from this basin drains to an on grade type inlet at design point 19.

**Basin A7** ( $Q_5 = 3.0\text{cfs}$ ,  $Q_{100} = 6.1\text{cfs}$ ) is 1.43 acres and 75 percent impervious is comprised of single family residential lots and local roads. The Runoff from this basin drains to a sump type R inlet located at design point 21.

**Basin A8** ( $Q_5 = 2.2\text{cfs}$ ,  $Q_{100} = 9.1\text{cfs}$ ) 4.22 acres and 13 percent impervious is comprised of a single family residential lots and open space. The runoff from this basin drains to a swale on western side of the site and into an area inlet located at design point 24.

**Basin A9** ( $Q_5 = 0.7\text{cfs}$ ,  $Q_{100} = 3.5\text{cfs}$ ) 2.02 acres and 8 percent impervious is comprised of a single family residential lots and open space. The runoff from this basin drains to a swale on western side of the site and into a flared end section and pipe located at design point 25.

**Basin A10** ( $Q_5 = 2.4\text{cfs}$ ,  $Q_{100} = 8.0\text{cfs}$ ) 3.23 acres and 24 percent impervious is comprised of a single family residential lots and open space. The runoff from this basin sheet flows to the south and into existing pond W5 at design point 27.

**Basin B1** ( $Q_5 = 6.2\text{cfs}$ ,  $Q_{100} = 12.0\text{cfs}$ ) is 2.44 acres and 80 percent impervious is comprised of single-family residential lots, local roads, two urban knuckles, and a cul-de sac. The runoff from basin B1 drains to a type R sump inlet located at design point 13.

**Basin B2** ( $Q_5 = 9.1\text{cfs}$ ,  $Q_{100} = 18.7\text{cfs}$ ) is 4.33 acres and 73 percent impervious is comprised of single family residential lots. Runoff from basin B2 drains to a type R sump inlet located at design point 12.

**Basin B3** ( $Q_5 = 3.5\text{cfs}$ ,  $Q_{100} = 7.3\text{cfs}$ ) is 2.34 acres and 61 percent impervious is comprised of open space and sidewalk. Runoff from basin B3 drains to a 15' type R on grade inlet located at design point 9 in existing Sterling Ranch Road. All of the runoff is captured in the 100 year event. Runoff from this sump inlet is piped and outfalls into pond W-5.

**Basin B4** ( $Q_5 = 2.3\text{cfs}$ ,  $Q_{100} = 5.6\text{cfs}$ ) is 1.80 acres and 51.3 percent impervious is comprised of single family residential lots and open space. Runoff from basin B4 drains to a rear lot area inlet at DP 10.

**Basin B5** ( $Q_5 = 0.7\text{cfs}$ ,  $Q_{100} = 1.7\text{cfs}$ ) is 0.45 acres and 51 percent impervious is comprised of single family residential lots and open space. Runoff from basin B4 drains to a rear lot area inlet at DP 11.

**Basin B6** ( $Q_5=0.8\text{cfs}$ ,  $Q_{100}=2.2\text{cfs}$ ) is 0.78 acres and 44 percent impervious is comprised of single family residential lots and open space. Runoff from basin B4 drains to a rear lot area inlet at DP 14.

**Basin C1** ( $Q_5= 5.5\text{cfs}$ ,  $Q_{100}=11.4\text{cfs}$ ) is 2.62 acres and 68.7 percent impervious is comprised of single family residential lots, local roads, and an urban knuckle Runoff from basin C1 drains to a sump type R inlet located at design point 6.

**Basin C2** ( $Q_5= 12.0\text{cfs}$ ,  $Q_{100}=25.9\text{cfs}$ ) is 6.74 acres and 63 percent impervious is comprised of local roads, single-family residential lots, an urban knuckle, open space, and paved walks. Runoff from basin C2 drains to a type R sump inlet located at design point 5.

**Basin C3** ( $Q_5= 2.2\text{cfs}$ ,  $Q_{100}=9.9\text{cfs}$ ) is 3.77 acres and 10 percent impervious is comprised of single family residential lots, open space, and paved walks. Runoff from basin C3 drains to a swale on the western side of the site and into an area inlet located at design point 7.

**Basin C4** ( $Q_5= 4.6\text{cfs}$ ,  $Q_{100}=10.2\text{ cfs}$ ) is 3.79 acres and 54.7 percent impervious is comprised of open space single family residential lots. Runoff from basin B3 drains to an on-grade 15' type R inlet located at design point 8 in existing Sterling Ranch Road. In the 100 year event 0.8 cfs is by-passed to a sump inlet adjacent to the intersection of Sterling Ranch Road and Marksheffel Road. From there on the runoff is piped out falls into pond W-5.

**Basin D1**( $Q_5= 0.3\text{cfs}$ ,  $Q_{100}=1.3\text{cfs}$ ) is 0.42 acres and 11.5 percent impervious is comprised of open space area. Runoff from basin D1 sheet flow to the, southeast and adjacent properties into Sandcreek as per the historic condition. Flows generated from this basin have been attributed to design point 28.

**Basin D2** ( $Q_5= 1.9\text{cfs}$ ,  $Q_{100}=10.5\text{ cfs}$ ) is 3.67 acres and 4.6 percent impervious is comprised of open space area. Runoff from basin D1 sheet flow to the southeast into Sandcreek as per the historic condition. Flows generated from this basin have been attributed to design point 29.

**Basin OS4** ( $Q_5= 2.8\text{cfs}$ ,  $Q_{100}=16.9\text{cfs}$ ) is 11.71 acres and 3.6 percent impervious and is located immediately north of Sterling Ranch Road and the eastern portion of the site. Runoff from this basin drains south into assumed existing storm sewer built with Filing 2 located at design point 2. Collected runoff is piped south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

**Basin OS6** ( $Q_5= 35.4\text{cfs}$ ,  $Q_{100}=72.2\text{cfs}$ ) is 18.38 acres and 54 percent impervious as is located northwest of the site in the Barbarick subdivision. Historic runoff from this basins drains south onto the site at design point 4. Detained flow from this basin will be piped through the site to the detention pond and will outfall to Sand Creek. Emergency overflow from this basin will be collected in a grated inlet at design point 4. Assumed pipe sizes will be confirmed with the FDR during final platting.





**Basin OS7** ( $Q_5 = 20.6\text{cfs}$ ,  $Q_{100} = 60.4\text{cfs}$ ) is 33.07 Acres and 23 percent impervious and is located directly north of the site in the Barbarick subdivision. Historic runoff from this site drains south onto the site at design point 1. Detained flow from this basin will be piped through the site to the detention pond and will outfall to Sand Creek. Emergency overflow from this basin will be routed around the lots and into the school site. Assumed pipe and channel sizes will be confirmed with the FDR during final platting. Flows from the eastern portion of the basin travel overland towards design point 2.

## INTERIM CONDITION PROPOSED SUB-BASIN DRAINAGE

In the interim site condition, all the basins stay the same except basins A2, A3, A4, A6, A7, A8, A9 and A10 will remain undeveloped. The undeveloped basins are summarized below. An interim condition map can be found in Appendix F.

**Basin I1** ( $Q_5 = 4.4\text{ cfs}$ ,  $Q_{100} = 31.2\text{cfs}$ ) 21.99 acres and 1 percent impervious is comprised of open space. The runoff from this basin sheet flows generally to the south and east into a temporary drainage channel where it is conveyed to an existing storm stub at design point I1.

**Basin I2** ( $Q_5 = 0.7\text{cfs}$ ,  $Q_{100} = 4.9\text{cfs}$ ) 3.47 acres and 0 percent impervious is comprised of open space. The runoff from this basin sheet flows to the south and east into an existing drainage swale where it eventually enters an existing storm stub provided from the Sterling Ranch Filing No 2. Project.

## DRAINAGE DESIGN CRITERIA

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### DEVELOPMENT CRITERIA REFERENCE

Storm drainage analysis and design criteria for this project were taken from the “*City of Colorado Springs/El Paso County Drainage Criteria Manual*” Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the “*Urban Storm Drainage Criteria Manual*” Volumes 1 to 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the “*Colorado Springs Drainage Criteria Manual*” (CSDCM), dated May 2014, as adopted by El Paso County.

### HYDROLOGIC CRITERIA

All hydrologic data was obtained from the “*El Paso Drainage Criteria Manual*” Volumes 1 and 2, and the “*Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual*” Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Runoff was calculated using the Rational Method, and rainfall intensities for the 5-year and the 100-year storm return frequencies were obtained from Table 6-2 of the CSDCM. One hour point rainfall data for the storm events is identified in the chart below. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the





CSDCM. Time of concentrations were developed using equations from CSDCM. All runoff calculations and applicable charts and graphs are included in the Appendices.

**Table 2 - 1-hr Point Rainfall Data**

<b>Storm</b>	<b>Rainfall (in.)</b>
5-year	1.50
100-year	2.52

## **HYDRAULIC CRITERIA**

The Rational Method and USDCM's SF-2 and SF-3 forms were used to determine the runoff from the minor and major storms on the site. Sump and on-grade inlets were sized using UDFCD UD-Inlet v4.05. StormCAD was used to model the proposed storm sewer system within the interim area and to analyze the proposed HGL calculations for the Construction Drawings. Autodesk Hydraflow express was used to size the overflow channel and the interim swale.

## **DRAINAGE FACILITY DESIGN**

### **GENERAL CONCEPT**

The proposed stormwater conveyance system was designed to convey the developed Sterling Ranch Phase 2 runoff to an existing (Filing 2) full spectrum water quality and detention pond via storm sewer. The proposed pond was designed to release at less than historic rates to minimize adverse impacts downstream. Treated water will outfall directly into the Sand Creek Drainage way, where it will eventually outfall into Fountain Creek. A proposed drainage map is presented in Appendix E showing locations of the pond. JR Engineering is working on a separate plan to stabilize Sand Creek directly adjacent to the site.

### **FOUR STEP PROCESS TO MINIMIZE ADVERSE IMPACTS OF URBANIZATION**

In accordance with the El Paso County Drainage Criteria Manual Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls.

**Step 1 – Reducing Runoff Volumes:** The Sterling Ranch Phase 2 development project consists of single-family homes with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roof drains from the structures will discharge to lawn areas, where feasible, to allow for infiltration and runoff volume reduction.

**Step 2 – Stabilize Drainageways:** The site lies within the Sand Creek Drainage Basin. Basin and bridge fees will be due at time of platting. These funds will be used for the channel stabilization being designed by JR Engineering adjacent to the site and on future projects within the basin to

stabilize drainageways. The site does not discharge directly into the open drainageway of Sand Creek, therefore no downstream stabilization will be accomplished with this project.

Step 3 – Treat the WQCV: Water Quality treatment for this site is provided in an existing full spectrum water quality detention pond (W5). The runoff from this site will be collected within inlets and conveyed to the proposed ponds via storm sewer. Upon entrance to the ponds, flows will be captured in a forebay designed to promote settlement of suspended solids. A trickle channel is also incorporated into the ponds to minimize the amount of standing water. The outlet structure has been designed to detain the water quality capture volume (WQCV) for 40 hours, and the extended urban runoff volume (EURV) for 72 hours. All flows released from the ponds will be reduced to less than historic rates.

Step 4 –BMPs will be utilized to minimize off-site contaminants and to protect the downstream receiving waters. The permanent erosion control BMPs include asphalt drives and parking, storm inlets and storm pipe, the full spectrum detention pond W-5 and permanent vegetation. Maintenance responsibilities and plans will be defined at the time of final platting.

## WATER QUALITY

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention are provided for all developed basins. This site will drain into an existing Full Spectrum Drainage Pond W5 developed during the Sterling Ranch Filing No. 2 Project. Further details as well as all pond volume, water quality, and outfall calculations are included in the Sterling Ranch Filing 2 Final Drainage Report. Pond W5 corresponds to pond FSD6 from the Master Development Drainage Plan for Sterling Ranch", (MMDP) prepared by M&S Civil Consultants, Inc., dated October 24, 2018. ( $Q_5=7.6$  cfs,  $Q_{100}=149.7$  cfs) and is releasing less than the MDDP values in the proposed design. A summary of Pond W-5 has been included below for reference.

Table 3. Pond Volumes & Release Rates

	REQUIRED VOLUME (AC-FT)	VOLUME PROVIDED (AC-FT)	WQCV (AC-FT)	EURV (AC-FT)	5-YEAR RELEASE (CFS)	100-YEAR RELEASE (CFS)
POND W5	18.217	18.441	3.29	11.71	2.7	137.1

## EROSION CONTROL PLAN

We respectfully request that the Erosion Control Plan and Cost Estimate be submitted in conjunction with the grading and erosion control plan and construction assurances posted prior to obtaining a grading permit.

## OPERATION & MAINTENANCE

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. The district shall be responsible for the inspection, maintenance, rehabilitation and repair of stormwater and erosion control facilities located on the property unless another party accepts such responsibility in writing and responsibility is properly assigned through legal documentation. Access is provided from onsite facilities and easements for proposed infrastructure located offsite. We respectfully request that the Operation & Maintenance Manual be submitted in conjunction with the construction documents, prior to obtaining a grading permit. A maintenance road was provided for the existing pond W5 and information on the road can be found in the Final Drainage Report for Sterling Ranch Filing No. 2. The maintenance road access is off of Marksheffel Road and wraps around the top of the pond providing access to the inflow pipe wingwalls and outlet structure for the pond.

## DRAINAGE AND BRIDGE FEES

The site lies within the Sand Creek Drainage Basin. Anticipated drainage and bridge fees are presented below and will be due at time of platting (depending on date of plat submittal):.

2021 DRAINAGE AND BRIDGE FEES – STERLING RANCH PHASE 2				
Impervious Acres (ac)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	Sterling Ranch Drainage Fee	Sterling Ranch Bridge Fee
37	\$20,387	\$8,339	\$754,319	\$308,543

## SUMMARY

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The proposed Sterling Ranch Phase 2 drainage improvements were designed to meet or exceed the El Paso County Drainage Criteria. The proposed development will not adversely affect the offsite drainageways or surrounding development. This report is in conformance and meets the latest El Paso County Storm Drainage Criteria requirements for this site.

## REFERENCES

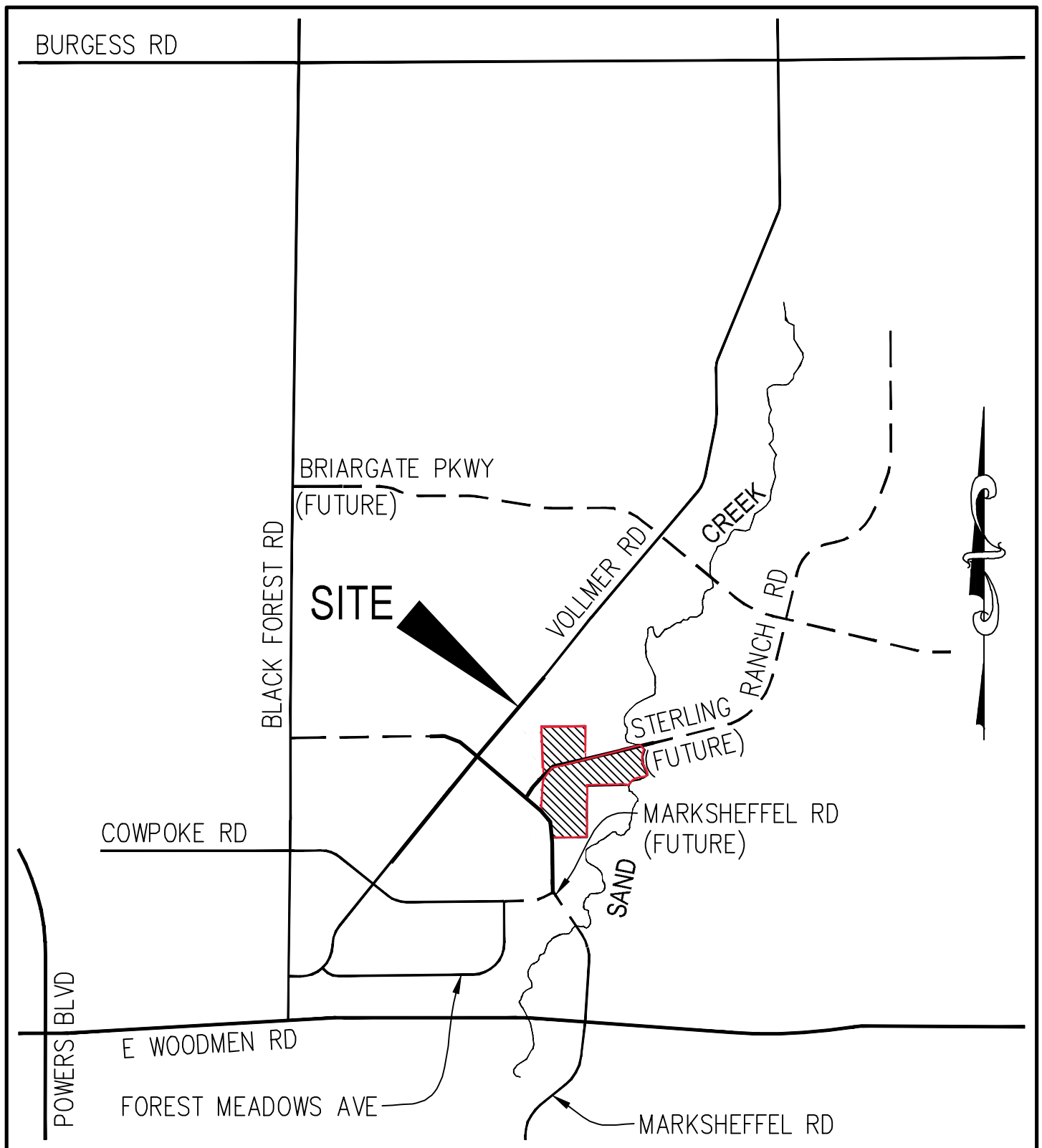
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1. "El Paso County and City of Colorado Springs Drainage Criteria Manual, Vol I & II".
  2. Sand Creek Channel Design Report, prepared by JR Engineering, May 19, 2021 (not yet approved)
  3. "Master Development Drainage Plan for Sterling Ranch", (MMDP) prepared by M&S Civil Consultants, Inc., dated October 24, 2018.
  4. Sand Creek Drainage Basin Planning Study, prepared Kiowa Engineering Corporation, January 1993, revised March 1996.
  5. "Sterling Ranch Filing 2 Final Drainage Report", prepared by JR Engineering, dated May 2020 (not yet approved)
  6. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.
  7. Sand Creek Stabilization at Aspen Meadows Subdivision Filing No. 1 – 100% Design Plans, April 2020
-

## **Appendix A**

### **Vicinity Map, Soil Descriptions, FEMA Floodplain Map**



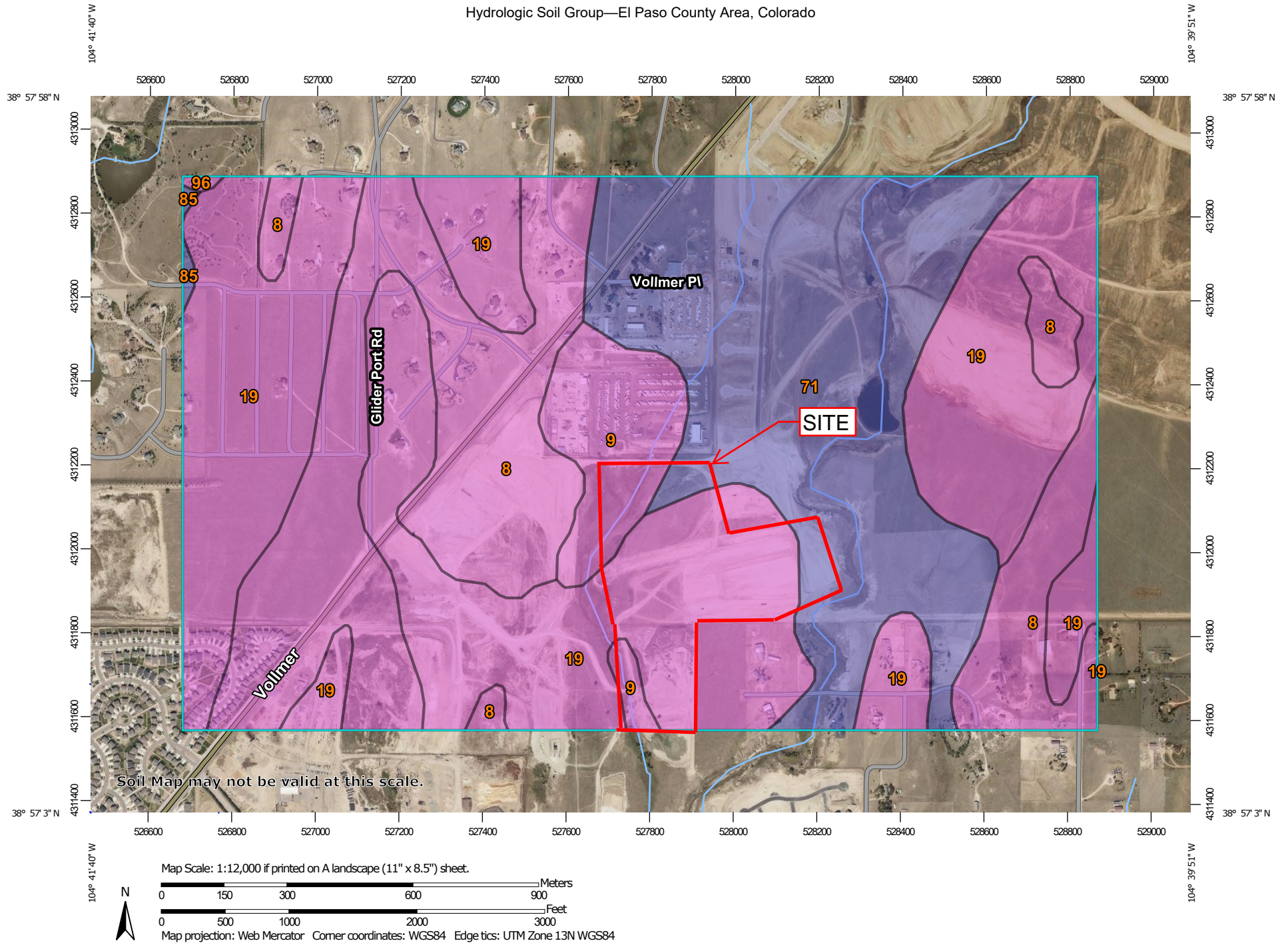


# VICINITY MAP

N.T.S.



# Hydrologic Soil Group—El Paso County Area, Colorado



**Natural Resources  
Conservation Service**

Web Soil Survey  
National Cooperative Soil Survey

5/1/2020  
Page 1 of 4

## 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 17, Sep 13, 2019

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

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

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



## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	182.3	25.4%
9	Blakeland-Fluvaquentic Haplaquolls	A	36.8	5.1%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	307.5	42.9%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	188.4	26.3%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	B	1.2	0.2%
96	Truckton sandy loam, 0 to 3 percent slopes	A	0.6	0.1%
<b>Totals for Area of Interest</b>			<b>716.9</b>	<b>100.0%</b>

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services  
NOAA NNGS12  
National Geodetic Survey  
SSMC-3, #9202  
1315 East-West Highway  
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (202) 773-3242 or visit its website at <http://www.ngs.noaa.gov/>.

**Base Map** information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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

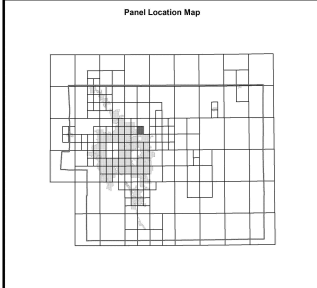
**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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

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

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

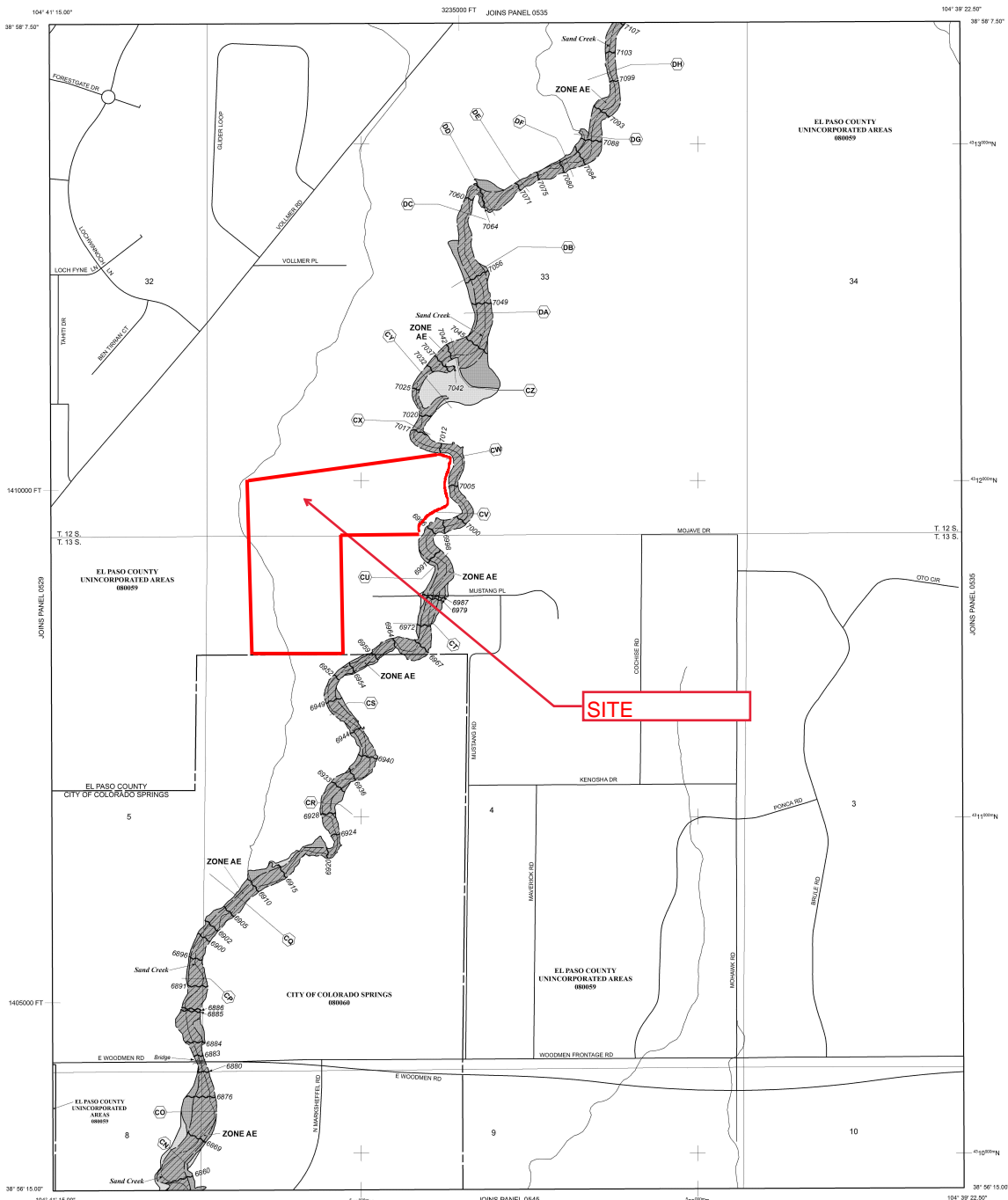
El Paso County Vertical Datum Offset Table	
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	



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



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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST, AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.

## LEGEND

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

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

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

**FLOODWAY AREAS IN ZONE AE**

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

**OTHER FLOOD AREAS**

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

**OTHER AREAS**

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

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

**COASTAL BARRIER PROTECTED SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

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

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.  
Base Flood Elevation line and value, elevation in feet\*  
Base Flood Elevation value where uniform within zone; elevation in feet\*

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

- Cross section line
- Traverse line

97° 07' 30.00"  
32° 22' 22.50" N  
Geographic coordinates (referenced to the North American Datum of 1983)  
1000-meter Universal Transverse Mercator grid ticks, zone 13

600000 FT  
1000-foot grid ticks: Colorado State Plane coordinate system (NAD83)  
Lambert Conformal Conic Projection

DX5510  
Bench mark (see explanation in Notes to Users section of this FIRM report)

M1.5  
River Mile

MAP REPOSITORIES  
Refer to Map Repositories list on Map Index

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

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

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.  
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



**NFIP**

**NATIONAL FLOOD INSURANCE PROGRAM**

PANEL 0533G

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

PANEL 533 OF 1300  
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:			
COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	08008	0533	G
EL PASO COUNTY	08008	0533	G

Notice to User: The Map Number shown below should be used when obtaining map copies. The Community Number shown above should be used on insurance applications for the insured community.

MAP NUMBER  
08041C0533G

MAP REVISED  
DECEMBER 7, 2018

Federal Emergency Management Agency

## **Appendix B**

### **Hydrologic Calculations**

## COMPOSITE % IMPERVIOUS & COMPOSITE EXISTING RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Sterling Ranch Subdivision- Existing  
 Location: El Paso County

Project Name: Sterling Ranch Phase 2  
 Project No.: 25188.02  
 Calculated By: CJD  
 Checked By: \_\_\_\_\_  
 Date: 5/4/21

Basin ID	Total Area (ac)	Streets (100% Impervious)				Residential (65% Impervious) Neighborhood Area (70% Impervious)				1 Acre lot Residential (20% Impervious) Light Commercial (80% Impervious)				Lawns (0% Impervious) School (55% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	
A1	5.17	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	5.17	2.0%	0.08	0.35	2.0%
A2	27.48	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	27.48	0.0%	0.08	0.35	0.0%
A3	11.68	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	11.68	0.0%	0.08	0.35	0.0%
B1	11.78	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	11.78	0.0%	0.08	0.35	0.0%
OS1	9.27	0.90	0.96	2.85	30.7%	0.45	0.59	0.00	0.0%	0.30	0.40	2.85	6.1%	0.08	0.35	3.57	0.0%	0.40	0.55	36.9%
OS2	1.94	0.90	0.96	1.94	100.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.90	0.96	100.0%
OS3	2.36	0.90	0.96	2.36	100.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.90	0.96	100.0%
OS4	11.71	0.90	0.96	0.00	0.0%	0.45	0.59	0.65	3.6%	0.59	0.70	0.00	0.0%	0.08	0.35	11.06	0.0%	0.10	0.36	3.6%
OS5	3.46	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	3.46	0.0%	0.08	0.35	0.0%
OS6	18.38	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.90	0.90	10.40	11.3%	0.08	0.35	7.98	0.0%	0.54	0.66	11.3%
OS7	33.07	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.90	0.90	7.91	19.1%	0.08	0.35	25.16	0.0%	0.28	0.48	19.1%
TOTAL (A1-B1)	56.11																			0.2%
TOTAL (OS1-OS7)	80.19																			20.6%
TOTAL	136.30																			12.2%

# EXISTING STANDARD FORM SF-2 TIME OF CONCENTRATION

Subdivision: Sterling Ranch Subdivision- Existing  
Location: El Paso County

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By: \_\_\_\_\_  
Date: 5/4/21

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					t <sub>c</sub> CHECK			FINAL
DATA						(T <sub>i</sub> )			(T <sub>t</sub> )					(URBANIZED BASINS)			
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C <sub>5</sub>	C <sub>100</sub>	L (ft)	S <sub>o</sub> (%)	t <sub>i</sub> (min)	L <sub>t</sub> (ft)	S <sub>t</sub> (%)	K	VEL. (ft/s)	t <sub>t</sub> (min)	COMP. t <sub>c</sub> (min)	TOTAL LENGTH (ft)	Urbanized t <sub>c</sub> (min)	
A1	5.17	A	2%	0.08	0.35	212	2.0%	21.4	517	2.1%	10.0	1.4	6.0	27.4	729.0	32.1	27.4
A2	27.48	A	0%	0.08	0.35	297	2.5%	23.4	1475	2.4%	10.0	1.6	15.7	39.1	1772.0	43.5	39.1
A3	11.68	A	0%	0.08	0.35	121	5.4%	11.6	784	2.7%	10.0	1.7	7.9	19.5	905.0	34.8	19.5
B1	11.78	A	0%	0.08	0.35	297	2.9%	22.4	380	5.2%	10.0	2.3	2.8	25.2	677.0	29.1	25.2
OS1	9.27	A	37%	0.40	0.55	298	2.7%	15.7	737	2.4%	10.0	1.5	8.0	23.7	1035.0	25.4	23.7
OS2	1.94	A	100%	0.90	0.96	117	3.1%	2.7	1745	1.6%	20.0	2.5	11.5	14.2	1862.0	19.0	14.2
OS3	2.36	A	100%	0.90	0.96	41	2.5%	1.7	1681	1.8%	20.0	2.7	10.5	12.2	1722.0	18.1	12.2
OS4	11.71	A	4%	0.10	0.36	491	1.4%	36.0	940	5.6%	10.0	2.4	6.6	42.6	1431.0	32.4	32.4
OS5	3.46	A	0%	0.08	0.35	298	3.0%	22.1	784	2.4%	10.0	1.6	8.4	30.4	1082.0	35.3	30.4
OS6	18.38	A	11%	0.54	0.66	165	3.4%	8.6	612	2.7%	10.0	1.6	6.2	14.8	777.0	30.0	14.8
OS7	33.07	A	19%	0.28	0.48	298	3.0%	17.9	1664	2.7%	10.0	1.6	16.9	34.7	1962.0	37.2	34.7

NOTES:

$$t_c = t_i + t_t$$

Equation 6-2

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

Equation 6-3

Where:

t<sub>c</sub> = computed time of concentration (minutes)

t<sub>i</sub> = overland (initial) flow time (minutes)

t<sub>t</sub> = channelized flow time (minutes).

Where:

t<sub>i</sub> = overland (initial) flow time (minutes)

C<sub>5</sub> = runoff coefficient for 5-year frequency (from Table 6-4)

L<sub>i</sub> = length of overland flow (ft)

S<sub>o</sub> = average slope along the overland flow path (ft/ft).

Use a minimum t<sub>c</sub> value of 5 minutes for urbanized areas and a minimum t<sub>c</sub> value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

$$\text{Equation 6-4 } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Equation 6-5

Where:

t<sub>t</sub> = channelized flow time (travel time, min)

L<sub>t</sub> = waterway length (ft)

S<sub>o</sub> = waterway slope (ft/ft)

V<sub>t</sub> = travel time velocity (ft/sec) = K√S<sub>o</sub>

K = NRCS conveyance factor (see Table 6-2).

Where:

t<sub>c</sub> = minimum time of concentration for first design point when less than t<sub>c</sub> from Equation 6-1.

L<sub>t</sub> = length of channelized flow path (ft)

i = imperviousness (expressed as a decimal)

S<sub>t</sub> = slope of the channelized flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

**STANDARD FORM SF-3 - EXISTING**  
**STORM DRAINAGE SYSTEM DESIGN**  
(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Subdivision- Existing  
Location: El Paso County  
Design Storm: 5-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By: \_\_\_\_\_  
Date: 5/4/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	1	A1	5.17	0.08	27.4	0.41	2.62	1.1															
	2	A2	27.48	0.08	39.1	2.20	2.08	4.6															Basin A2
	3	OS1	9.27	0.40	23.7	3.71	2.83	10.5															Basin A1
	4	OS5	3.46	0.08	30.4	0.28	2.46	0.7															Basin A4
	6	B1	11.78	0.08	25.2	0.94	2.74	2.6															Basin OS1
	7	OS2	1.94	0.90	14.2	1.75	3.60	6.3															Basin OS2
	8	OS3	2.36	0.90	12.2	2.12	3.83	8.1															Basin OS3
	9	OS4	11.71	0.10	32.4	1.18	2.37	2.8															Basin OS4
	10	OS6	18.38	0.54	14.8	10.00	3.54	35.4						10.0	3.4					998	1.8	9.1	Basin OS6 travel to design point 5.1
	11	OS7	33.07	0.28	34.7	9.13	2.26	20.6						9.13	3.2					936	1.8	8.7	Basin OS7 travel to design point 5.1
	5	A3	11.68	0.08	19.5	0.93	3.13	2.9															Basin A3
	5.1								19.5	20.06	3.13	62.7											Design point 5.1 fed by basins A3, OS6, and OS7

Notes:  
Street and Pipe C\*A values are determined by Q/I using the catchment's intensity value.  
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

**STANDARD FORM SF-3 - EXISTING**  
**STORM DRAINAGE SYSTEM DESIGN**  
(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Subdivision- Existing  
Location: El Paso County  
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By: \_\_\_\_\_  
Date: 5/4/21

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	$Q_{pipe}$ (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	$t_t$ (min)	
	1	A1	5.17	0.35	27.4	1.81	4.39	8.0															
	2	A2	27.48	0.35	39.1	9.62	3.49	33.6															Basin A2
	3	OS1	9.27	0.55	23.7	5.13	4.76	24.4															Basin A1
	4	OS5	3.46	0.35	30.4	1.21	4.13	5.0															Basin A4
	6	B1	11.78	0.35	25.2	4.12	4.60	19.0															Basin OS1
	7	OS2	1.94	0.96	14.2	1.86	6.04	11.2															Basin OS2
	8	OS3	2.36	0.96	12.2	2.27	6.44	14.6															Basin OS3
	9	OS4	11.71	0.36	32.4	4.25	3.97	16.9															Basin OS4
	10	OS6	18.38	0.66	14.8	12.15	5.94	72.2						12.2	3.4					998	1.8	9.1	Basin OS6 travel to design point 5.1
	11	OS7	33.07	0.48	34.7	15.93	3.79	60.4						15.93	3.2					936	1.8	8.7	Basin OS7 travel to design point 5.1
	5	A3	11.68	0.35	19.5	4.09	5.25	21.5															Basin A3
	5.1								19.5	32.17	5.25	168.9											Design point 5.1 fed by basins A3, OS6, and OS7

**Notes:**

Street and Pipe C\*A values are determined by Q/I using the catchment's intensity value.  
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.



**STANDARD FORM SF-3 - EXISTING**  
**STORM DRAINAGE SYSTEM DESIGN**  
(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Subdivision- Existing  
Location: El Paso County  
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By: \_\_\_\_\_  
Date: 5/4/21

Description	Design Point	DIRECT RUNOFF						TOTAL RUNOFF				STREET/SWALE	PIPE			TRAVEL TIME			REMARKS				
		Basin ID	Area (ac)	Runoff Coeff.	t <sub>c</sub> (min)	C * A (ac)	I (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C * A (ac)	I (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C * A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C * A (ac)	Slope (%)		Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)

# COMPOSITE % IMPERVIOUS & COMPOSITE PROPOSED RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Sterling Ranch Subdivision- Interim  
 Location: El Paso County

Project Name: Sterling Ranch Phase 2  
 Project No.: 25188.02  
 Calculated By: CJD  
 Checked By: \_\_\_\_\_  
 Date: 5/4/20

Basin ID	Total Area (ac)	Streets (100% Impervious)				Residential (65% Impervious)				Light Industrial (80% Impervious) Commercial (95% Impervious)				Lawns (0% Impervious) School (55% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	
A1	4.31	0.90	0.96	0.92	21.3%	0.45	0.59	2.79	42.1%	0.59	0.70	0.00	0.0%	0.08	0.35	0.60	0.0%	0.49	0.64	63.4%
A5	0.45	0.90	0.96	0.17	37.8%	0.45	0.59	0.28	40.4%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.62	0.73	78.2%
I1	21.99	0.90	0.96	0.12	0.5%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	21.87	0.0%	0.08	0.35	0.5%
I2	3.47	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	3.47	0.0%	0.08	0.35	0.0%
B1	2.44	0.90	0.96	1.04	42.6%	0.45	0.59	1.40	37.3%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.64	0.75	79.9%
B2	4.33	0.90	0.96	0.94	21.7%	0.45	0.59	3.39	50.9%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.55	0.67	72.6%
C1	3.29	0.90	0.96	0.72	21.9%	0.45	0.59	1.66	32.8%	0.59	0.70	0.00	0.0%	0.08	0.35	0.91	0.0%	0.45	0.60	54.7%
C2	6.74	0.90	0.96	1.49	22.1%	0.45	0.59	4.21	40.6%	0.59	0.70	0.00	0.0%	0.08	0.35	1.04	0.0%	0.49	0.63	62.7%
C3	3.11	0.90	0.96	0.10	3.2%	0.45	0.59	0.37	7.7%	0.59	0.70	0.00	0.0%	0.08	0.35	2.64	0.0%	0.15	0.40	10.9%
B6	0.78	0.90	0.96	0.00	0.0%	0.45	0.59	0.53	44.2%	0.59	0.70	0.00	0.0%	0.08	0.35	0.25	0.0%	0.33	0.51	44.2%
B5	0.45	0.90	0.96	0.00	0.0%	0.45	0.59	0.35	50.6%	0.59	0.70	0.00	0.0%	0.08	0.35	0.10	0.0%	0.37	0.54	50.6%
B4	1.55	0.90	0.96	0.00	0.0%	0.45	0.59	1.35	56.6%	0.59	0.70	0.00	0.0%	0.08	0.35	0.20	0.0%	0.40	0.56	56.6%
B3	0.66	0.90	0.96	0.34	51.5%	0.45	0.59	0.12	11.8%	0.59	0.70	0.00	0.0%	0.08	0.35	0.20	0.0%	0.57	0.71	63.3%
C4	1.34	0.90	0.96	0.19	14.2%	0.45	0.59	0.80	38.8%	0.59	0.70	0.00	0.0%	0.08	0.35	0.35	0.0%	0.42	0.58	53.0%
D1	0.77	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.77	0.0%	0.08	0.35	0.0%
D2	3.92	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	3.92	0.0%	0.08	0.35	0.0%
OS6	18.38	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.90	0.90	10.40	53.8%	0.08	0.35	7.98	0.0%	0.54	0.66	53.8%
OS4	11.71	0.90	0.96	0.00	0.0%	0.45	0.59	0.65	3.6%	0.59	0.70	0.00	0.0%	0.58	0.68	11.06	51.9%	0.57	0.68	55.6%
OS7	33.07	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.90	0.90	7.91	22.7%	0.08	0.35	25.16	0.0%	0.28	0.48	22.7%
TOTAL (A1-C4)(I1-I2)	59.60																			28.9%
TOTAL (OS4 -OS7)	63.16																			37.8%
TOTAL	122.76																			33.5%

PROPOSED  
STANDARD FORM SF-2  
TIME OF CONCENTRATION

Subdivision: Sterling Ranch Subdivision- Interim  
Location: El Paso County

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 5/4/20

SUB-BASIN DATA						INITIAL/OVERLAND (T <sub>i</sub> )			TRAVEL TIME (T <sub>t</sub> )					t <sub>c</sub> CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C <sub>5</sub>	C <sub>100</sub>	L (ft)	S <sub>o</sub> (%)	t <sub>i</sub> (min)	L <sub>t</sub> (ft)	S <sub>t</sub> (%)	K	VEL. (ft/s)	t <sub>t</sub> (min)	COMP. t <sub>c</sub> (min)	TOTAL LENGTH (ft)	Urbanized t <sub>c</sub> (min)	t <sub>c</sub> (min)
A1	4.31	A	63%	0.49	0.64	79	1.7%	8.2	1007	3.7%	20.0	3.8	4.4	12.5	1086.0	20.1	12.5
A5	0.45	A	78%	0.62	0.73	54	3.7%	4.1	217	3.9%	20.0	4.0	0.9	5.0	271.0	13.6	5.0
I1	21.99	A	1%	0.08	0.35	793	3.1%	35.5	627	3.7%	10.0	1.9	5.4	41.0	1420.0	31.9	31.9
I2	3.47	A	0%	0.08	0.35	383	3.2%	24.6	394	1.0%	10.0	1.0	6.6	31.1	777.0	33.3	31.1
B1	2.44	A	80%	0.64	0.75	50	2.5%	4.3	1066	1.6%	20.0	2.5	7.1	11.4	1116.0	19.4	11.4
B2	4.33	A	73%	0.55	0.67	226	4.9%	8.8	346	0.7%	20.0	1.7	3.4	12.2	572.0	17.2	12.2
C1	3.29	A	55%	0.45	0.60	228	4.3%	11.0	393	1.8%	20.0	2.7	2.5	13.5	621.0	19.7	13.5
C2	6.74	A	63%	0.49	0.63	99	1.8%	9.0	796	1.7%	20.0	2.6	5.1	14.1	895.0	21.1	14.1
C3	3.11	A	11%	0.15	0.40	144	9.6%	9.8	255	3.5%	15.0	2.8	1.5	11.3	399.0	26.3	11.3
B6	0.78	A	44%	0.33	0.51	246	1.5%	19.1	0	1.0%	20.0	2.0	0.0	19.1	246.0	18.5	18.5
B5	0.45	A	51%	0.37	0.54	129	5.0%	8.8	0	1.0%	20.0	2.0	0.0	8.8	129.0	17.4	8.8
B4	1.55	B	57%	0.40	0.56	222	11.0%	8.5	914	1.1%	20.0	2.1	7.4	15.9	1136.0	25.1	15.9
B3	0.66	A	63%	0.57	0.71	165	3.4%	8.2	612	2.7%	10.0	1.6	6.2	14.4	777.0	18.7	14.4
C4	1.34	A	53%	0.42	0.58	298	3.0%	14.8	1664	2.7%	10.0	1.6	16.9	31.7	1962.0	27.3	27.3
D1	0.77	A	0%	0.08	0.35	16	2.0%	5.9	570	6.0%	10.0	2.4	3.9	9.7	586.0	30.3	9.7
D2	3.92	A	0%	0.08	0.35	105	25.0%	6.5	975	50.0%	15.0	10.6	1.5	8.1	1080.0	28.6	8.1
OS6	18.38	A	54%	0.54	0.66	165	3.4%	8.6	612	2.7%	10.0	1.6	6.2	14.8	777.0	20.6	14.8
OS4	11.71	A	56%	0.57	0.68	491	1.4%	19.0	940	5.6%	10.0	2.4	6.6	25.6	1431.0	20.5	20.5
OS7	33.07	A	23%	0.28	0.48	298	3.0%	17.9	1664	2.7%	10.0	1.6	16.9	34.7	1962.0	36.0	34.7

NOTES:

$$t_c = t_i + t_t$$

Equation 6-2

Where:

t<sub>c</sub> = computed time of concentration (minutes)

t<sub>i</sub> = overland (initial) flow time (minutes)

t<sub>t</sub> = channelized flow time (minutes)

$$t_i = \frac{L_i}{60K\sqrt{S_o}} = \frac{L_i}{60V_i}$$

Equation 6-4

Where:

t<sub>i</sub> = channelized flow time (travel time, min)

L<sub>i</sub> = waterway length (ft)

S<sub>o</sub> = waterway slope (ft/ft)

V<sub>i</sub> = travel time velocity (ft/sec) = K√S<sub>o</sub>

K = NRCS conveyance factor (see Table 6-2)

Use a minimum t<sub>i</sub> value of 5 minutes for urbanized areas and a minimum t<sub>i</sub> value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

$$t_t = \frac{0.395(1 - C_1)\sqrt{L_t}}{S_o^{0.33}}$$

Equation 6-3

Where:

t<sub>t</sub> = overland (initial) flow time (minutes)

C<sub>1</sub> = runoff coefficient for 5-year frequency (from Table 6-4)

L<sub>t</sub> = length of overland flow (ft)

S<sub>o</sub> = average slope along the overland flow path (ft/ft)

$$L = (26 - 17i) + \frac{L_i}{60(14i + 9)\sqrt{S_o}}$$

Where:

i<sub>t</sub> = minimum time of concentration for first design point when less than t<sub>i</sub> from Equation 6-1.

L<sub>i</sub> = length of channelized flow path (ft)

i = imperviousness (expressed as a decimal)

S<sub>o</sub> = slope of the channelized flow path (ft/ft)

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Equation 6-5

**STANDARD FORM SF-3 - PROPOSED**  
**STORM DRAINAGE SYSTEM DESIGN**  
**(RATIONAL METHOD PROCEDURE)**

Subdivision: Sterling Ranch Subdivision- Interim  
Location: El Paso County  
Design Storm: 5-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 5/4/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (Ac)	I <sub>t</sub> (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I <sub>t</sub> (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	1	OS7	33.07	0.28	34.7	9.13	2.26	20.6								20.6	9.13	1.0	42	725	8.2	1.5	Offsite Barbarick Subdivision pond release Piped to DP 3
	2	OS4	11.71	0.57	20.5	6.71	3.05	20.5								20.5	6.71	1.0	36	112	8.3	0.2	Offsite future school Piped to DP 3
	3								36.2	15.84	2.20	34.8											Piped to existing storm sewer in Sterling Ranch Road
	4	OS6	18.38	0.54	14.8	10.00	3.54	35.4								35.4	10.00	1.0	48	800	9.4	1.4	Offsite subdivision pond release Piped to DP 7.1
	5	C2	6.74	0.49	14.1	3.32	3.61	12.0								12.0	3.32	1.0	24	63	7.3	0.1	Sump Inlet Piped to DP 6.1
	6	C1	3.29	0.45	13.5	1.47	3.68	5.4															Sump Inlet Piped to DP 6.1
	6.1								14.3	4.79	3.59	17.2				17.2	4.79	1.0	36	245	7.9	0.5	Piped to DP 7.1
	7	C3	3.11	0.15	11.3	0.47	3.95	1.9															Area Inlet Piped to DP 7.1
	7.1								16.2	15.26	3.40	51.9											Piped to existing storm sewer in Sterling Ranch Road
	8	C4	1.34	0.42	27.3	0.56	2.62	1.5															Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road
	9	B3	0.66	0.57	14.4	0.38	3.58	1.4															Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road
	10	B4	1.55	0.40	15.9	0.62	3.43	2.1								2.1	0.62	1.0	12	380	4.7	1.3	Rear lot and area inlets Piped to DP 11.1
	11	B5	0.45	0.37	8.8	0.17	4.31	0.7															Area Inlet Piped to DP 14.1
	11.1								17.3	0.79	3.31	2.6				2.6	0.79	1.0	18	357	4.9	1.2	Piped to DP 14.1
	12	B2	4.33	0.55	12.2	2.37	3.83	9.1								9.1	2.37	1.0	18	38	6.7	0.1	Sump Inlet Piped to DP 13.1
	13	B1	2.44	0.64	11.4	1.57	3.93	6.2															Sump Inlet Piped to DP 13.1
	13.1								12.3	3.94	3.82	15.0				15.0	3.94	1.0	24	125	7.7	0.3	Piped to DP 14.1
	14	B6	0.78	0.33	18.5	0.26	3.21	0.8															Area Inlet Piped to DP 14.1
	14.1								18.5	4.99	3.21	16.0				16.0	4.99	1.0	24	415	7.8	0.9	Piped to DP 15.1

# STANDARD FORM SF-3 - PROPOSED STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Subdivision- Interim  
Location: El Paso County  
Design Storm: 5-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 5/4/20

[illegible]

Notes:  
Street and Pipe C\*A values are determined by Q/i using the catchment's intensity value.  
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

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

Subdivision: Sterling Ranch Subdivision- Interim  
Location: El Paso County  
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 5/4/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	1	OS7	33.07	0.48	34.7	15.93	3.79	60.4								60.4	15.93	1.0	42	725	10.9	1.1	Offsite Barbarick Subdivision pond release Piped to DP 3
	2	OS4	11.71	0.68	20.5	7.90	5.12	40.5								40.5	7.90	1.0	36	112	9.9	0.2	Offsite future school Piped to DP 3
	3								35.9	23.83	3.71	88.5											Piped to existing storm sewer in Sterling Ranch Road Offsite subdivision pond release
	4	OS6	18.38	0.66	14.8	12.15	5.94	72.2								72.2	12.15	1.0	48	800	11.4	1.2	Piped to DP 7.1 Sump Inlet
	5	C2	6.74	0.63	14.1	4.28	6.06	25.9								25.9	4.28	1.0	24	63	8.3	0.1	Piped to DP 6.1 Sump Inlet
	6	C1	3.29	0.60	13.5	1.99	6.18	12.3															Piped to DP 6.1
	6.1								14.3	6.27	6.04	37.8				37.8	6.27	1.0	36	245	9.7	0.4	Piped to DP 7.1
	7	C3	3.11	0.40	11.3	1.24	6.63	8.2															Area Inlet Piped to DP 7.1
	7.1								16.0	19.66	5.75	113.0											Piped to existing storm sewer in Sterling Ranch Road Offsite flow to existing inlet in Sterling Ranch Road
	8	C4	1.34	0.58	27.3	0.78	4.40	3.4															Piped to existing storm sewer in Sterling Ranch Road Offsite flow to existing inlet in Sterling Ranch Road
	9	B3	0.66	0.71	14.4	0.47	6.01	2.8															Piped to existing storm sewer in Sterling Ranch Road Rear lot and area inlets
	10	B4	1.55	0.56	15.9	0.87	5.76	5.0								5.0	0.87	1.0	12	380	6.4	1.0	Piped to DP 11.1
	11	B5	0.45	0.54	8.8	0.24	7.24	1.7															Area Inlet Piped to DP 14.1
	11.1								16.9	1.11	5.61	6.2				6.2	1.11	1.0	18	357	6.2	1.0	Piped to DP 14.1
	12	B2	4.33	0.67	12.2	2.90	6.43	18.7								18.7	2.90	1.0	18	38	10.6	0.1	Sump Inlet Piped to DP 13.1
	13	B1	2.44	0.75	11.4	1.82	6.60	12.0															Sump Inlet Piped to DP 13.1
	13.1								12.3	4.72	6.42	30.3				30.3	4.72	1.0	24	125	9.7	0.2	Piped to DP 14.1
	14	B6	0.78	0.51	18.5	0.40	5.38	2.2															Area Inlet Piped to DP 14.1
	14.1								18.5	6.23	5.38	33.5				33.5	6.23	1.0	24	415	10.7	0.6	Piped to DP 15.1
	15	A1	4.31	0.64	12.5	2.74	6.37	17.4					10.0	1.5777	1.6	7.4				230	2.5	1.5	On-grade Inlet Captured Flows piped to DP 15.1, Bypass flow to DP 17
	15.1								19.1	8.97	5.30	47.5				47.5	8.97	1.0	24	45	15.1	0.0	On-grade Inlet Captured Flows piped to DP 16.1

# STANDARD FORM SF-3 - PROPOSED STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Subdivision- Interim  
Location: El Paso County  
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 5/4/20

[illegible]

Notes:  
Street and Pipe C\*A values are determined by Q/i using the catchment's intensity value.  
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

# COMPOSITE % IMPERVIOUS & COMPOSITE PROPOSED RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Sterling Ranch Subdivision -Proposed  
 Location: El Paso County

Project Name: Sterling Ranch Phase 2  
 Project No.: 25188.02  
 Calculated By: CJD  
 Checked By: \_\_\_\_\_  
 Date: 4/27/20

Basin ID	Total Area (ac)	Paved/Streets (100% Impervious)				Residential (65% Impervious)				Light Industrial (80% Impervious) Commercial (95% Impervious)				Lawns (0% Impervious) School (55% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	
A1	4.31	0.90	0.96	0.92	21.3%	0.45	0.59	2.79	42.1%	0.59	0.70	0.00	0.0%	0.08	0.35	0.60	0.3%	0.49	0.64	63.7%
A2	1.41	0.90	0.96	0.22	15.6%	0.45	0.59	0.34	15.7%	0.59	0.70	0.00	0.0%	0.08	0.35	0.85	0.0%	0.30	0.50	31.3%
A3	3.68	0.90	0.96	0.71	19.3%	0.45	0.59	2.59	45.7%	0.59	0.70	0.00	0.0%	0.08	0.35	0.38	0.0%	0.50	0.64	65.1%
A4	3.94	0.90	0.96	0.67	17.0%	0.45	0.59	2.13	35.1%	0.59	0.70	0.00	0.0%	0.08	0.35	1.14	0.0%	0.42	0.58	52.1%
A5	0.45	0.90	0.96	0.17	37.8%	0.45	0.59	0.28	40.4%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.62	0.73	78.2%
A6	7.60	0.90	0.96	1.76	23.2%	0.45	0.59	5.84	49.9%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.55	0.68	73.1%
A7	1.43	0.90	0.96	0.43	29.8%	0.45	0.59	1.00	45.5%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.58	0.70	75.3%
A8	4.22	0.90	0.96	0.12	2.8%	0.45	0.59	0.68	10.5%	0.59	0.70	0.00	0.0%	0.08	0.35	3.42	0.0%	0.16	0.41	13.3%
B1	2.44	0.90	0.96	1.04	42.6%	0.45	0.59	1.40	37.3%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.64	0.75	79.9%
B2	4.33	0.90	0.96	0.94	21.7%	0.45	0.59	3.39	50.9%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.55	0.67	72.6%
C1	2.62	0.90	0.96	0.72	27.5%	0.45	0.59	1.66	41.2%	0.59	0.70	0.00	0.0%	0.08	0.35	0.24	0.0%	0.54	0.67	68.7%
C2	6.74	0.90	0.96	1.49	22.1%	0.45	0.59	4.21	40.6%	0.59	0.70	0.00	0.0%	0.08	0.35	1.04	0.0%	0.49	0.63	62.7%
C3	3.77	0.90	0.96	0.13	3.4%	0.45	0.59	0.37	6.4%	0.59	0.70	0.00	0.0%	0.08	0.35	3.27	0.0%	0.14	0.39	9.8%
A9	2.02	0.90	0.96	0.06	3.0%	0.45	0.59	0.15	4.8%	0.59	0.70	0.00	0.0%	0.08	0.35	1.81	0.0%	0.13	0.39	7.8%
A10	3.23	0.90	0.96	0.14	4.3%	0.45	0.59	0.98	19.7%	0.59	0.70	0.00	0.0%	0.08	0.35	2.11	0.0%	0.23	0.45	24.1%
B6	0.78	0.90	0.96	0.00	0.0%	0.45	0.59	0.53	44.2%	0.59	0.70	0.00	0.0%	0.08	0.35	0.25	0.0%	0.33	0.51	44.2%
B5	0.45	0.90	0.96	0.00	0.0%	0.45	0.59	0.35	50.6%	0.59	0.70	0.00	0.0%	0.08	0.35	0.10	0.0%	0.37	0.54	50.6%
B4	1.80	0.90	0.96	0.05	2.6%	0.45	0.59	1.35	48.8%	0.59	0.70	0.00	0.0%	0.08	0.35	0.40	0.0%	0.38	0.55	51.3%
B3	2.36	0.90	0.96	1.37	57.9%	0.45	0.59	0.12	3.3%	0.59	0.70	0.00	0.0%	0.08	0.35	0.87	0.0%	0.57	0.72	61.2%
C4	3.79	0.90	0.96	1.55	41.0%	0.45	0.59	0.80	13.7%	0.59	0.70	0.00	0.0%	0.08	0.35	1.44	0.0%	0.49	0.65	54.7%
D1	0.42	0.90	0.96	0.05	11.5%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.37	0.0%	0.17	0.42	11.5%
D2	3.67	0.90	0.96	0.17	4.6%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	3.50	0.0%	0.12	0.38	4.6%
OS6	18.38	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.90	0.90	10.40	53.8%	0.08	0.35	7.98	0.0%	0.54	0.66	53.8%
OS4	11.71	0.90	0.96	0.00	0.0%	0.45	0.59	0.65	3.6%	0.59	0.70	0.00	0.0%	0.58	0.68	11.06	51.9%	0.57	0.68	55.6%
OS7	33.07	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.90	0.90	7.91	22.7%	0.08	0.35	25.16	0.0%	0.28	0.48	22.7%
TOTAL (A1-C4)	61.37																			53.2%
TOTAL (OS4 -OS7)	63.16																			37.8%
TOTAL	128.62																			44.1%



Basin ID	Total Area (ac)	Paved/Streets (100% Impervious)				Res
		C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>

Basin ID	Total Area (ac)	Paved/Streets (100% Impervious)				Res
		C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>

PROPOSED  
STANDARD FORM SF-2  
TIME OF CONCENTRATION

Subdivision: Sterling Ranch Subdivision -Proposed  
Location: El Paso County

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By: \_\_\_\_\_  
Date: 4/27/20

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					t <sub>c</sub> CHECK			FINAL
DATA						(T <sub>i</sub> )			(T <sub>t</sub> )					(URBANIZED BASINS)			
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C <sub>5</sub>	C <sub>100</sub>	L (ft)	S <sub>o</sub> (%)	t <sub>i</sub> (min)	L <sub>t</sub> (ft)	S <sub>t</sub> (%)	K	VEL. (ft/s)	t <sub>t</sub> (min)	COMP. t <sub>c</sub> (min)	TOTAL LENGTH (ft)	Urbanized t <sub>c</sub> (min)	
A1	4.31	A	64%	0.49	0.64	79	1.7%	8.2	1007	3.7%	20.0	3.8	4.4	12.5	1086.0	20.0	12.5
A2	1.41	A	31%	0.30	0.50	266	3.7%	15.4	141	1.5%	20.0	2.4	1.0	16.3	407.0	22.1	16.3
A3	3.68	A	65%	0.50	0.64	120	3.7%	7.7	1008	2.4%	20.0	3.1	5.5	13.2	1128.2	21.0	13.2
A4	3.94	A	52%	0.42	0.58	118	2.1%	10.5	814	1.9%	20.0	2.8	4.9	15.4	932.0	23.2	15.4
A5	0.45	A	78%	0.62	0.73	54	3.7%	4.1	217	3.9%	20.0	4.0	0.9	5.0	271.0	13.6	5.0
A6	7.60	A	73%	0.55	0.68	212	4.3%	8.9	723	1.4%	20.0	2.4	5.0	13.9	934.9	18.8	13.9
A7	1.43	A	75%	0.58	0.70	303	3.4%	10.9	367	1.2%	20.0	2.2	2.8	13.7	670.0	16.1	13.7
A8	4.22	A	13%	0.16	0.41	233	4.9%	15.3	307	0.9%	15.0	1.4	3.6	18.9	540.0	28.7	18.9
B1	2.44	A	80%	0.64	0.75	50	2.5%	4.3	1066	1.6%	20.0	2.5	7.1	11.4	1116.0	19.4	11.4
B2	4.33	A	73%	0.55	0.67	226	4.9%	8.8	346	0.7%	20.0	1.7	3.4	12.2	572.0	17.2	12.2
C1	2.62	A	69%	0.54	0.67	228	4.3%	9.5	393	1.8%	20.0	2.7	2.5	11.9	621.0	17.0	11.9
C2	6.74	A	63%	0.49	0.63	99	1.8%	9.0	796	1.7%	20.0	2.6	5.1	14.1	895.0	21.1	14.1
C3	3.77	A	10%	0.14	0.39	144	9.6%	9.8	255	3.5%	15.0	2.8	1.5	11.3	399.0	26.5	11.3
A9	2.02	A	8%	0.13	0.39	452	2.4%	27.8	108	2.6%	20.0	3.2	0.6	28.4	560.0	25.8	25.8
A10	3.23	A	24%	0.23	0.45	248	2.8%	17.6	0	1.0%	20.0	2.0	0.0	17.6	248.0	21.9	17.6
B6	0.78	A	44%	0.33	0.51	246	1.5%	19.1	0	1.0%	20.0	2.0	0.0	19.1	246.0	18.5	18.5
B5	0.45	A	51%	0.37	0.54	129	5.0%	8.8	0	1.0%	20.0	2.0	0.0	8.8	129.0	17.4	8.8
B4	1.80	B	51%	0.38	0.55	222	11.0%	8.8	914	1.1%	20.0	2.1	7.4	16.2	1136.0	26.4	16.2
B3	2.36	A	61%	0.57	0.72	165	3.4%	8.1	1595	1.5%	10.0	1.2	21.7	29.8	1760.0	27.9	27.9
C4	3.79	A	55%	0.49	0.65	298	3.0%	13.1	1664	1.5%	10.0	1.2	22.6	35.8	1962.0	30.3	30.3
D1	0.42	A	12%	0.17	0.42	16	2.0%	5.3	570	6.0%	10.0	2.4	3.9	9.2	586.0	27.7	9.2
D2	3.67	A	5%	0.12	0.38	105	25.0%	6.3	975	50.0%	15.0	10.6	1.5	7.8	1080.0	27.6	7.8
OS6	18.38	A	54%	0.54	0.66	165	3.4%	8.6	612	2.7%	10.0	1.6	6.2	14.8	777.0	20.6	14.8
OS4	11.71	A	56%	0.57	0.68	491	1.4%	19.0	940	5.6%	10.0	2.4	6.6	25.6	1431.0	20.5	20.5
OS7	33.07	A	23%	0.28	0.48	298	3.0%	17.9	1664	2.7%	10.0	1.6	16.9	34.7	1962.0	36.0	34.7

# PROPOSED STANDARD FORM SF-2 TIME OF CONCENTRATION

Subdivision: Sterling Ranch Subdivision -Proposed  
Location: El Paso County

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By: \_\_\_\_\_  
Date: 4/27/20

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					tc CHECK			FINAL
DATA						(T <sub>i</sub> )			(T <sub>t</sub> )					(URBANIZED BASINS)			
BASIN	D.A.	Hydrologic	Impervious	C <sub>5</sub>	C <sub>100</sub>	L	S <sub>o</sub>	t <sub>i</sub>	L <sub>t</sub>	S <sub>t</sub>	K	VEL.	t <sub>t</sub>	COMP. t <sub>c</sub>	TOTAL	Urbanized t <sub>c</sub>	t <sub>c</sub>

## NOTES:

$$t_c = t_i + t_t$$

Equation 6-2

Where:

t<sub>c</sub> = computed time of concentration (minutes)

t<sub>i</sub> = overland (initial) flow time (minutes)

t<sub>t</sub> = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

Equation 6-4

Where:

t<sub>t</sub> = channelized flow time (travel time, min)

L<sub>t</sub> = waterway length (ft)

S<sub>o</sub> = waterway slope (ft/ft)

V<sub>t</sub> = travel time velocity (ft/sec) = K√S<sub>o</sub>

K = NRCS conveyance factor (see Table 6-2).

Use a minimum t<sub>c</sub> value of 5 minutes for urbanized areas and a minimum t<sub>c</sub> value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L_i}}{S_o^{0.33}}$$

Equation 6-3

Where:

t<sub>i</sub> = overland (initial) flow time (minutes)

C<sub>s</sub> = runoff coefficient for 5-year frequency (from Table 6-4)

L<sub>i</sub> = length of overland flow (ft)

S<sub>o</sub> = average slope along the overland flow path (ft/ft).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Equation 6-5

Where:

t<sub>c</sub> = minimum time of concentration for first design point when less than t<sub>c</sub> from Equation 6-1.

L<sub>t</sub> = length of channelized flow path (ft)

i = imperviousness (expressed as a decimal)

S<sub>t</sub> = slope of the channelized flow path (ft/ft).

**STANDARD FORM SF-3 - PROPOSED**  
**STORM DRAINAGE SYSTEM DESIGN**  
**(RATIONAL METHOD PROCEDURE)**

Subdivision: Sterling Ranch Subdivision -Proposed  
Location: El Paso County  
Design Storm: 5-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 4/27/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (Ac)	I <sub>t</sub> (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I <sub>t</sub> (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	1	OS7	33.07	0.28	34.7	9.13	2.26	20.6								20.6	9.13	1.0	42	725	8.2	1.5	Offsite Barbarick Subdivision pond release Piped to DP 3
	2	OS4	11.71	0.57	20.5	6.71	3.05	20.5								20.5	6.71	1.0	36	112	8.3	0.2	Offsite future school Piped to DP 3
	3								36.2	15.84	2.20	34.8											Piped to existing storm sewer in Sterling Ranch Road
	4	OS6	18.38	0.54	14.8	10.00	3.54	35.4								35.4	10.00	1.0	48	800	9.4	1.4	Offsite subdivision pond release Piped to DP 7.1
	5	C2	6.74	0.49	14.1	3.32	3.61	12.0								12.0	3.32	1.0	24	63	7.3	0.1	Sump Inlet Piped to DP 6.1
	6	C1	2.62	0.54	11.9	1.41	3.87	5.5															Sump Inlet Piped to DP 6.1
	6.1								14.3	4.73	3.59	17.0				17.0	4.73	1.0	36	245	7.8	0.5	Piped to DP 7.1
	7	C3	3.77	0.14	11.3	0.55	3.94	2.2															Area Inlet Piped to DP 7.1
	7.1								16.2	15.28	3.40	52.0											Piped to existing storm sewer in Sterling Ranch Road
	8	C4	3.79	0.49	30.3	1.87	2.47	4.6															Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road
	9	B3	2.36	0.57	27.9	1.35	2.59	3.5															Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road
	10	B4	1.80	0.38	16.2	0.68	3.41	2.3								2.3	0.68	1.0	12	380	4.8	1.3	Rear lot and area inlets Piped to DP 11.1
	11	B5	0.45	0.37	8.8	0.17	4.31	0.7															Area Inlet Piped to DP 14.1
	11.1								17.5	0.85	3.29	2.8				2.8	0.85	1.0	18	357	5.0	1.2	Piped to DP 14.1
	12	B2	4.33	0.55	12.2	2.37	3.83	9.1								9.1	2.37	1.0	18	38	6.7	0.1	Sump Inlet Piped to DP 13.1
	13	B1	2.44	0.64	11.4	1.57	3.93	6.2															Sump Inlet Piped to DP 13.1
	13.1								12.3	3.94	3.82	15.0				15.0	3.94	1.0	24	125	7.7	0.3	Piped to DP 14.1
	14	B6	0.78	0.33	18.5	0.26	3.21	0.8															Area Inlet Piped to DP 14.1
	14.1								18.7	5.05	3.19	16.1				16.1	5.05	1.0	24	415	7.8	0.9	Piped to DP 15.1

**STANDARD FORM SF-3 - PROPOSED**  
**STORM DRAINAGE SYSTEM DESIGN**  
(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Subdivision -Proposed  
Location: El Paso County  
Design Storm: 5-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 4/27/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	15	A1	4.31	0.49	12.5	2.13	3.79	8.1					0.7	0.18	1.6	7.4	1.95			230	2.5	1.5	On-grade Inlet Captured Flows piped to DP 15.1, Bypass flow to DP 17
	15.1								19.6	7.00	3.12	21.8				21.8	7.00	1.0	24	48	8.2	0.1	Captured Flows piped to DP 16.1
	16	A5	0.45	0.62	5.0	0.28	5.16	1.4					0.0	0	2.9	1.4							On-grade Inlet Captured Flows piped to DP 16.1
	16.1								19.7	7.28	3.11	22.7				22.7	7.28	1.0	24	280	8.2	0.6	Piped to DP 18.1
	17	A2	1.41	0.30	16.3	0.42	3.40	1.4	16.3	0.60	3.40	2.0	0.0	0		2.0	0.42	1.0	24	27	4.4	0.1	On-grade Inlet Piped to DP 18.1
	18.1								20.3	7.88	3.07	24.2				24.2	0.00	1.0	30	600	8.7	1.1	Piped to DP20.1
	19	A6	7.60	0.55	13.9	4.21	3.64	15.3					4.5	1.24	1.0	10.8	2.97	1.0	18	30	6.8	0.1	On-grade Inlet Captured Flows piped to DP 20.1, Bypass flow to DP 21
	20	A3	3.68	0.50	13.2	1.84	3.72	6.8					0.0	0	1.0	6.8	1.84	1.0	18	4	6.3	0.0	On-grade Inlet Captured Flows piped to DP 20.1
	20.1								21.4	12.69	2.99	37.9				37.9	12.69	1.0	36	220	9.7	0.4	Piped to DP23
	21	A7	1.43	0.58	13.7	0.83	3.66	3.0	14.0	2.07	3.63	7.5				7.5	2.07	1.0	18	60	6.4	0.2	Sump Inlet Piped to DP22.1
	22	A4	3.94	0.42	15.4	1.65	3.48	5.7	15.4	1.65	3.48	5.7											Sump Inlet Piped to DP22.1
	22.1								15.4	3.72	3.48	12.9				12.9	3.72	1.0	24	10	7.4	0.0	Piped to DP23
	23								21.8	16.41	2.96	48.6				48.6	16.41	1.0	42	145	10.3	0.2	Piped to DP26
	24	A8	4.22	0.16	18.9	0.69	3.17	2.2															Area Inlet Piped to EX 84" Storm Line Built w/ SR Filing 2 First Phase
	25	A9	2.02	0.13	25.8	0.27	2.71	0.7								0.7	0.27	1.0	18	30	3.4	0.1	EX FES Piped to EX 84" Storm Line Built w/ SR Filing 2 First Phase
	27	A10	3.23	0.23	17.6	0.74	3.28	2.4															Pervious area sheet flows into EX Pond W5
	28	D1	0.42	0.17	9.2	0.07	4.25	0.3															Pervious area sheet flows into Sand Creek
	29	D2	3.67	0.12	7.8	0.43	4.50	1.9															Pervious area sheet flows into Sand Creek

Notes:

Street and Pipe C\*A values are determined by Q/i using the catchment's intensity value.  
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

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

Subdivision: Sterling Ranch Subdivision -Proposed  
Location: El Paso County  
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 4/21/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	$Q_{pipe}$ (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	$t_t$ (min)	
	1	OS7	33.07	0.48	34.7	15.93	3.79	60.4								60.4	15.93	1.0	42	725	10.9	1.1	Offsite Barbarick Subdivision pond release Piped to DP 3
	2	OS4	11.71	0.68	20.5	7.90	5.12	40.5								40.5	7.90	1.0	36	112	9.9	0.2	Offsite future school Piped to DP 3
	3								35.9	23.83	3.71	88.5											Piped to existing storm sewer in Sterling Ranch Road Offsite subdivision pond release
	4	OS6	18.38	0.66	14.8	12.15	5.94	72.2								72.2	12.15	1.0	48	800	11.4	1.2	Piped to DP 7.1 Sump Inlet
	5	C2	6.74	0.63	14.1	4.28	6.06	25.9								25.9	4.28	1.0	24	63	8.3	0.1	Piped to DP 6.1 Sump Inlet
	6	C1	2.62	0.67	11.9	1.75	6.49	11.4															Piped to DP 6.1
	6.1								14.3	6.03	6.04	36.4				36.4	6.03	1.0	36	245	9.6	0.4	Piped to DP 7.1 Area Inlet
	7	C3	3.77	0.39	11.3	1.49	6.61	9.9															Piped to DP 7.1
	7.1								16.0	19.67	5.75	113.1											Piped to existing storm sewer in Sterling Ranch Road Offsite flow to existing inlet in Sterling Ranch Road
	8	C4	3.79	0.65	30.3	2.47	4.14	10.2															Piped to existing storm sewer in Sterling Ranch Road Offsite flow to existing inlet in Sterling Ranch Road
	9	B3	2.36	0.72	27.9	1.69	4.34	7.3															Piped to existing storm sewer in Sterling Ranch Road Rear lot and area inlets
	10	B4	1.80	0.55	16.2	0.98	5.72	5.6								5.6	0.98	1.0	12	380	7.2	0.9	Piped to DP 11.1 Area Inlet
	11	B5	0.45	0.54	8.8	0.24	7.24	1.7															Piped to DP 14.1
	11.1								17.1	1.22	5.58	6.8				6.8	1.22	1.0	18	357	6.3	0.9	Piped to DP 14.1 Sump Inlet
	12	B2	4.33	0.67	12.2	2.90	6.43	18.7								18.7	2.90	1.0	18	38	10.6	0.1	Piped to DP 13.1 Sump Inlet
	13	B1	2.44	0.75	11.4	1.82	6.60	12.0															Piped to DP 13.1
	13.1								12.3	4.72	6.42	30.3				30.3	4.72	1.0	24	125	9.7	0.2	Piped to DP 14.1 Area Inlet
	14	B6	0.78	0.51	18.5	0.40	5.38	2.2															Piped to DP 14.1
	14.1								18.5	6.34	5.38	34.1				34.1	6.34	1.0	24	415	10.9	0.6	Piped to DP 15.1
	15	A1	4.31	0.64	12.5	2.74	6.37	17.4					5.0	0.7854	1.6	12.4	1.95			230	2.5	1.5	On-grade Inlet Captured Flows piped to DP 15.1, Bypass flow to DP 17
	15.1								19.1	8.29	5.30	43.9				43.9	8.29	1.0	24	48	14.0	0.1	Captured Flows piped to DP 16.1

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

Subdivision: Sterling Ranch Subdivision -Proposed  
Location: El Paso County  
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 2  
Project No.: 25188.02  
Calculated By: CJD  
Checked By:  
Date: 4/21/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	$Q_{pipe}$ (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	$t_t$ (min)	
	16	A5	0.45	0.73	5.0	0.33	8.66	2.9					0.0	0	2.9	2.9							On-grade Inlet Captured Flows piped to DP 16.1
	16.1								19.2	8.62	5.29	45.6				45.6	8.62	1.0	24	280	14.5	0.3	Piped to DP 18.1
	17	A2	1.41	0.50	16.3	0.71	5.70	4.0	16.3	1.50	5.70	8.5	0.9	0.1579	1.5	8.5	0.71	1.0	24	27	6.7	0.1	On-grade Inlet Piped to DP 18.1
	18.1								19.5	10.12	5.25	53.1				53.1	10.12	1.0	30	600	10.8	0.9	Piped to DP20.1
	19	A6	7.60	0.68	13.9	5.14	6.11	31.4					15.6	2.5552	1.0	15.8	2.58	1.0	18	30	8.9	0.1	On-grade Inlet Captured Flows piped to DP 20.1, Bypass flow to DP 21
	20	A3	3.68	0.64	13.2	2.34	6.24	14.6					3.0	0.4809	1.0	11.6	1.86	1.0	18	4	6.6	0.0	On-grade Inlet Captured Flows piped to DP 20.1, Bypass flow to DP 22
	20.1								20.4	14.56	5.13	74.7				74.7	14.56	1.0	36	220	10.6	0.3	Piped to DP23
	21	A7	1.43	0.70	13.7	1.00	6.14	6.1	13.9	3.56	6.10	21.7				21.7	3.56	1.0	18	60	12.3	0.1	Sump Inlet Piped to DP22.1
	22	A4	3.94	0.58	15.4	2.30	5.84	13.4	15.4	2.94	5.84	17.2											Sump Inlet Piped to DP22.1
	22.1								15.4	6.49	5.84	37.9				37.9	6.49	1.0	24	10	12.1	0.0	Piped to DP23
	23								20.8	21.06	5.09	107.2				107.2	21.06	1.0	42	145	11.8	0.2	Piped to DP26
	24	A8	4.22	0.41	18.9	1.71	5.32	9.1															Area Inlet Piped to EX 84" Storm Line Built w/ SR Filing 2 First Phase
	25	A9	2.02	0.39	25.8	0.78	4.55	3.5								3.5	0.78	1.0	18	30	5.4	0.1	EX FES Piped to EX 84" Storm Line Built w/ SR Filing 2 First Phase
	27	A10	3.23	0.45	17.6	1.45	5.50	8.0															Pervious area sheet flows into EX Pond W5
	28	D1	0.42	0.42	9.2	0.18	7.14	1.3															Pervious area sheet flows into Sand Creek
	29	D2	3.67	0.38	7.8	1.39	7.55	10.5															Pervious area sheet flows into Sand Creek

Notes:  
Street and Pipe C\*A values are determined by Q/i using the catchment's intensity value.  
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.



## **Appendix C**

### **Hydraulic Calculations**



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

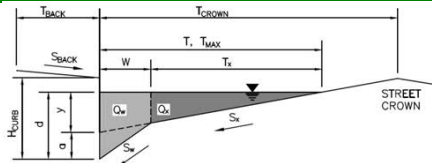
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

A1 - DP15

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 5.5$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.013$

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 17.0$  ft  
 $W = 2.00$  ft  
 $S_X = 0.020$  ft/ft  
 $S_W = 0.083$  ft/ft  
 $S_O = 0.033$  ft/ft  
 $n_{STREET} = 0.013$

Max. Allowable Spread for Minor &amp; Major Storm

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	7.8	inches

☐ check = yes

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

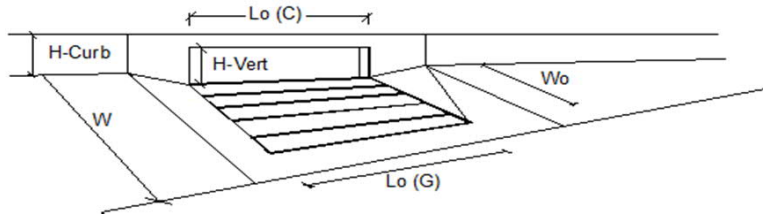
	Minor Storm	Major Storm	
$Q_{allow} =$	21.2	24.3	cfs

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')		$a_{LOCAL}$ =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		$N_o$ =	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)		$C_r \cdot G$ =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		$C_r \cdot C$ =	0.10	0.10	
<b>Street Hydraulics: OK - Q &lt; Allowable Street Capacity*</b>		MINOR		MAJOR	
Total Inlet Interception Capacity		Q =	7.8	12.4	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		$Q_b$ =	0.3	5.0	cfs
Capture Percentage = $Q_i/Q_o$ =		C% =	96	71	%

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

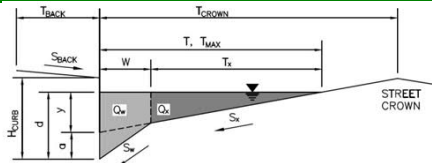
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

A2 - DP17

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 8.8$  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)

 $n_{BACK} = 0.016$ 

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

 $W = 1.17$  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

 $S_o = 0.026$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.8	17.0	ft

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$d_{MAX} =$	4.6	7.8	inches

Allow Flow Depth at Street Crown (leave blank for no)

check = yes

**MINOR STORM Allowable Capacity is based on Spread Criterion**

	Minor Storm	Major Storm	
$Q_{allow} =$	13.3	49.1	cfs

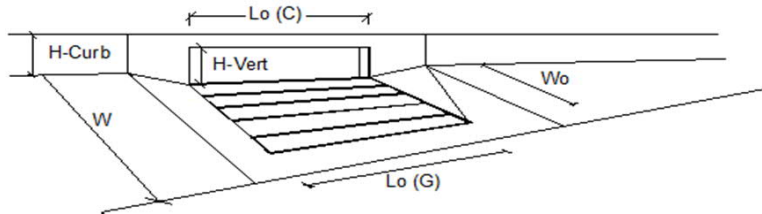
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet  
 Local Depression (additional to continuous gutter depression 'a')  
 Total Number of Units in the Inlet (Grate or Curb Opening)  
 Length of a Single Unit Inlet (Grate or Curb Opening)  
 Width of a Unit Grate (cannot be greater than W, Gutter Width)  
 Clogging Factor for a Single Unit Grate (typical min. value = 0.5)  
 Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
$a_{LOCAL}$ =	3.0	3.0	inches
No =	1	1	
$L_o$ =	15.00	15.00	ft
$W_o$ =	N/A	N/A	ft
$C_r-G$ =	N/A	N/A	
$C_r-C$ =	0.10	0.10	

## Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$

Total Inlet Interception Capacity  
 Total Inlet Carry-Over Flow (flow bypassing inlet)  
 Capture Percentage =  $Q_a/Q_o$  =

	MINOR	MAJOR	
$Q$ =	2.0	7.6	cfs
$Q_b$ =	0.0	0.9	cfs
$C\%$ =	100	90	%

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

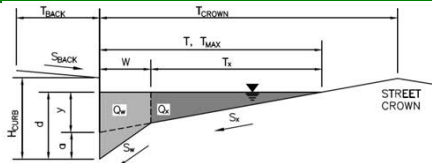
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

A4 - DP22

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 8.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

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

 $W = 1.17$  ft

Street Transverse Slope

 $S_x = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_w = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_o = 0.000$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.8	17.0	ft
$d_{MAX} =$	4.6	7.8	inches

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

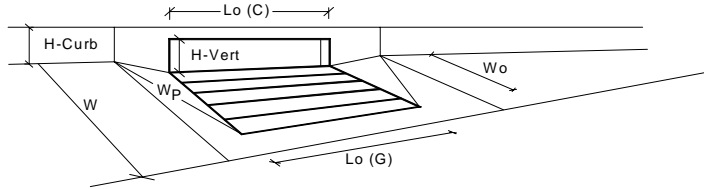
MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

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

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from above)  
Number of Unit Inlets (Grate or Curb Opening)  
Water Depth at Flowline (outside of local depression)

### Grate Information

Length of a Unit Grate  
Width of a Unit Grate  
Area Opening Ratio for a Grate (typical values 0.15-0.90)  
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
Grate Weir Coefficient (typical value 2.15 - 3.60)  
Grate Orifice Coefficient (typical value 0.60 - 0.80)

### Curb Opening Information

Length of a Unit Curb Opening  
Height of Vertical Curb Opening in Inches  
Height of Curb Orifice Throat in Inches  
Angle of Throat (see USDCM Figure ST-5)  
Side Width for Depression Pan (typically the gutter width of 2 feet)  
Clogging Factor for a Single Curb Opening (typical value 0.10)  
Curb Opening Weir Coefficient (typical value 2.3-3.7)  
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

### Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
Depth for Curb Opening Weir Equation  
Combination Inlet Performance Reduction Factor for Long Inlets  
Curb Opening Performance Reduction Factor for Long Inlets  
Grated Inlet Performance Reduction Factor for Long Inlets

### Total Inlet Interception Capacity (assumes clogged condition)

**WARNING: Inlet Capacity less than Q Peak for Major Storm**

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a <sub>local</sub> =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	4.6	5.0	inches
	MINOR	MAJOR	
L <sub>o</sub> (G) =	N/A	N/A	feet
W <sub>o</sub> =	N/A	N/A	feet
A <sub>ratio</sub> =	N/A	N/A	
C <sub>r</sub> (G) =	N/A	N/A	
C <sub>w</sub> (G) =	N/A	N/A	
C <sub>o</sub> (G) =	N/A	N/A	
	MINOR	MAJOR	
L <sub>o</sub> (C) =	15.00	15.00	feet
H <sub>vert</sub> =	6.00	6.00	inches
H <sub>throat</sub> =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W <sub>p</sub> =	1.17	1.17	feet
C <sub>r</sub> (C) =	0.10	0.10	
C <sub>w</sub> (C) =	3.60	3.60	
C <sub>o</sub> (C) =	0.67	0.67	
	MINOR	MAJOR	
d <sub>Grate</sub> =	N/A	N/A	ft
d <sub>Curb</sub> =	0.29	0.32	ft
RF <sub>Combination</sub> =	0.43	0.47	
RF <sub>Curb</sub> =	0.69	0.72	
RF <sub>Grate</sub> =	N/A	N/A	
	MINOR	MAJOR	
Q <sub>a</sub> =	6.2	7.5	cfs
Q <sub>PEAK REQUIRED</sub> =	5.7	17.2	cfs

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

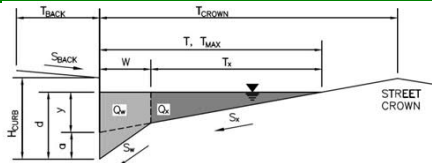
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

A6 - DP19

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 8.8$  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)

 $n_{BACK} = 0.016$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 16.2$  ft

Gutter Width

 $W = 1.17$  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

 $S_o = 0.010$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.8	16.2	ft

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$d_{MAX} =$	4.6	7.8	inches

Allow Flow Depth at Street Crown (leave blank for no)

check = yes

MINOR STORM Allowable Capacity is based on Spread Criterion

	Minor Storm	Major Storm	
$Q_{allow} =$	8.3	8.7	cfs

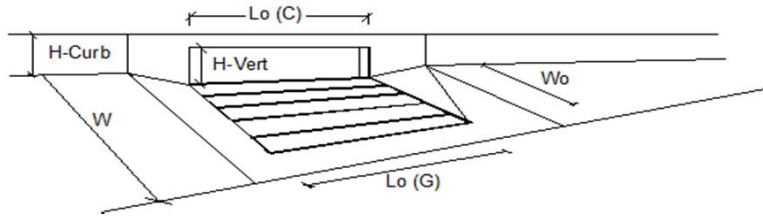
MAJOR STORM Allowable Capacity is based on Spread Criterion

**WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'****WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'**



# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')		$a_{LOCAL}$ =	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)		$C_r \cdot G$ =	N/A	N/A
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		$C_r \cdot C$ =	0.10	0.10
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR &amp; MAJOR STORM</b>				
Total Inlet Interception Capacity		Q =	10.8	15.8 cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		$Q_b$ =	4.5	15.6 cfs
Capture Percentage = $Q_i/Q_o$ =		C% =	71	50 %

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

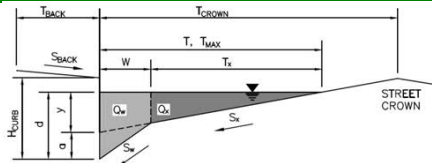
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

A5 - DP16

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 8.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

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

 $W = 1.17$  ft

Street Transverse Slope

 $S_X = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_W = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.029$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.8	17.0	ft

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$d_{MAX} =$	4.6	7.8	inches

Allow Flow Depth at Street Crown (leave blank for no)

check = yes

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

	Minor Storm	Major Storm	
$Q_{allow} =$	13.6	40.2	cfs

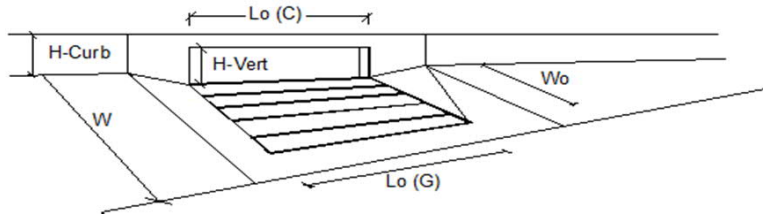
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a <sub>LOCAL</sub> = 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 <sub>o</sub> = 10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T</sub> -G = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>T</sub> -C = 0.10	0.10	
<b>Street Hydraulics: OK - Q &lt; Allowable Street Capacity*</b>			
Total Inlet Interception Capacity	Q = 1.4	2.9	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.0	0.0	cfs
Capture Percentage = Q <sub>i</sub> /Q <sub>a</sub> =	C% = 100	100	%

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

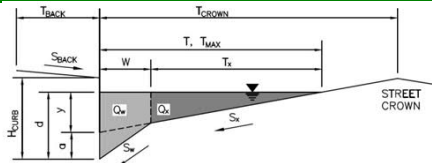
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

A3 - DP 20

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 7.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

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)

 $S_W = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.007$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	19.3	26.0	ft

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$d_{MAX} =$	6.0	7.7	inches

Allow Flow Depth at Street Crown (leave blank for no)

check = yes

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

	Minor Storm	Major Storm	
$Q_{allow} =$	11.5	26.7	cfs

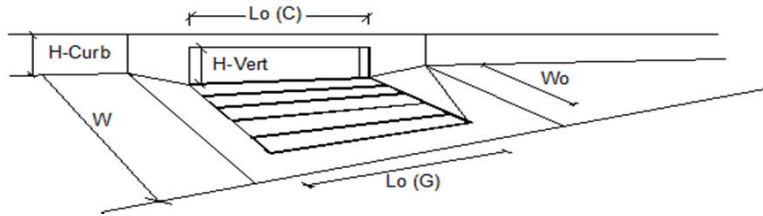
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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')		$a_{LOCAL}$ =	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)		$C_r \cdot G$ =	N/A	N/A
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		$C_r \cdot C$ =	0.10	0.10
Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$				
Total Inlet Interception Capacity		Q =	6.8	11.6 cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		$Q_b$ =	0.0	3.0 cfs
Capture Percentage = $Q_i/Q_o$ =		C% =	100	79 %

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

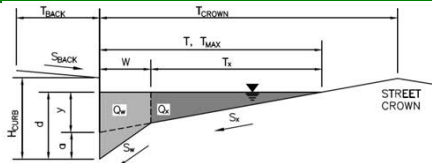
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

A7 - DP21

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 15.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

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

 $W = 1.17$  ft

Street Transverse Slope

 $S_x = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_w = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_o = 0.000$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.8	17.0	ft
$d_{MAX} =$	4.6	12.0	inches

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

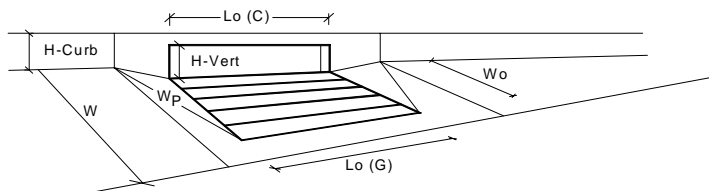
Check boxes are not applicable in SUMP conditions

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

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

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from above)  
Number of Unit Inlets (Grate or Curb Opening)  
Water Depth at Flowline (outside of local depression)

## Grate Information

Length of a Unit Grate  
Width of a Unit Grate  
Area Opening Ratio for a Grate (typical values 0.15-0.90)  
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
Grate Weir Coefficient (typical value 2.15 - 3.60)  
Grate Orifice Coefficient (typical value 0.60 - 0.80)

## Curb Opening Information

Length of a Unit Curb Opening  
Height of Vertical Curb Opening in Inches  
Height of Curb Orifice Throat in Inches  
Angle of Throat (see USDCM Figure ST-5)  
Side Width for Depression Pan (typically the gutter width of 2 feet)  
Clogging Factor for a Single Curb Opening (typical value 0.10)  
Curb Opening Weir Coefficient (typical value 2.3-3.7)  
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

## Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
Depth for Curb Opening Weir Equation  
Combination Inlet Performance Reduction Factor for Long Inlets  
Curb Opening Performance Reduction Factor for Long Inlets  
Grated Inlet Performance Reduction Factor for Long Inlets

## Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a <sub>local</sub> =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	6.0	12.0	inches
	MINOR	MAJOR	<input checked="" type="checkbox"/> Override
L <sub>o</sub> (G) =	N/A	N/A	feet
W <sub>o</sub> =	N/A	N/A	feet
A <sub>ratio</sub> =	N/A	N/A	
C <sub>r</sub> (G) =	N/A	N/A	
C <sub>w</sub> (G) =	N/A	N/A	
C <sub>o</sub> (G) =	N/A	N/A	
	MINOR	MAJOR	
L <sub>o</sub> (C) =	15.00	15.00	feet
H <sub>vert</sub> =	6.00	6.00	inches
H <sub>throat</sub> =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W <sub>p</sub> =	1.17	1.17	feet
C <sub>r</sub> (C) =	0.10	0.10	
C <sub>w</sub> (C) =	3.60	3.60	
C <sub>o</sub> (C) =	0.67	0.67	
	MINOR	MAJOR	
d <sub>Grate</sub> =	N/A	N/A	ft
d <sub>Curb</sub> =	0.40	0.90	ft
RF <sub>Combination</sub> =	0.57	1.00	
RF <sub>Curb</sub> =	0.79	1.00	
RF <sub>Grate</sub> =	N/A	N/A	
	MINOR	MAJOR	
Q <sub>a</sub> =	11.9	39.1	cfs
Q <sub>PEAK REQUIRED</sub> =	7.5	21.7	cfs

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

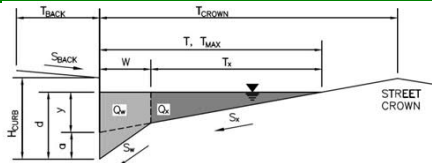
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

B1- DP12

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 17.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

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

 $W = 1.17$  ft

Street Transverse Slope

 $S_x = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_w = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_o = 0.000$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$d_{MAX} =$	6.0	12.0	inches

Check boxes are not applicable in SUMP conditions

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

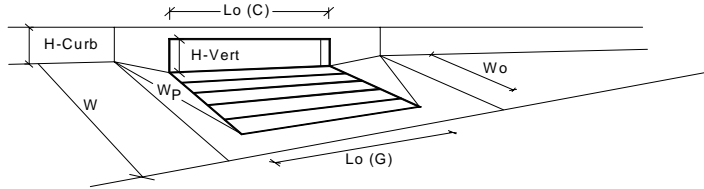
	Minor Storm	Major Storm	
$Q_{allow} =$	SUMP	SUMP	cfs

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



# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from above)  
Number of Unit Inlets (Grate or Curb Opening)  
Water Depth at Flowline (outside of local depression)  
**Grate Information**  
Length of a Unit Grate  
Width of a Unit Grate  
Area Opening Ratio for a Grate (typical values 0.15-0.90)  
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
Grate Weir Coefficient (typical value 2.15 - 3.60)  
Grate Orifice Coefficient (typical value 0.60 - 0.80)

## Curb Opening Information

Length of a Unit Curb Opening  
Height of Vertical Curb Opening in Inches  
Height of Curb Orifice Throat in Inches  
Angle of Throat (see USDCM Figure ST-5)  
Side Width for Depression Pan (typically the gutter width of 2 feet)  
Clogging Factor for a Single Curb Opening (typical value 0.10)  
Curb Opening Weir Coefficient (typical value 2.3-3.7)  
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

## Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
Depth for Curb Opening Weir Equation  
Combination Inlet Performance Reduction Factor for Long Inlets  
Curb Opening Performance Reduction Factor for Long Inlets  
Grated Inlet Performance Reduction Factor for Long Inlets

## Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a <sub>local</sub> =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	5.0	12.0	inches
	MINOR	MAJOR	<input checked="" type="checkbox"/> Override
L <sub>o</sub> (G) =	N/A	N/A	feet
W <sub>o</sub> =	N/A	N/A	feet
A <sub>ratio</sub> =	N/A	N/A	
C <sub>r</sub> (G) =	N/A	N/A	
C <sub>w</sub> (G) =	N/A	N/A	
C <sub>o</sub> (G) =	N/A	N/A	
	MINOR	MAJOR	
L <sub>o</sub> (C) =	15.00	15.00	feet
H <sub>vert</sub> =	6.00	6.00	inches
H <sub>throat</sub> =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W <sub>p</sub> =	1.17	1.17	feet
C <sub>r</sub> (C) =	0.10	0.10	
C <sub>w</sub> (C) =	3.60	3.60	
C <sub>o</sub> (C) =	0.67	0.67	
	MINOR	MAJOR	
d <sub>Grate</sub> =	N/A	N/A	ft
d <sub>Curb</sub> =	0.32	0.90	ft
RF <sub>Combination</sub> =	0.47	1.00	
RF <sub>Curb</sub> =	0.72	1.00	
RF <sub>Grate</sub> =	N/A	N/A	
	MINOR	MAJOR	
Q <sub>a</sub> =	7.5	39.1	cfs
Q <sub>PEAK REQUIRED</sub> =	6.2	12.0	cfs

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

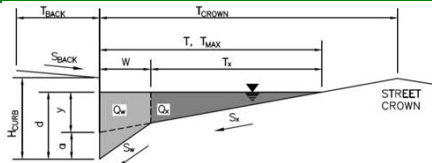
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

B2 - DP13

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 17.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

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

 $W = 1.17$  ft

Street Transverse Slope

 $S_x = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_w = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_o = 0.000$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$d_{MAX} =$	6.0	12.0	inches

Check boxes are not applicable in SUMP conditions

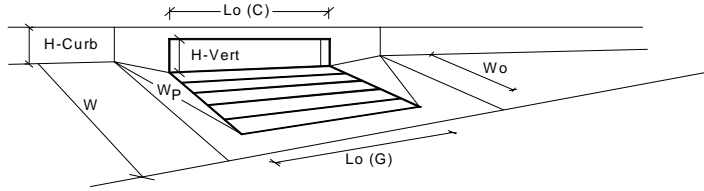
MINOR STORM Allowable Capacity is based on Depth Criterion

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

MAJOR STORM Allowable Capacity is based on Depth Criterion

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from above)  
Number of Unit Inlets (Grate or Curb Opening)  
Water Depth at Flowline (outside of local depression)

### Grate Information

Length of a Unit Grate  
Width of a Unit Grate  
Area Opening Ratio for a Grate (typical values 0.15-0.90)  
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
Grate Weir Coefficient (typical value 2.15 - 3.60)  
Grate Orifice Coefficient (typical value 0.60 - 0.80)

### Curb Opening Information

Length of a Unit Curb Opening  
Height of Vertical Curb Opening in Inches  
Height of Curb Orifice Throat in Inches  
Angle of Throat (see USDCM Figure ST-5)  
Side Width for Depression Pan (typically the gutter width of 2 feet)  
Clogging Factor for a Single Curb Opening (typical value 0.10)  
Curb Opening Weir Coefficient (typical value 2.3-3.7)  
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

### Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
Depth for Curb Opening Weir Equation  
Combination Inlet Performance Reduction Factor for Long Inlets  
Curb Opening Performance Reduction Factor for Long Inlets  
Grated Inlet Performance Reduction Factor for Long Inlets

### Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a <sub>local</sub> =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	5.6	12.0	inches
	MINOR	MAJOR	<input checked="" type="checkbox"/> Override
L <sub>o</sub> (G) =	N/A	N/A	feet
W <sub>o</sub> =	N/A	N/A	feet
A <sub>ratio</sub> =	N/A	N/A	
C <sub>r</sub> (G) =	N/A	N/A	
C <sub>w</sub> (G) =	N/A	N/A	
C <sub>o</sub> (G) =	N/A	N/A	
	MINOR	MAJOR	
L <sub>o</sub> (C) =	20.00	20.00	feet
H <sub>vert</sub> =	6.00	6.00	inches
H <sub>throat</sub> =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W <sub>p</sub> =	1.17	1.17	feet
C <sub>r</sub> (C) =	0.10	0.10	
C <sub>w</sub> (C) =	3.60	3.60	
C <sub>o</sub> (C) =	0.67	0.67	
	MINOR	MAJOR	
d <sub>Grate</sub> =	N/A	N/A	ft
d <sub>Curb</sub> =	0.37	0.90	ft
RF <sub>Combination</sub> =	0.53	1.00	
RF <sub>Curb</sub> =	0.76	1.00	
RF <sub>Grate</sub> =	N/A	N/A	
	MINOR	MAJOR	
Q <sub>a</sub> =	13.1	52.7	cfs
Q <sub>PEAK REQUIRED</sub> =	9.1	18.7	cfs

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

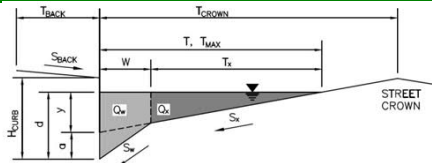
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

C1 - DP 6

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 7.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

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)

 $S_W = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.000$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	19.3	26.0	ft
$d_{MAX} =$	6.0	7.7	inches

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

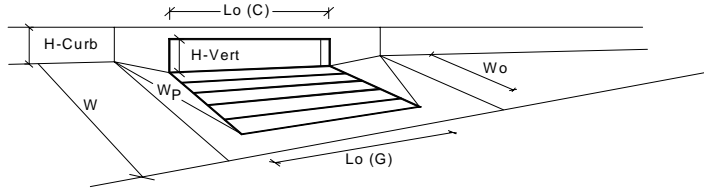
Check boxes are not applicable in SUMP conditions

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

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

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from above)  
Number of Unit Inlets (Grate or Curb Opening)  
Water Depth at Flowline (outside of local depression)  
**Grate Information**  
Length of a Unit Grate  
Width of a Unit Grate  
Area Opening Ratio for a Grate (typical values 0.15-0.90)  
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
Grate Weir Coefficient (typical value 2.15 - 3.60)  
Grate Orifice Coefficient (typical value 0.60 - 0.80)

## Curb Opening Information

Length of a Unit Curb Opening  
Height of Vertical Curb Opening in Inches  
Height of Curb Orifice Throat in Inches  
Angle of Throat (see USDCM Figure ST-5)  
Side Width for Depression Pan (typically the gutter width of 2 feet)  
Clogging Factor for a Single Curb Opening (typical value 0.10)  
Curb Opening Weir Coefficient (typical value 2.3-3.7)  
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

## Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
Depth for Curb Opening Weir Equation  
Combination Inlet Performance Reduction Factor for Long Inlets  
Curb Opening Performance Reduction Factor for Long Inlets  
Grated Inlet Performance Reduction Factor for Long Inlets

## Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a <sub>local</sub> =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	6.0	7.7	inches
	MINOR	MAJOR	
L <sub>o</sub> (G) =	N/A	N/A	feet
W <sub>o</sub> =	N/A	N/A	feet
A <sub>ratio</sub> =	N/A	N/A	
C <sub>r</sub> (G) =	N/A	N/A	
C <sub>w</sub> (G) =	N/A	N/A	
C <sub>o</sub> (G) =	N/A	N/A	
	MINOR	MAJOR	
L <sub>o</sub> (C) =	15.00	15.00	feet
H <sub>vert</sub> =	6.00	6.00	inches
H <sub>throat</sub> =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W <sub>p</sub> =	2.00	2.00	feet
C <sub>r</sub> (C) =	0.10	0.10	
C <sub>w</sub> (C) =	3.60	3.60	
C <sub>o</sub> (C) =	0.67	0.67	
	MINOR	MAJOR	
d <sub>Grate</sub> =	N/A	N/A	ft
d <sub>Curb</sub> =	0.33	0.48	ft
RF <sub>Combination</sub> =	0.57	0.73	
RF <sub>Curb</sub> =	0.79	0.88	
RF <sub>Grate</sub> =	N/A	N/A	
	MINOR	MAJOR	
Q <sub>a</sub> =	9.7	18.5	cfs
Q <sub>PEAK REQUIRED</sub> =	5.4	12.3	cfs

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

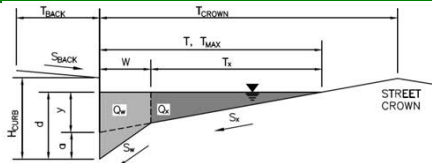
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

C2 - DP5

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 9.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

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)

 $S_w = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_o = 0.000$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	19.3	26.0	ft
$d_{MAX} =$	6.0	7.7	inches

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Check boxes are not applicable in SUMP conditions

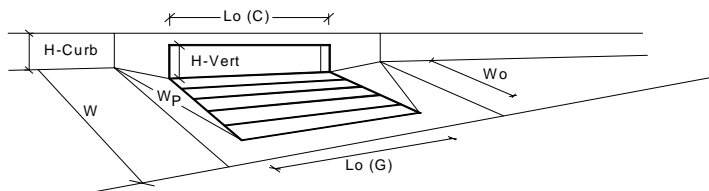
MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

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

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

Type of Inlet  
Local Depression (additional to continuous gutter depression 'a' from above)  
Number of Unit Inlets (Grate or Curb Opening)  
Water Depth at Flowline (outside of local depression)

### Grate Information

Length of a Unit Grate  
Width of a Unit Grate  
Area Opening Ratio for a Grate (typical values 0.15-0.90)  
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)  
Grate Weir Coefficient (typical value 2.15 - 3.60)  
Grate Orifice Coefficient (typical value 0.60 - 0.80)

### Curb Opening Information

Length of a Unit Curb Opening  
Height of Vertical Curb Opening in Inches  
Height of Curb Orifice Throat in Inches  
Angle of Throat (see USDCM Figure ST-5)  
Side Width for Depression Pan (typically the gutter width of 2 feet)  
Clogging Factor for a Single Curb Opening (typical value 0.10)  
Curb Opening Weir Coefficient (typical value 2.3-3.7)  
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)

### Low Head Performance Reduction (Calculated)

Depth for Grate Midwidth  
Depth for Curb Opening Weir Equation  
Combination Inlet Performance Reduction Factor for Long Inlets  
Curb Opening Performance Reduction Factor for Long Inlets  
Grated Inlet Performance Reduction Factor for Long Inlets

## Total Inlet Interception Capacity (assumes clogged condition)

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a <sub>local</sub> =	3.00	3.00	inches
No =	3	3	
Ponding Depth =	6.0	8.0	inches
	MINOR	MAJOR	<input checked="" type="checkbox"/> Override
L <sub>o</sub> (G) =	N/A	N/A	feet
W <sub>o</sub> =	N/A	N/A	feet
A <sub>ratio</sub> =	N/A	N/A	
C <sub>r</sub> (G) =	N/A	N/A	
C <sub>w</sub> (G) =	N/A	N/A	
C <sub>o</sub> (G) =	N/A	N/A	
	MINOR	MAJOR	
L <sub>o</sub> (C) =	5.00	5.00	feet
H <sub>vert</sub> =	6.00	6.00	inches
H <sub>throat</sub> =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W <sub>p</sub> =	2.00	2.00	feet
C <sub>r</sub> (C) =	0.10	0.10	
C <sub>w</sub> (C) =	3.60	3.60	
C <sub>o</sub> (C) =	0.67	0.67	
	MINOR	MAJOR	
d <sub>Grate</sub> =	N/A	N/A	ft
d <sub>Curb</sub> =	0.33	0.50	ft
RF <sub>Combination</sub> =	0.57	0.75	
RF <sub>Curb</sub> =	0.79	0.89	
RF <sub>Grate</sub> =	N/A	N/A	
	MINOR	MAJOR	
Q <sub>a</sub> =	13.5	27.9	cfs
Q <sub>PEAK REQUIRED</sub> =	12.0	25.9	cfs

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

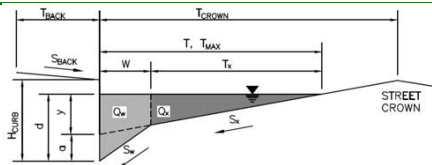
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

C4 - DP8

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 5.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 30.0$  ft

Gutter Width

 $W = 2.00$  ft

Street Transverse Slope

 $S_X = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_W = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.015$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.0	30.0	ft

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$d_{MAX} =$	6.0	6.0	inches

Allow Flow Depth at Street Crown (leave blank for no)

☐ ☐ check = yes
**MINOR STORM Allowable Capacity is based on Spread Criterion**

	Minor Storm	Major Storm	
$Q_{allow} =$	9.8	16.9	cfs

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

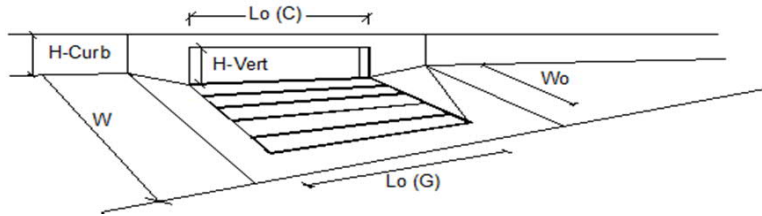
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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



# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	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)	$N_o = 3$	$3$	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$	$5.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r-G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r-C = 0.10$	$0.10$	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	$Q = 4.6$	$9.4$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.0$	$0.8$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 100$	$92$	%

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

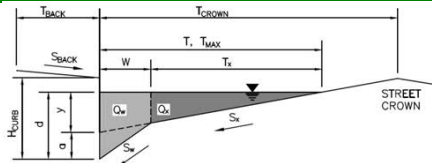
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Sterling Ranch Phase 2

Inlet ID:

B3 - DP9

**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 5.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

 $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

 $n_{BACK} = 0.016$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 30.0$  ft

Gutter Width

 $W = 2.00$  ft

Street Transverse Slope

 $S_X = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

 $S_W = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.015$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.0	30.0	ft
$d_{MAX} =$	6.0	6.0	inches

Max. Allowable Depth at Gutter Flowline for Minor &amp; Major Storm

Allow Flow Depth at Street Crown (leave blank for no)

☐ ☐ check = yes
**MINOR STORM Allowable Capacity is based on Spread Criterion****MAJOR STORM Allowable Capacity is based on Depth Criterion**

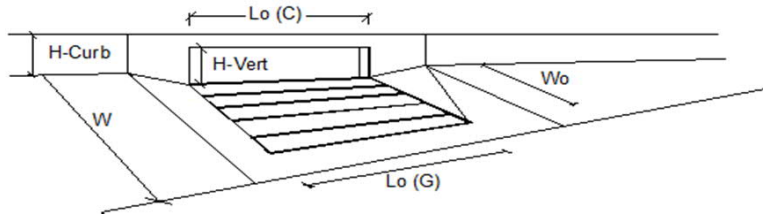
	Minor Storm	Major Storm	
$Q_{allow} =$	9.8	16.9	cfs

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	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)	$N_o = 3$	$3$	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$	$5.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r-G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r-C = 0.10$	$0.10$	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	$Q = 3.5$	$7.3$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.0$	$0.0$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 100$	$100$	%

# Channel Report

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

Tuesday, Apr 27 2021

## Barbarick FSD Overflow Channel

### Trapezoidal

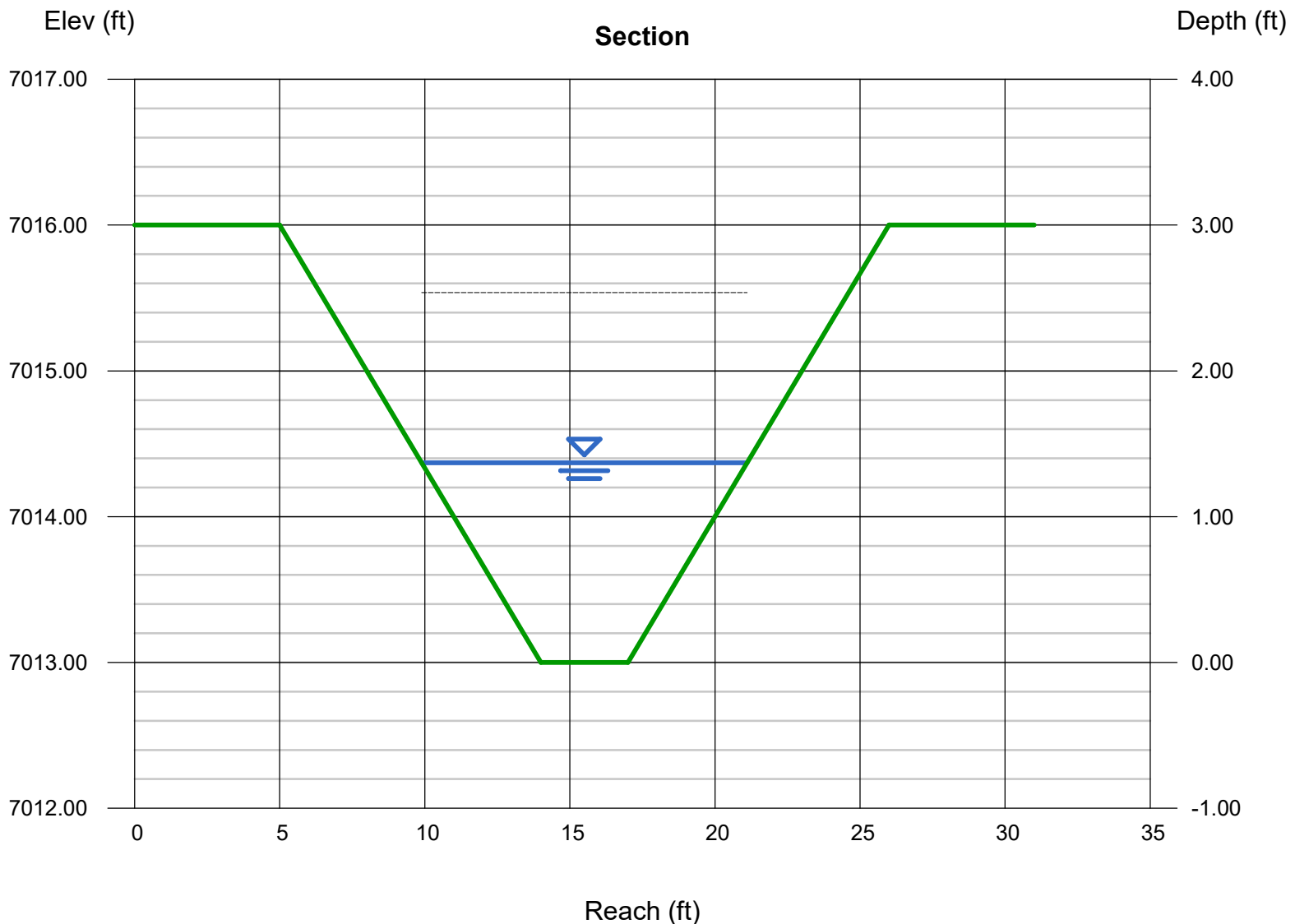
Bottom Width (ft) = 3.00  
Side Slopes (z:1) = 3.00, 3.00  
Total Depth (ft) = 3.00  
Invert Elev (ft) = 7013.00  
Slope (%) = 0.75  
N-Value = 0.013

### Calculations

Compute by: Known Q  
Known Q (cfs) = 84.40

### Highlighted

Depth (ft) = 1.37  
Q (cfs) = 84.40  
Area (sqft) = 9.74  
Velocity (ft/s) = 8.66  
Wetted Perim (ft) = 11.66  
Crit Depth, Yc (ft) = 1.75  
Top Width (ft) = 11.22  
EGL (ft) = 2.54



# Channel Report

## Interim Channel - DP I1

### Triangular

Side Slopes (z:1) = 4.00, 4.00  
Total Depth (ft) = 3.00

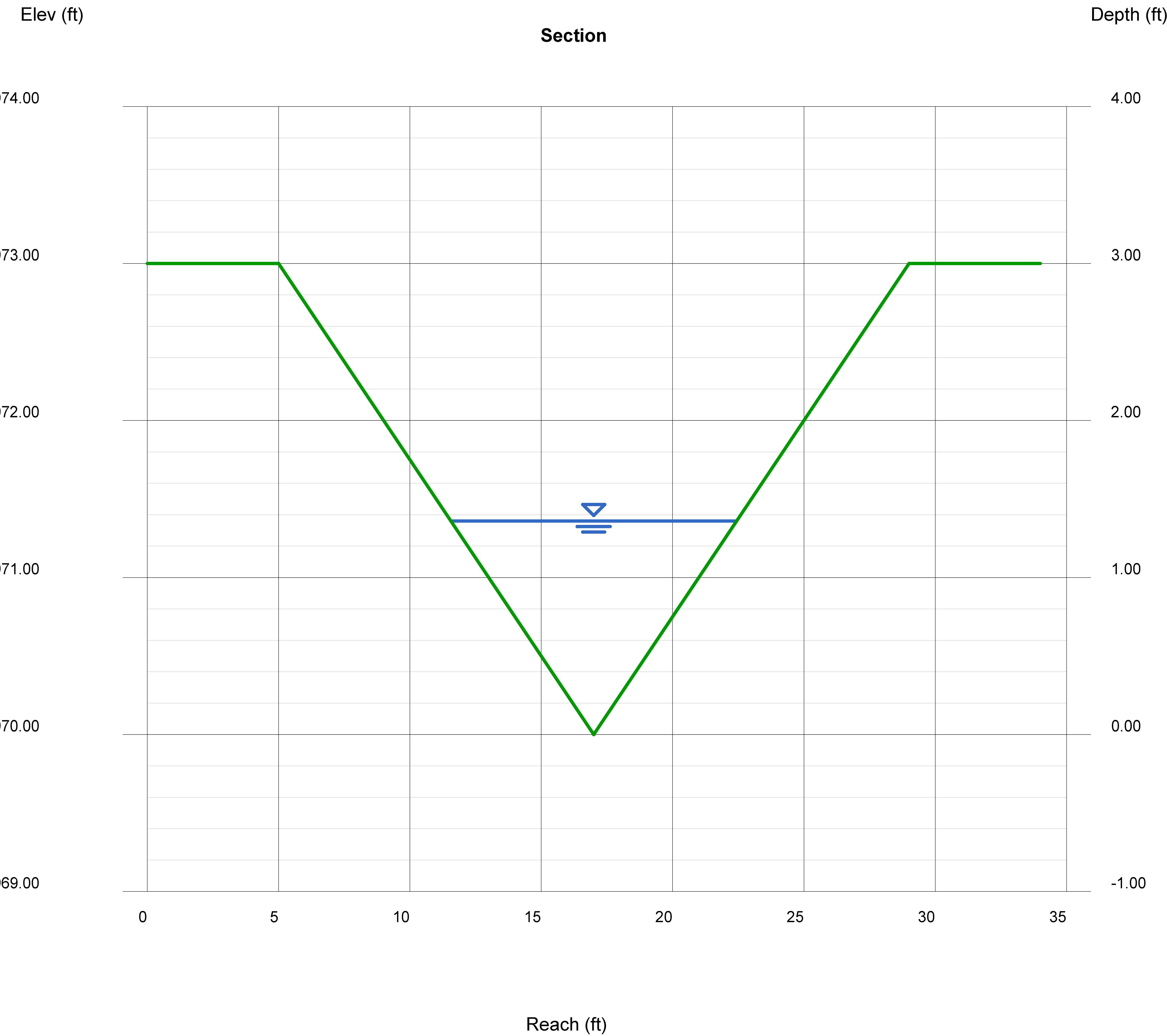
Invert Elev (ft) = 6970.00  
Slope (%) = 0.88  
N-Value = 0.025

### Calculations

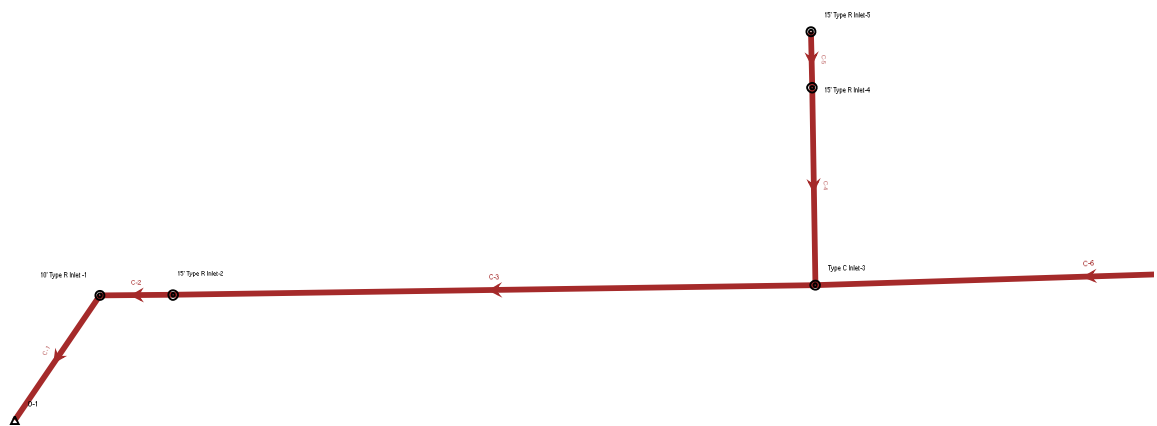
Compute by: Known Q  
Known Q (cfs) = 31.20

### Highlighted

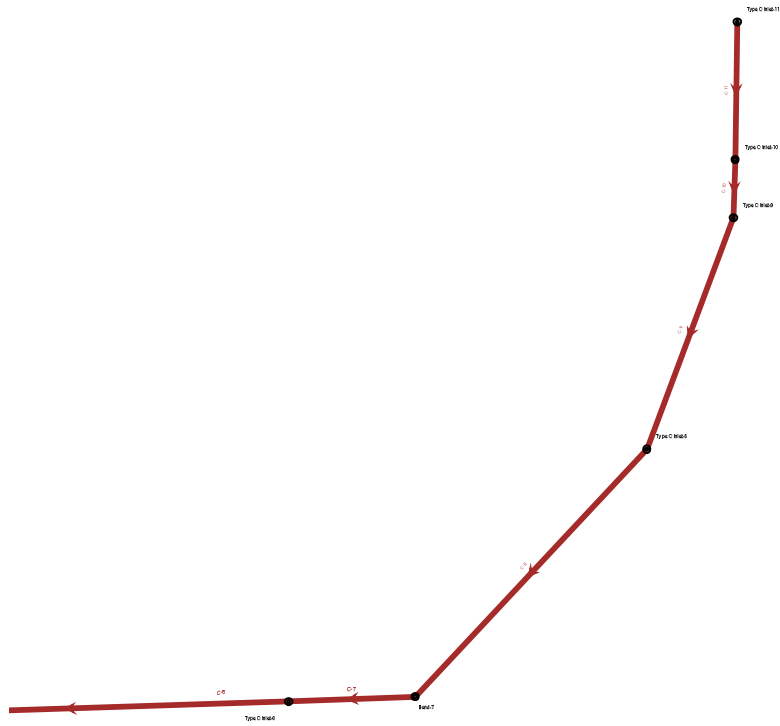
Depth (ft) = 1.36  
Q (cfs) = 31.20  
Area (sqft) = 7.40  
Velocity (ft/s) = 4.22  
Wetted Perim (ft) = 11.21  
Crit Depth, Yc (ft) = 1.31  
Top Width (ft) = 10.88  
EGL (ft) = 1.64



## Scenario: 100 Year



## Scenario: 100 Year



**Scenario: 100 Year**  
**Current Time Step: 0.000 h**  
**FlexTable: Conduit Table**

Label	Flow (cfs)	Diameter (in)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Notes
C-11	1.40	18.0	109.7	0.027	0.013	5.84	17.13	7,013.59	7,010.88	12' RCP
C-10	2.80	18.0	45.0	0.016	0.013	5.99	13.38	7,010.87	7,009.97	12' RCP
C-9	4.20	18.0	199.1	0.015	0.013	6.50	12.83	7,005.26	7,002.09	12' RCP
C-5	18.70	18.0	34.0	0.010	0.013	10.58	10.66	7,003.46	7,002.36	18' RCP
C-4	30.30	24.0	126.1	0.019	0.013	11.20	30.88	7,002.17	6,999.57	24' RCP
C-8	5.60	18.0	275.2	0.010	0.013	3.17	10.65	6,999.20	6,998.41	12' RCP
C-3	34.10	30.0	416.6	0.003	0.013	6.95	22.47	6,995.28	6,992.40	24' RCP
C-6	6.80	18.0	355.0	0.003	0.013	3.85	5.77	6,998.10	6,996.61	18' RCP
C-7	5.60	18.0	101.9	0.011	0.013	3.17	11.16	6,998.40	6,998.11	12' RCP
C-2	43.90	30.0	45.6	0.003	0.013	8.94	22.73	6,992.34	6,991.82	24' RCP
C-1	45.60	30.0	93.8	0.003	0.013	9.29	22.46	6,991.19	6,989.88	30' RCP

X:\2510000.all\2518800\StormCAD\Sterling Ranch PH 2\Sterling Ranch PH-2.stsw



**Scenario: 5 Year**  
**Current Time Step: 0.000 h**  
**FlexTable: Conduit Table**

Label	Flow (cfs)	Diameter (in)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Notes
C-11	0.57	18.0	109.7	0.027	0.013	4.49	17.13	7,013.43	7,010.64	12' RCP
C-10	1.15	18.0	45.0	0.016	0.013	4.63	13.38	7,010.63	7,009.80	12' RCP
C-9	1.73	18.0	199.1	0.015	0.013	5.06	12.83	7,004.96	7,001.87	12' RCP
C-5	9.10	18.0	34.0	0.010	0.013	6.78	10.66	7,002.42	7,001.97	18' RCP
C-4	15.00	24.0	126.1	0.019	0.013	9.76	30.88	7,001.70	6,998.93	24' RCP
C-8	2.30	18.0	275.2	0.010	0.013	4.81	10.65	6,997.07	6,994.26	12' RCP
C-3	16.10	30.0	416.6	0.003	0.013	4.98	22.47	6,992.02	6,990.93	24' RCP
C-6	2.80	18.0	355.0	0.003	0.013	3.24	5.77	6,993.26	6,992.70	18' RCP
C-7	2.30	18.0	101.9	0.011	0.013	4.97	11.16	6,994.24	6,993.27	12' RCP
C-2	21.80	30.0	45.6	0.003	0.013	5.27	22.73	6,990.91	6,990.55	24' RCP
C-1	22.70	30.0	93.8	0.003	0.013	5.22	22.46	6,989.85	6,989.26	30' RCP

X:\2510000.all\2518800\StormCAD\Sterling Ranch PH 2\Sterling Ranch PH-2.stsw

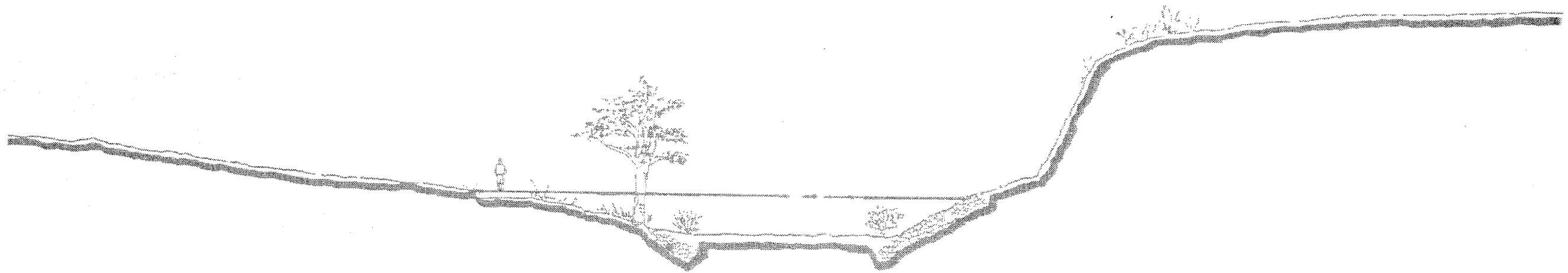
## **Appendix D**

### **Reference Material**

**SAND CREEK DRAINAGE BASIN PLANNING STUDY**

**PRELIMINARY DESIGN REPORT**

**CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO**



**PREPARED FOR:**

City of Colorado Springs  
Department of Comprehensive Planning, Development and Finance  
Engineering Division  
30 S. Nevada  
Colorado Springs, Colorado 80903

**PREPARED BY:**

Kiowa Engineering Corporation  
1011 North Weber  
Colorado Springs, CO 80903

## II. STUDY AREA DESCRIPTION

The Sand Creek drainage basin is a left-bank tributary to the Fountain Creek lying in the west-central portions of El Paso County. Sand Creek's drainage area at Fountain Creek is approximately 54 square miles of which approximately 18.8 square miles are inside the City of Colorado Springs corporate limits. The basin is divided into five major sub-basins, the Sand Creek mainstem, the East Fork Sand Creek, the Central Tributary to East Fork, the West Fork, and the East Fork Subtributary. Figure II-1 shows the location of the Sand Creek basin.

### Basin Description

The Sand Creek basin covers a total of 54 square miles in unincorporated El Paso County and Colorado Springs, Colorado. Of this total, approximately 28 square miles is encompassed by the Sand Creek basin, and 26 square miles for the East Fork Sand Creek basin. The basin trends in generally a south to southwesterly direction, entering the Fountain Creek approximately two miles upstream of the Academy Boulevard bridge over Fountain Creek. Two main tributaries drain the basin, those being the mainstem of Sand Creek and East Fork Sand Creek. Development presence is most evident along the mainstream. At this time, approximately 25 percent of the basin is developed. This alternative evaluation focuses upon the Sand Creek basin only.

The maximum basin elevation is approximately 7,620 feet above mean sea level, and falls to approximately 5,790 feet at the confluence with Fountain Creek. The headwaters of the basin originate in the conifer covered areas of The Black Forest. The middle eastern portions of the basin are typified by rolling range land with fair to good vegetative cover associated with semi-arid climates.

### Climate

This area of El Paso County can be described, in general as high plains, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry. Precipitation ranges from 14 to 16 inches per year, with the majority of this precipitation occurring in spring and summer in the form of rainfall. Thunderstorms are common during the summer months, and are typified by quick-moving low pressure cells which draw moisture from the Gulf of Mexico into the region. Average temperatures range from about 30°F in the winter

to 75° in the summer. The relative humidity ranges from about 25 percent in the summer to 45 percent in the winter.

### Soils and Geology

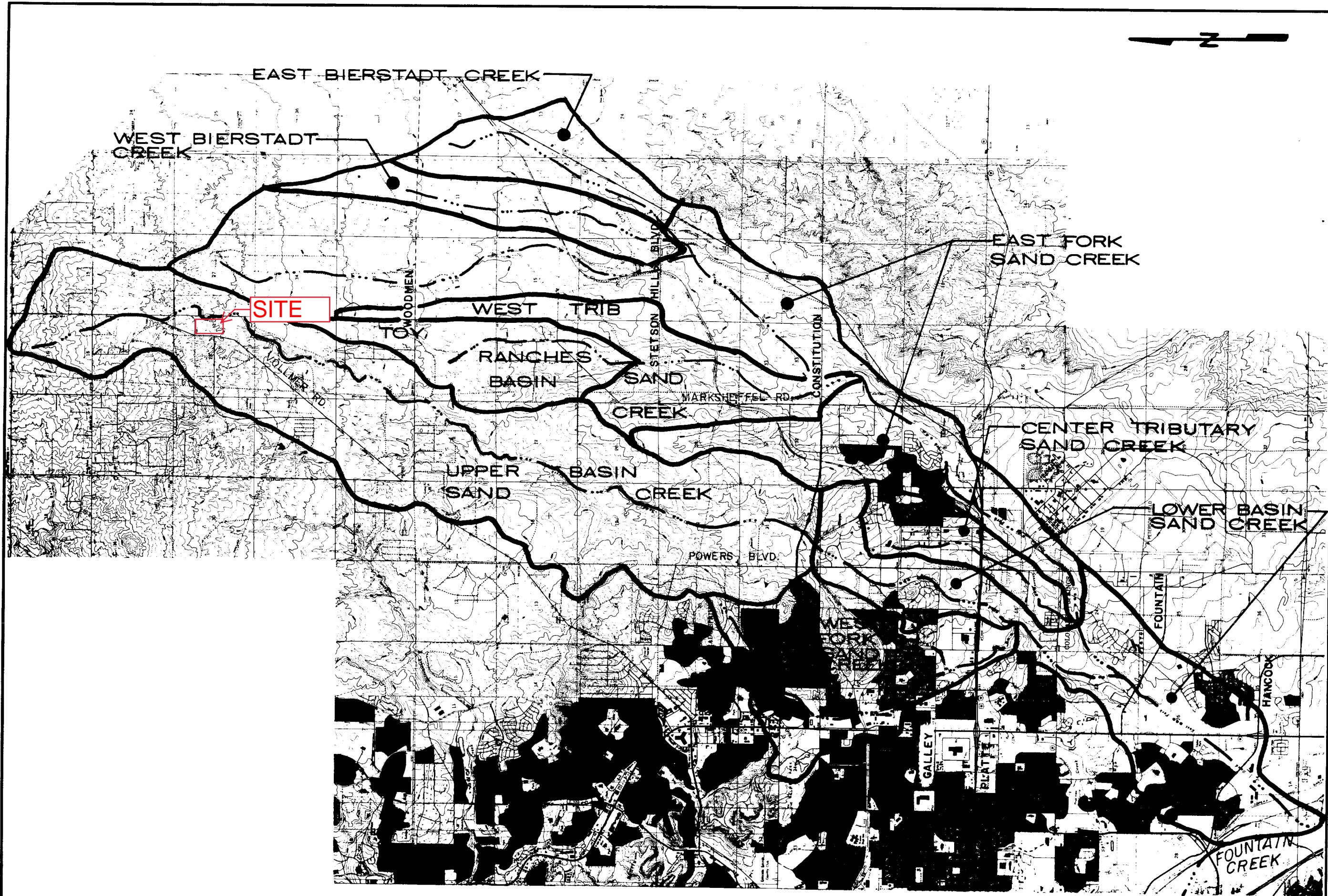
Soils within the Sand Creek basin vary between soil types A through D, as identified by the U. S. Department of Agriculture, Soil Conservation Service. The predominant soil groupings are in the Truckton and Bresser soil associations. The soils consist of deep, well drained soils that formed in alluvium and residuum, derived from sedimentary rock. The soils have high to moderate infiltration rates, and are extremely susceptible to wind and water erosion where poor vegetation cover exists. In undeveloped areas, the predominance of Type A and B soils give this basin a lower runoff per unit area as compared to basins with soils dominated by Types C and D. Presented on Figure II-2 is the Hydrologic Soil distribution map for the Sand Creek basin.

### Property Ownership and Impervious Land Densities

Property ownership along the major drainageway within the Sand Creek basin vary from public to private. Along the developed reaches, drainage right-of-ways and greenbelts have been dedicated during the development of the adjacent residential and commercial land. Where development has not occurred, the drainageways remain under private ownership with no delineated drainage right-of-way or easements. There are several public parks which abut the mainstem of Sand Creek. Roadway and utility easements abutting or crossing the major drainageways occur most frequently in the developed portions of the basin.

Land use information for the existing and future conditions were reviewed as part of the planning effort. This information is used in the hydrologic analysis to predict runoff rates and volumes for the purposes of facility evaluation. The identification of land uses abutting the drainageways is also useful in the identification of feasible plans for stabilization and aesthetic treatment of the creek. Presented on Figure II-3 is the proposed land use map used in the evaluation of impervious land densities discussed in the hydrologic section of this report. Figure II-3 is not intended to reflect the future zoning or land use policies of the City or the County.

The land use information within the Banning-Lewis Ranch property was obtained from Aries Properties during the time the draft East Fork Sand Creek Drainage Basin Planning Study was being prepared. The land use information was again reviewed with the City of Colorado Springs Department of Planning and was found to be appropriate for use in the estimation of hydrology for the East Fork Basin. The location of future arterial streets and roadways within

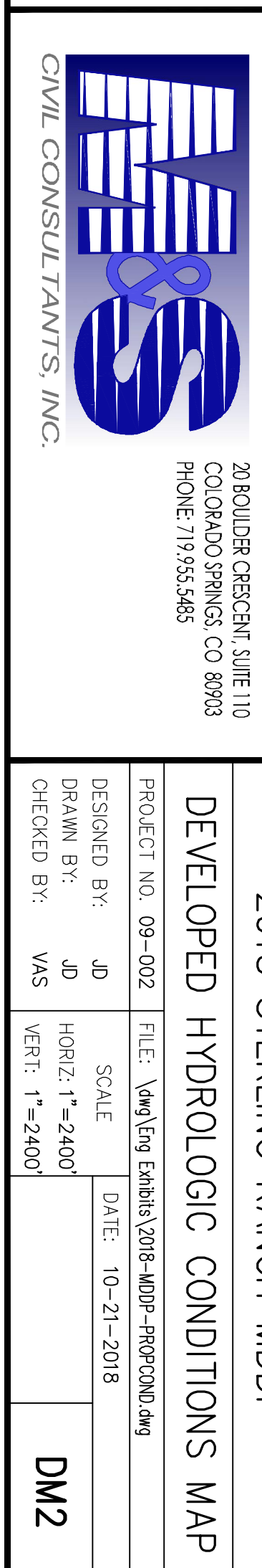



Kiowa Engineering Corporation  
419 W. Bijou Street  
Colorado Springs, Colorado  
80905-1308

SAND CREEK DRAINAGE  
BASIN PLANNING STUDY  
REGIONAL SUB-BASINS

Project No	90-04-09
Date:	11/90
Design:	
Drawn:	EAK
Check:	
Revisions:	







**M&S**  
CIVIL CONSULTANTS, INC.

20 BOLLINGER CREEK/ST. CLITE 110  
COLLADO SPRINGS, CO 80903  
PHONE: 719.955.5485

<b>DEVELOPED HYDROLOGIC CONDITIONS MAP</b>	
PROJECT NO. 09-002 DESIGNED BY: JD DRAWN BY: JD CHECKED BY: VAS	FILE: \ang\ang Exhibits 2016-WDP-PROCOND\ang SCALE: DATE: 10-21-2018 HORIZ: 1"=2400' VERT: 1"=2400'
<b>DM2</b>	

PROJECT NO. 09-002		FILE: Yang Ying Exhibit 2018-MDP-PHPCRD-09g
DESIGNED BY: JD	SCALE	DATE: 10-21-2018
DRAWN BY: JD	HORIZ. 1"=2400'	
CHECKED BY: VAS	VERT. 1"=2400'	DM2

--	--	--	--	--	--



---

## Worksheet for FSD Outlet Orifice Plate

---

### Project Description

Solve For                      Diameter

### Input Data

Discharge	45.90	ft <sup>3</sup> /s	(16.5 H <sub>15</sub> + 29.4 P <sub>200</sub> )
Headwater Elevation	4.70	ft	
Centroid Elevation	0.00	ft	
Tailwater Elevation	0.00	ft	
Discharge Coefficient	0.60		

### Results

Diameter	2.37	ft
Headwater Height Above Centroid	4.70	ft
Tailwater Height Above Centroid	0.00	ft
Flow Area	4.40	ft <sup>2</sup>
Velocity	10.43	ft/s

---

## Worksheet for FSD Overflow - Pass

---

### Project Description

Solve For                      Discharge

### Input Data

Headwater Elevation		0.90	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Gravel		
Crest Breadth		12.00	ft
Crest Length		36.00	ft

### Results

Discharge	86.22	ft <sup>3</sup> /s
Headwater Height Above Crest	0.90	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	2.80	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	2.80	US
Flow Area	32.40	ft <sup>2</sup>
Velocity	2.66	ft/s
Wetted Perimeter	37.80	ft
Top Width	36.00	ft

$$(55 \text{ DSI} + 29.4 \text{ pass} = 84.4 \text{ cfs})$$



---

## Worksheet for FSD Overflow - Pass

---

### Project Description

Solve For                      Discharge

### Input Data

Headwater Elevation		0.90	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Gravel		
Crest Breadth		12.00	ft
Crest Length		36.00	ft

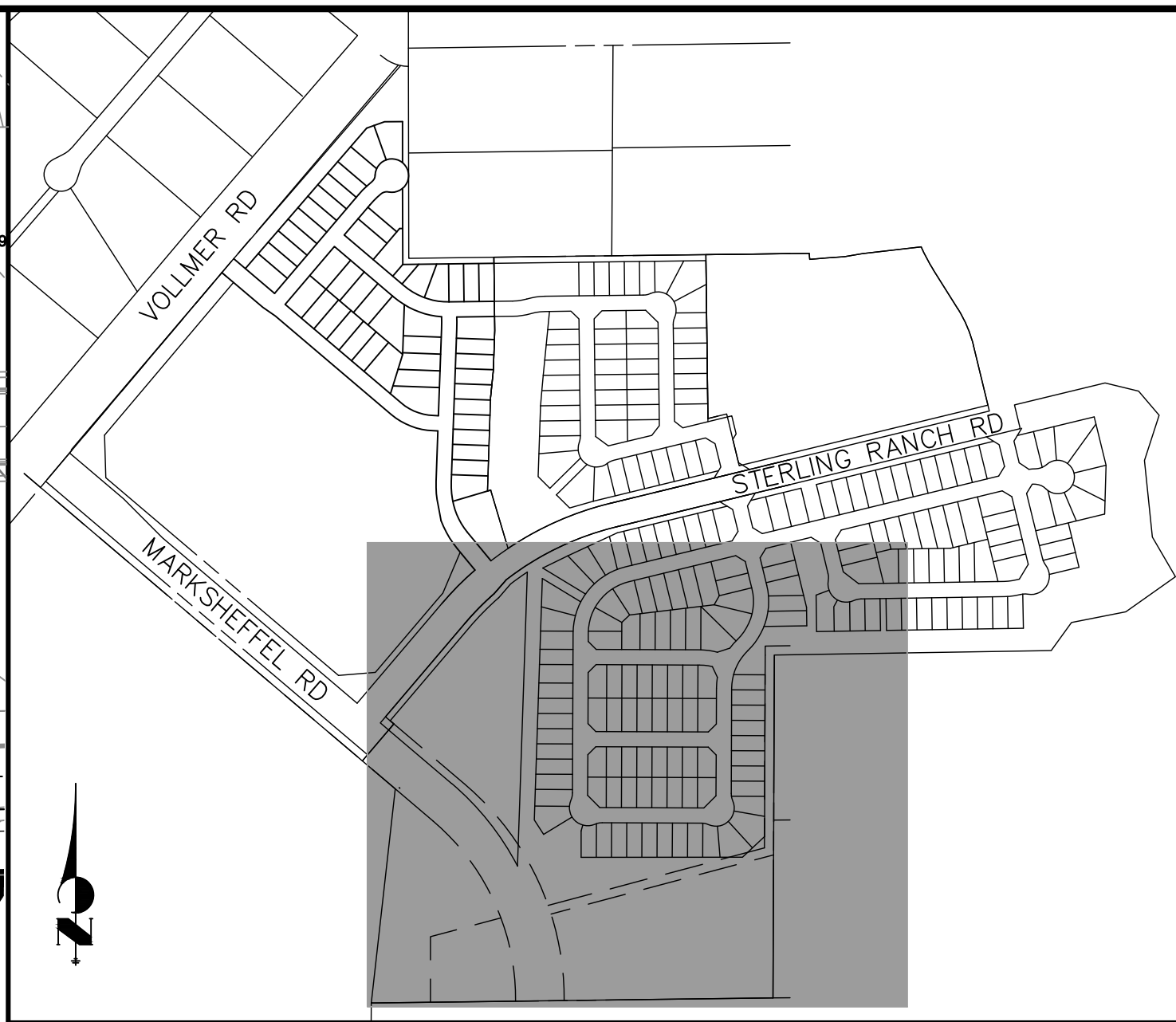
### Results

Discharge	86.22	ft <sup>3</sup> /s
Headwater Height Above Crest	0.90	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	2.80	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	2.80	US
Flow Area	32.40	ft <sup>2</sup>
Velocity	2.66	ft/s
Wetted Perimeter	37.80	ft
Top Width	36.00	ft

$$(55 \text{ DSI} + 29.4 \text{ pass} = 84.4 \text{ ft})$$







DESIGN POINT			
DP	Q5	Q100	Q100
	Total	Total	Total
1	4.4	9.4	9.4
2	1.9	3.9	3.9
3	11.1	24.7	24.7
4	3.7	7.4	7.4
5	4.1	19.6	19.6
6	3.3	6.7	6.7
6A	2.2	4.1	4.1
7	27.5	60.6	60.6
8	3.0	12.5	12.5
9	1.9	4.8	4.8
10	9.2	17.3	17.3
11	9.5	19.9	19.9
12	1.9	9.5	9.5
13	15.7	34.6	34.6
14	16.0	37.9	37.9
15	5.4	11.7	11.7
16	4.4	9.6	9.6
17	1.4	4.7	4.7
18	4.3	14.0	14.0
19	38.8	85.4	85.4
20	7.1	13.4	13.4
21	7.4	15.2	15.2
22	2.7	15.4	15.4
23	8.8	15.8	15.8
24	11.5	20.6	20.6
25	61.0	310.0	310.0
26	4.2	21.9	21.9
27	8.3	14.4	14.4
28	8.4	16.7	16.7
29	3.1	16.3	16.3
30	0.9	6.4	6.4
31	2.0	15.0	15.0
32	1.4	10.0	10.0
1.0	6.0	10.3	10.3
1.1	12.6	19.7	19.7
1.2	17.6	28.2	28.2
1.3	25.9	46.9	46.9
1.3A	5.0	8.7	8.7
1.4	52.5	105.9	105.9
1.5	55.1	103.9	103.9
1.6	56.4	107.7	107.7
1.7	17.3	25.3	25.3
1.8	68.8	125.0	125.0
2.0	23.2	74.5	74.5
2.1	38.1	106.6	106.6
2.2	56.9	138.7	138.7
2.3	9.6	17.2	17.2
2.4	63.7	151.9	151.9
2.5	96.6	250.7	250.7
2.6	97.8	250.4	250.4
2.7	162.0	336.8	336.8
2.8	189.8	424.4	424.4
2.9	14.2	22.5	22.5
3.0	189.8	424.4	424.4
3.1	14.2	22.5	22.5
3.2	187.5	428.2	428.2
4.0	18.4	26.1	26.1
4.1	56.2	264.7	264.7
4.2	16.0	31.0	31.0
4.3	49.9	293.1	293.1
4.4	3.1	3.1	3.1
4.5	51.2	51.2	51.2
4.6	56.7	245.8	245.8
4.7	58.5	248.6	248.6
4.8	59.9	320.3	320.3
OS2	13.8	39.1	39.1
OS3	17.6	48.9	48.9
OS4	2.6	8.5	8.5

BASIN SUMMARY TABLE									
Tributary	Area	Percent	C <sub>s</sub>	C <sub>100</sub>	t <sub>c</sub>	Q <sub>s</sub>	Q <sub>100</sub>		
Sub-basin	(acres)	Impervious			(min)	(cfs)	(cfs)		
A1	2.06	66%	0.51	0.65	9.7	4.4	9.4		
A2	0.82	69%	0.53	0.66	9.1	1.9	3.9		
A3	6.76	60%	0.47	0.62	15.0	11.1	24.7		
A4	1.51	77%	0.60	0.71	10.2	3.7	7.4		
A5	1.70	76%	0.59	0.70	9.9	4.1	8.3		
A6	1.37	75%	0.58	0.70	10.0	3.3	6.6		
A6A	0.53	95%	0.81	0.88	5.0	2.2	4.1		
A7	19.00	65%	0.45	0.59	18.3	27.5	60.6		
A8	1.48	63%	0.56	0.70	13.9	3.0	6.3		
A9	0.61	79%	0.73	0.83	8.7	1.9	3.7		
A10	2.61	86%	0.79	0.88	7.9	9.2	17.3		
A11	2.89	83%	0.76	0.86	8.7	9.5	18.1		
A12	3.87	8%	0.13	0.38	11.9	1.9	9.5		
A13	9.65	65%	0.45	0.59	14.0	15.7	34.6		
A14	11.76	55%	0.39	0.55	15.3	16.0	37.9		
A15	2.91	54%	0.52	0.68	14.9	5.4	11.7		
A16	2.34	56%	0.54	0.69	14.7	4.4	9.6		
A17	1.76	24%	0.21	0.44	13.7	1.4	4.7		
A18	5.27	21%	0.24	0.47	16.4	4.3	14.0		
A19	31.85	67%	0.45	0.59	25.8	38.8	85.4		
A20	1.83	89%	0.81	0.89	8.0	6.6	12.2		
A21	1.93	90%	0.82	0.90	8.7	6.8	12.6		
A22	8.68	5%	0.11	0.37	23.3	2.7	15.4		
B1	2.98	100%	0.90	0.96	17.6	8.8	15.8		
B2	3.89	100%	0.90	0.96	17.6	11.5	20.6		
B3	2.05	100%	0.90	0.96	9.4	7.8	14.0		
B4	1.94	100%	0.90	0.96	9.4	7.4	13.2		
B5	2.91	5%	0.08	0.35	13.1	0.9	6.4		
C1	8.01	95%	0.81	0.88	9.9	2.0	15.0		
C2	5.06	95%	0.81	0.88	7.9	1.4	10.0		
OS20	308.00	9%	0.13	0.40	68.9	61.0	310.0		
OS21A	20.26	12%	0.13	0.40	53.5	4.2	21.9		
OS21B	8.71	12%	0.13	0.40	24.5	3.1	16.3		
OS2	17.00	70%	0.49	0.62	36.0	13.8	39.1		
OS3	28.70	70%	0.49	0.62	52.6	17.6	48.9		
OS4	5.08	15%	0.20	0.40	29.5	2.6	8.5		

**LEGEND:**

- PROPOSED STORM SEWER
- 5000 FUTURE RD MAJOR CONTOUR
- 5000 FUTURE RD MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 5000 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- DRAINAGE BASIN
- A = BASIN DESIGNATION
- B = AREA IN ACRES
- C = 5-YR RUNOFF COEFFICIENT
- D = 100-YR RUNOFF COEFFICIENT
- DESIGN POINT
- HIGH POINT
- LOW POINT
- DRAINAGE ARROW
- EXISTING DRAINAGE ARROW
- PROPOSED DRAINAGE SWALE

DRAINAGE MAP  
STERLING RANCH FILING 2  
JOB NO. 25188.01  
4/16/21  
SHEET 1 OF 6



## **Appendix E**

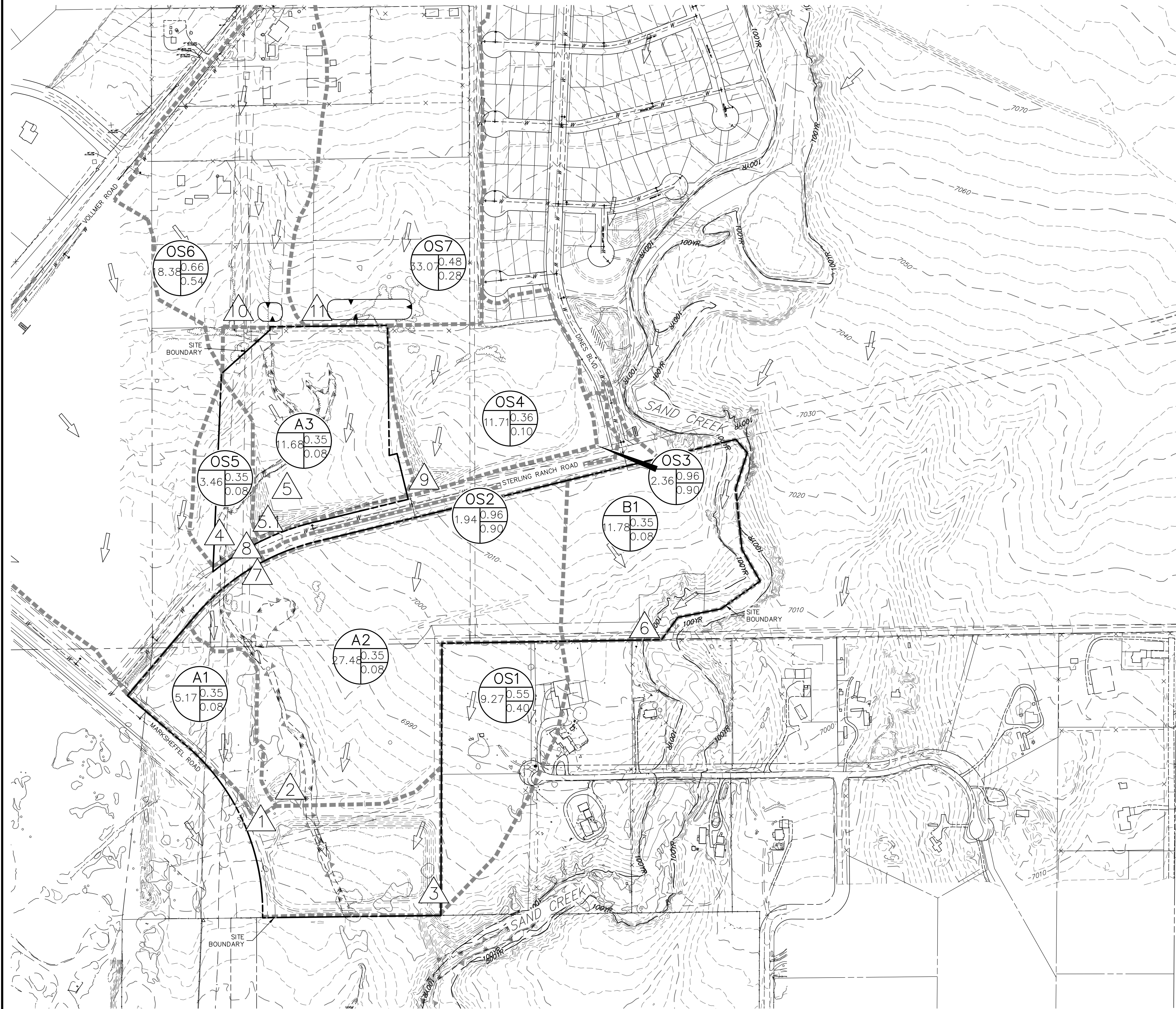
### **Drainage Maps**





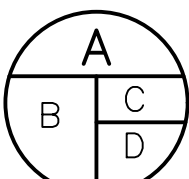
# STERLING RANCH PHASE 2

## EXISTING DRAINAGE MAP



### LEGEND

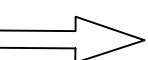
BASIN ID  
A: BASIN LABEL  
B: AREA  
C: C -100 YR  
D: C-5 YR



DESIGN POINT



EXISTING FLOW DIRECTION



BASIN DRAINAGE AREA



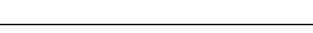
EXISTING STORM SEWER



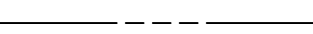
SITE BOUNDARY



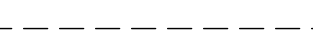
EXISTING PROPERTY LINE



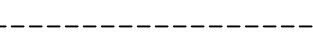
ROW EXISTING



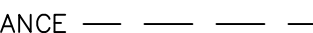
FL EXISTING



SIDEWALK EXISTING



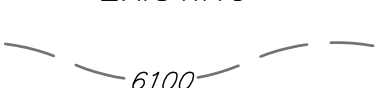
DRAINAGE ACCESS & MAINTENANCE



EASEMENT



EXISTING



### BASIN SUMMARY TABLE

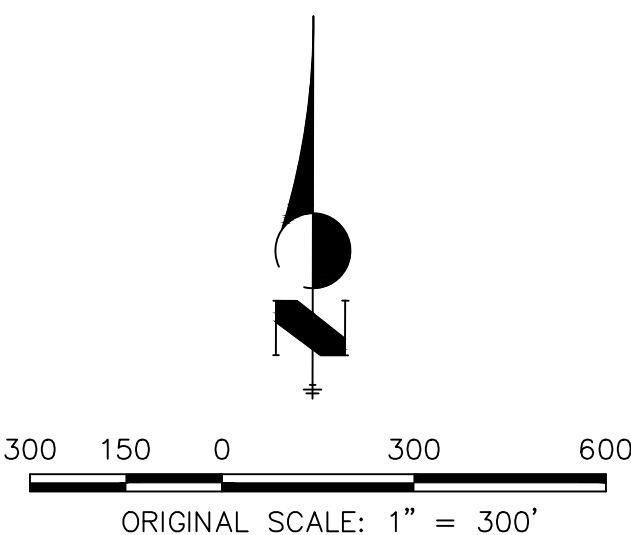
Tributary Sub-basin	Area (acres)	Percent Impervious	C <sub>s</sub>	C <sub>100</sub>	t <sub>c</sub> (min)	Q <sub>s</sub> (cfs)	Q <sub>100</sub> (cfs)
A1	5.17	2%	0.08	0.35	27.4	1.1	8.0
A2	27.48	0%	0.08	0.35	39.1	4.6	33.6
A3	11.68	0%	0.08	0.35	19.5	2.9	21.5
B1	11.78	0%	0.08	0.35	25.2	2.6	19.0
OS1	9.27	37%	0.40	0.55	23.7	10.5	24.4
OS2	5.00	100%	0.90	0.96	14.2	6.3	11.2
OS3	2.36	100%	0.90	0.96	12.2	8.1	14.6
OS4	11.71	4%	0.10	0.36	32.4	2.8	16.9
OS5	3.46	0%	0.08	0.35	30.4	0.7	5.0
OS6	18.38	11%	0.54	0.66	14.8	35.4	72.2
OS7	33.07	19%	0.28	0.48	34.7	20.6	60.4

### DESIGN POINT

DP	Q5 Total	Q100 Total
1	1.1	8.0
2	4.6	33.6
3	10.5	24.4
4	0.7	5.0
6	2.6	19.0
7	6.3	11.2
8	8.1	14.6
9	2.8	16.9
10	35.4	72.2
11	20.6	60.4
5	2.9	21.5
5.1	62.7	168.9

### TITLE

EXISTING GRADING ASSUMES FILING 2, STERLING RANCH ROAD, & MARKSHEFFEL ROAD ARE BUILT.



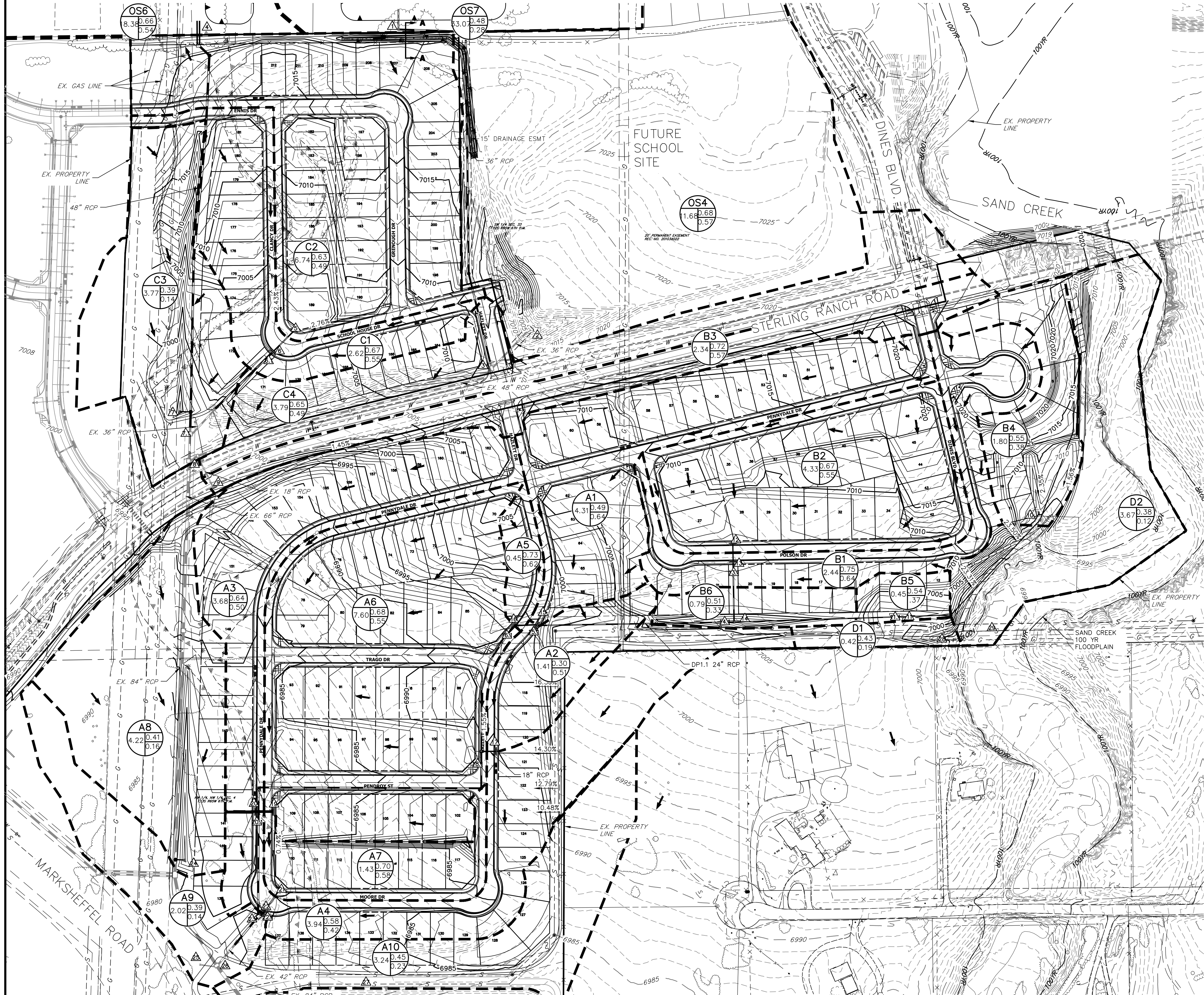
STERLING RANCH PHASE 2  
EXISTING DRAINAGE MAP  
JOB NO. 25188.02  
04/26/21  
SHEET 1 OF 1



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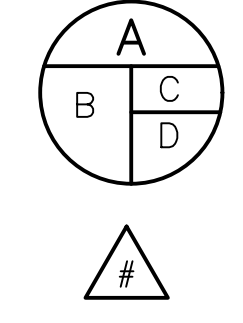


STERLING RANCH PHASE 2  
PROPOSED DRAINAGE MAP



LEGEND

BASIN ID  
A: BASIN LABEL  
B: AREA  
C: C-100 YR  
D: C-5 YR



DESIGN POINT

PROPOSED FLOW DIRECTION

BASIN DRAINAGE AREA

EXISTING STORM SEWER

STORM SEWER PROPOSED

PROPOSED R.O.W

PROPOSED PROPERTY LINES

PROPOSED SIDEWALK

EXISTING PROPERTY LINE

ROW EXISTING

FL EXISTING

SIDEWALK EXISTING

DRAINAGE ACCESS & MAINTENANCE

EASEMENT

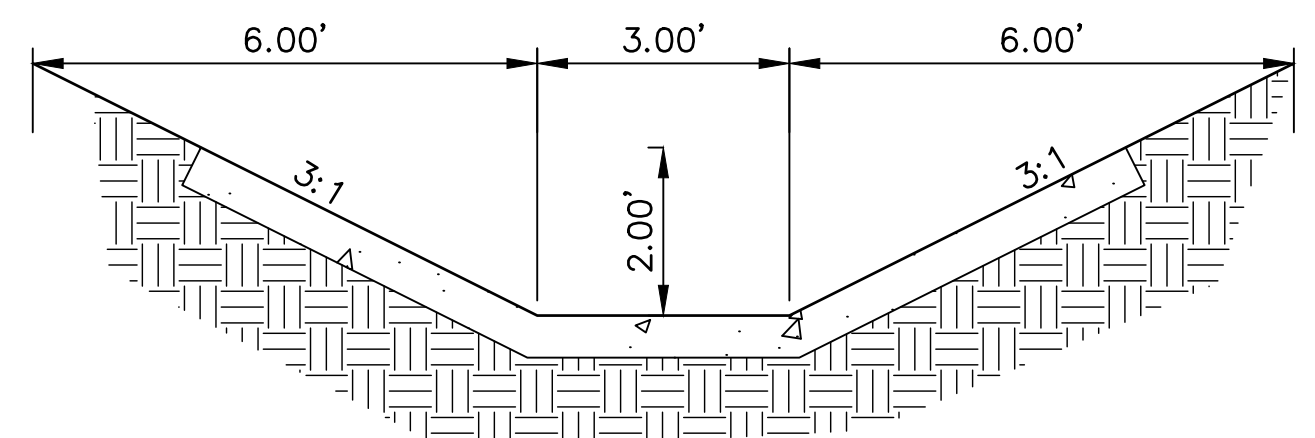


DESIGN POINT

DP	Q5	Q100
Total	Total	Total
1	20.6	60.4
2	20.5	40.5
3	34.8	88.5
4	35.4	72.2
5	12.0	25.9
6	5.5	11.4
6.1	17.0	36.4
7	2.2	9.9
7.1	52.0	113.1
8	4.6	10.2
9	3.5	7.3
10	2.3	5.6
11	0.7	1.7
11.1	2.8	6.8
12	9.1	18.7
13	6.2	12.0
13.1	15.0	30.3
14	0.8	2.2
14.1	16.1	34.1
15	8.1	17.4
15.1	21.8	43.9
16	1.4	2.9
16.1	22.7	45.6
17	2.0	8.5
18.1	24.2	53.1
19	15.3	31.4
20	6.8	14.6
20.1	37.9	74.7
21	7.5	21.7
22	5.7	17.2
22.1	12.9	37.9
23	48.6	107.2
24	2.2	9.1
25	0.7	3.5
27	2.4	8.0
28	0.3	1.3
29	1.9	10.5

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C <sub>s</sub>	C <sub>100</sub>	t <sub>c</sub> (min)	Q <sub>s</sub> (cfs)	Q <sub>100</sub> (cfs)
A1	4.31	64%	0.49	0.64	12.5	8.1	17.4
A2	1.41	31%	0.30	0.50	16.3	1.4	4.0
A3	3.68	65%	0.50	0.64	13.2	6.8	14.6
A4	3.94	52%	0.42	0.58	15.4	5.7	13.4
A5	0.45	78%	0.62	0.73	5.0	1.4	2.9
A6	7.60	73%	0.55	0.68	13.9	15.3	31.4
A7	1.43	75%	0.58	0.70	13.7	3.0	6.1
A8	4.22	13%	0.16	0.41	18.9	2.2	9.1
B1	2.44	80%	0.64	0.75	11.4	6.2	12.0
B2	4.33	73%	0.55	0.67	12.2	9.1	18.7
C1	2.62	69%	0.54	0.67	11.9	5.5	11.4
C2	6.74	63%	0.49	0.63	14.1	12.0	25.9
C3	3.77	10%	0.14	0.39	11.3	2.2	9.9
A9	2.02	8%	0.13	0.39	25.8	0.7	3.5
A10	3.23	24%	0.23	0.45	17.6	2.4	8.0
B6	0.78	44%	0.33	0.51	18.5	0.8	2.2
B5	0.45	51%	0.37	0.54	8.8	0.7	1.7
B4	1.80	51%	0.38	0.55	16.2	2.3	5.6
B3	2.36	61%	0.57	0.72	27.9	3.5	7.3
C4	3.79	55%	0.49	0.65	30.3	4.6	10.2
D1	0.42	12%	0.17	0.42	9.2	0.3	1.3
D2	3.67	5%	0.12	0.38	7.8	1.9	10.5
OS6	18.38	54%	0.54	0.66	14.8	35.4	72.2
OS4	11.71	56%	0.57	0.68	20.5	20.5	40.5
OS7	33.07	23%	0.28	0.48	34.7	20.6	60.4



SECTION AA  
OVERFLOW DITCH CROSS SECTION

OVERFLOW = 84.4 CFS  
VELOCITY = 8.66 FT/S  
SHEAR STRESS = 4.05 LB/FT<sup>2</sup>

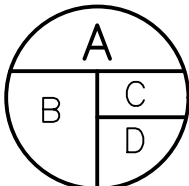
STERLING RANCH PHASE 2  
PROPOSED DRAINAGE MAP  
JOB NO. 25188.00  
04/27/21  
SHEET 1 OF 2



# STERLING RANCH PHASE 2 PROPOSED DRAINAGE MAP

## LEGEND

BASIN ID  
A: BASIN LABEL  
B: AREA  
C: C-100 YR  
D: C-5 YR



DESIGN POINT



PROPOSED FLOW DIRECTION



BASIN DRAINAGE AREA



EXISTING STORM SEWER



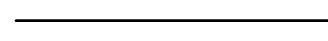
STORM SEWER PROPOSED



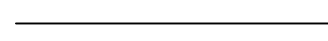
PROPOSED R.O.W



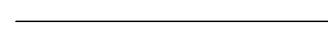
PROPOSED SIDEWALK



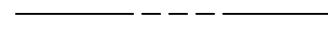
EXISTING PROPERTY LINE



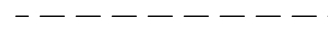
ROW EXISTING



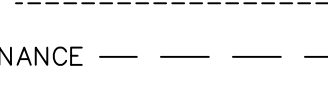
FL EXISTING



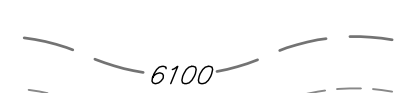
SIDEWALK EXISTING



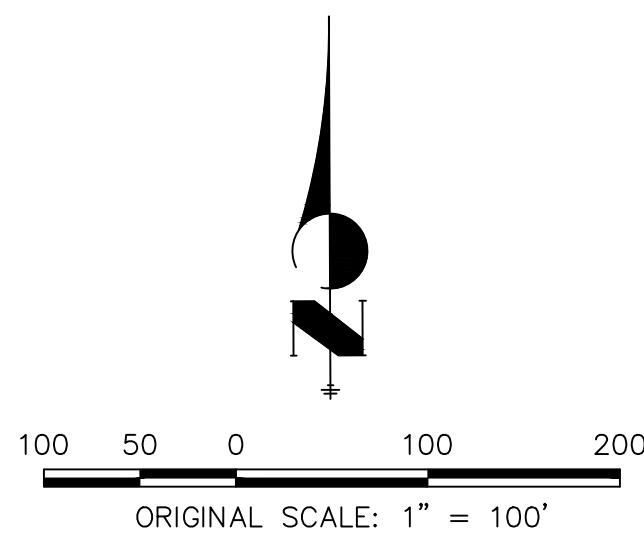
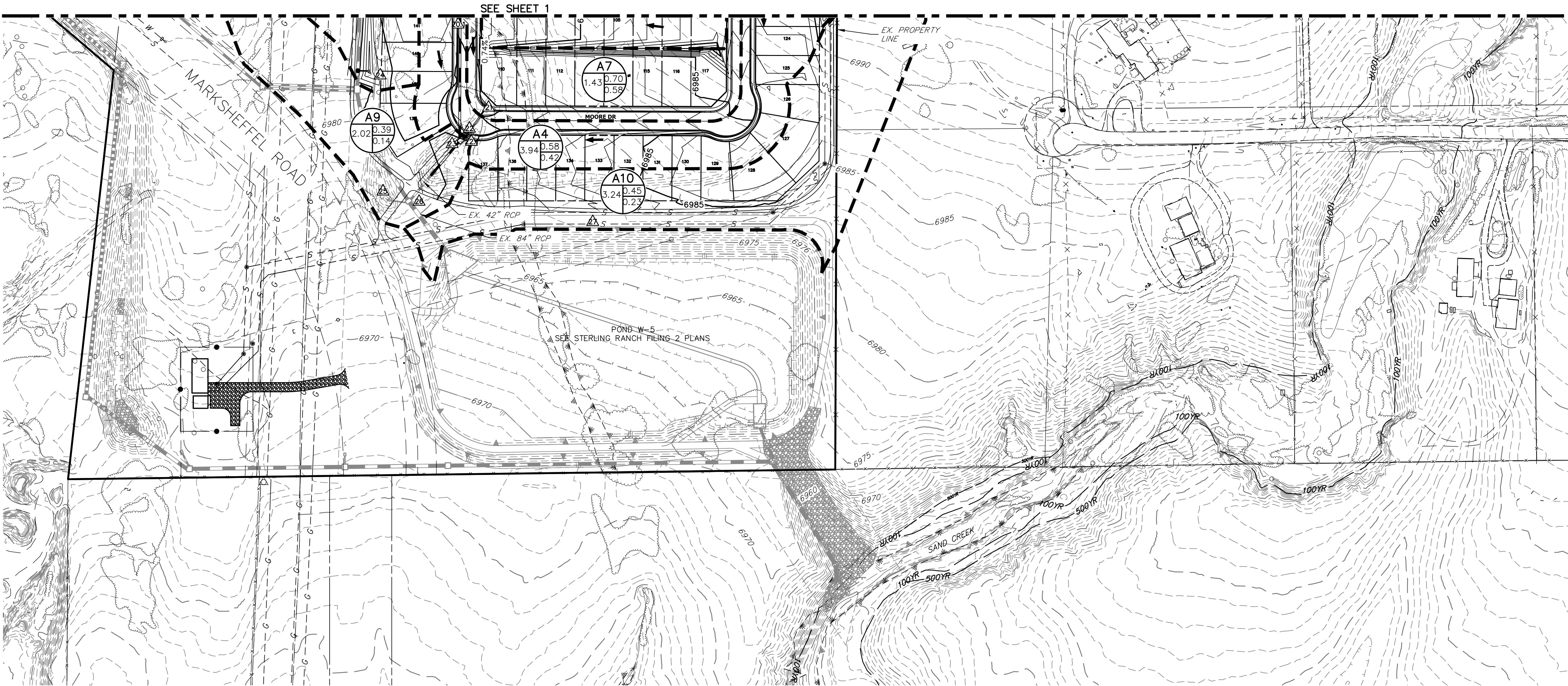
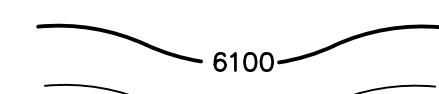
DRAINAGE ACCESS & MAINTENANCE  
EASEMENT



EXISTING



PROPOSED



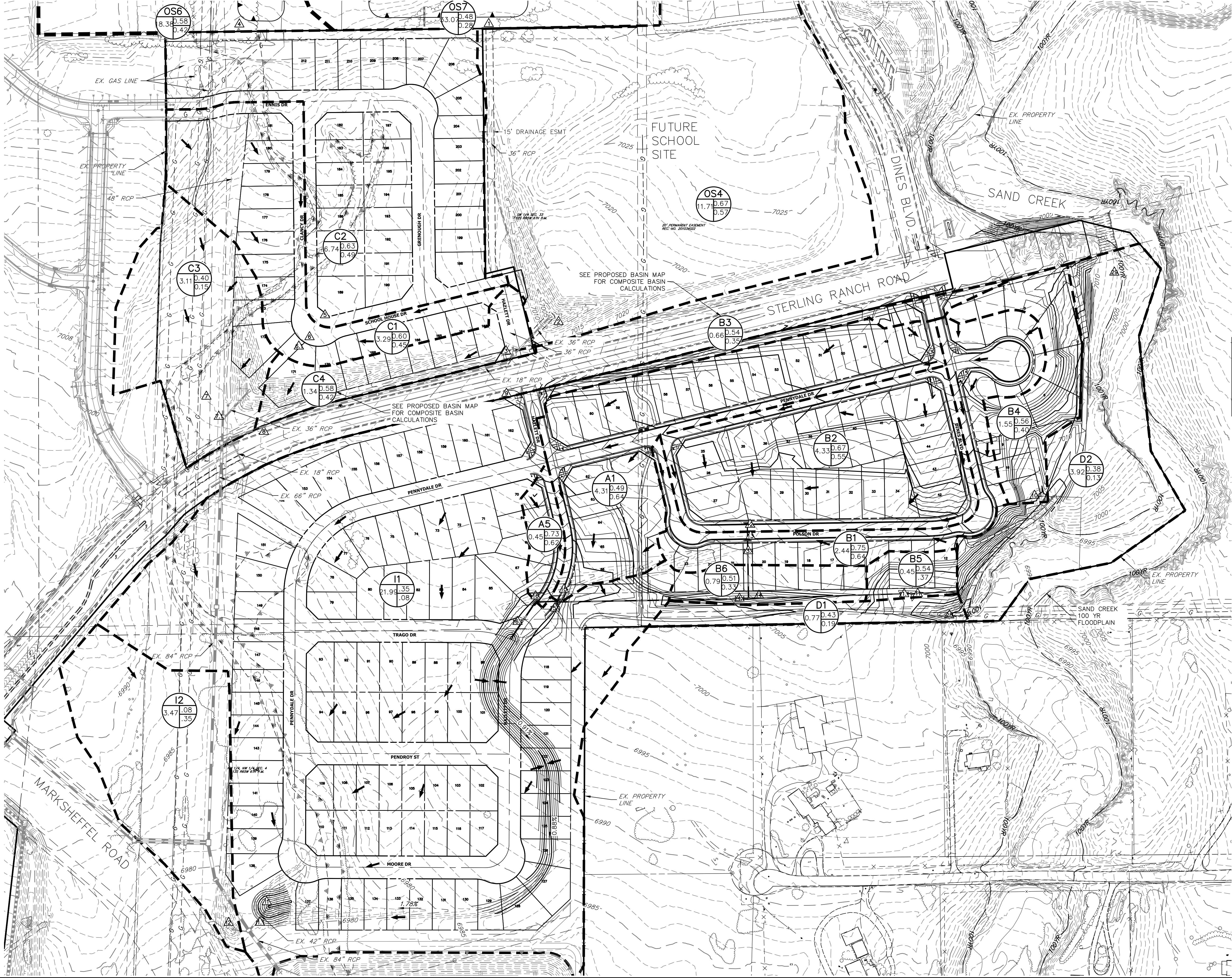
STERLING RANCH PHASE 2  
PROPOSED DRAINAGE MAP  
JOB NO. 25188.00  
04/27/21  
SHEET 2 OF 2

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STERLING RANCH PHASE 2  
INTERIM - PROPOSED DRAINAGE MAP



LEGEND

- BASIN ID  
A: BASIN LABEL  
B: AREA  
C: C-100 YR  
D: C-5 YR
- DESIGN POINT  
PROPOSED FLOW DIRECTION
- BASIN DRAINAGE AREA  
EXISTING STORM SEWER  
STORM SEWER PROPOSED  
PROPOSED R.O.W  
PROPOSED PROPERTY LINES  
PROPOSED SIDEWALK  
EXISTING PROPERTY LINE  
ROW EXISTING  
FL EXISTING  
SIDEWALK EXISTING  
DRAINAGE ACCESS & MAINTENANCE  
EASEMENT

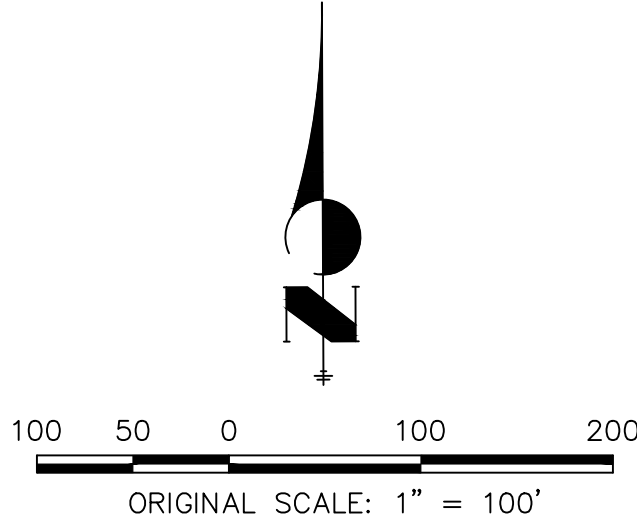
EXISTING PROPOSED

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C <sub>s</sub>	C <sub>100</sub>	t <sub>c</sub> (min)	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)
I1	21.99	1%	0.08	0.35	31.9	4.4	31.2
I2	3.47	0%	0.08	0.35	31.1	0.7	4.9

DESIGN POINT

DP	Q5	Q100
	Total	Total
I1	4.4	31.2
I1.1	22.1	68.4
I2	0.7	4.9



STERLING RANCH PHASE 2  
INTERIM CONDITION DRAINAGE MAP  
JOB NO. 25188.00  
10/01/20  
SHEET 1 OF 1

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