FINAL DRAINAGE REPORT
FOR
STERLING RANCH FILING 3

Prepared For:

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April 2022
Project No. 25188.02
SF-2132

Prepared By:

JR Engineering, LLC
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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. 32314
For and On Behalf of JR Engineering, LLC

COLORADO LICENSED MIKE BRAMLETT MB 32314 4/19/22 PROFESSIONAL ENGINEER

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.

APPROVED
Engineering Department
06/09/2022 2:23:25 PM
dsdnijkamp
EPC Planning & Community Development Department

County Engineer/ ECM Administrator

Date

Conditions:

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PURPOSE

This document is the Final Drainage Report for Sterling Ranch Filing 3. 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

GENERAL LOCATION

Sterling Ranch Filing 3 (hereby referred to as the "site") is a proposed development within the Sterling Ranch master planned community with a total area of approximately 19.5 acres that are presently undeveloped.

The site is located in portions of the southwest quarter of Section 33, Township 12 South, Range 65 West of the Sixth Principal Meridian in El Paso County, State of Colorado. The site is bounded by Pawnee Rancheros Filing 2 to the south and un-platted land to the west, Sterling Ranch Road to the north, and Sand Creek borders the site to east. 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 12 acres), as well as open space and drainage tracts (approximately 7.5 acres). 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 and southwest toward existing Pond W-5 (constructed with Sterling Ranch Filing No. 2).

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, JR Engineering 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. Grading is proposed in the floodplain at the northeast corner of the site to protect lots east of Dines Blvd. FIRM Maps have been presented in Appendix A.

EXISTING DRAINAGE CONDITIONS

MAJOR BASIN DESCRIPTIONS

The site lies within the Sand Creek Drainage Basin based **o**n 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, JR Engineering 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 an offsite basin. 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= 1.1cfs, Q_{100}=8.0cfs) is 5.17 acres and 0 percent impervious this basin is the east of the Sterling Ranch Filing 3 site. 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= 4.6cfs, Q_{100}=33.6cfs) 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 B1 (Q_5= 2.6cfs, Q_{100}=19.0cfs) 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 4.

Sub-basin OS1(Q_5= 13.4cfs, Q_{100}=29.8cfs) is 9.27 acres is 30.7 percent impervious and is located to the south of the Sterling Ranch Filing 3 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 sheet flows south to the existing detention pond built with Filing 2 and outfalls to Sand Creek.

PROPOSED DRAINAGE CONDITIONS

PROPOSED SUB-BASIN DRAINAGE

The proposed site was broken into three major basins: Basin A and I (western-portion), Basin B (eastern–portion) and Basin D (offsite eastern-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= 8.2cfs, Q_{100}=17.7cfs) is 4.37 acres and 64 percent impervious and is comprised of single-family residential lots, and a local road. Runoff from this basin drains to design point 15, a 15’ type R on grade inlet at the southwest corner of the basin.

Basin A5 (Q_5= 1.4cfs, Q_{100}=2.9cfs) is 0.45 acres and 78 percent impervious is comprised of future single-family residential lots and a local road. Runoff from this basin drains to an on grade 10’ inlet at design point 16.

Basin B1 (Q_5= 5.9 cfs, Q_{100}=11.8 cfs) is 2.44 acres and 77 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 15’ R sump inlet located at design point 13.

Basin B2 (Q_5= 9.1cfs, Q_{100}=18.7cfs) is 4.33 acres and 73 percent impervious is comprised of single family residential lots. Runoff from basin B2 drains to a type 15' R sump inlet located at design point 12.

Basin B3 (Q_5= 1.1 cfs, Q_{100}=2.4cfs) is 0.59 acres and 58 percent impervious is comprised of open space and sidewalk. Runoff from basin B3 drains to a 15' type R on grade inlet located west of the Sterling Ranch Filing 3 site at design point 9 in existing Sterling Ranch Road. All of the runoff is captured in the 100 year event. Runoff is piped and outfalls into pond W-5.

Basin B4 (Q_5= 2.2cfs, Q_{100}=5.1cfs) is 1.59 acres and 56 percent impervious is comprised of single family residential lots and open space. Runoff from basin B4 drains to four rear lot type C area inlet(s) that confluence at DP 10.

Basin B5 (Q_5=0.7cfs, Q_{100}=1.7cfs) 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=0.8cfs, Q_{100}=2.2cfs) 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 D1(Q_5= 0.4cfs, Q_{100}=1.2 cfs) is 0.38 acres and 18 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. The runoff is not treated and drains directly into Sand Creek. No residential development is within this basin. While the cumulative untreated area for Sterling Ranch Filing No.3 is more than 1 acre, a portion of this basin can be excluded per ECM APP1.7.1.B.9, given that the improvements within this basin include a trail and maintenance access road for Sand Creek. There is also a runoff reduction component in that runoff from the proposed trail sheet flow across grass areas.

Basin D2 (Q_5= 2.5cfs, Q_{100}=11.9 cfs) is 3.92 acres and 8 percent impervious is comprised of open space area and trail/access roads. Runoff from basin D2 sheet flows to the southeast into Sandcreek as per the historic condition. Flows generated from this basin have been attributed to design point 29. The runoff is not treated and drains directly into Sand Creek. No residential development is within this basin. While the cumulative untreated area for Sterling Ranch Filing No.3 is more than 1 acre, a portion of this basin can be excluded per ECM APP1.7.1.B.9 and APP1.7.1.B.8 given that the improvements within this basin include bank stabilization for Sand Creek and a trail/ maintenance access road for Sand Creek. The north part of this basin borders the future Sterling Ranch Road, wherein the interim conditions, the area will remain undeveloped, and when the road is built, the runoff will be conveyed east to a future water quality and detention pond where water quality will be provided for the street runoff. There is also a runoff reduction component in that runoff from the proposed trail sheet flow across grass areas.

Basin I1 (Q_5= 5.2 cfs, Q_{100}=35.1 cfs) 24.5 acres and 1 percent impervious is comprised of open space, tail/ access roads and planned future development that has been accounted within pond W5's design in the Sterling Ranch Filing No. 2 Drainage Report as shown in Appendix D. 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= 0.7cfs, Q_{100}=4.9cfs) 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 a 42" existing storm stub provided from the Sterling Ranch Filing No 2. Project.

DRAINAGE DESIGN CRITERIA

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

Table 2 - 1-hr Point Rainfall Data

Storm	Rainfall (in.)
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. Autodesk Hydraflow express was used to size the overflow channel and an interim swale. Using Storm StormCAD V8i, a modeling program for stormwater drainage, the hydraulic grade lines and energy grade lines were determined for the storm sewer network. Manhole and pipe losses for the model were obtained from the *Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computation Methods*, by AMEC Earth & Environmental, Inc. The manhole loss coefficients used in the model can be seen in Table 2. StormCAD, Autodesk Hydraflow results along with street and inlet capacities are presented in Appendix C.

Table 2 - StormCAD Standard Method Conversions

StormCAD Conversion Table			
Bend Loss	Bend Angle	K coefficient Conversion	
	0	0.05	
	22.5	0.1	
	45	0.4	
	60	0.64	
	90	1.32	
Lateral Loss	1 Lateral K coefficient Conversion		
	Bend Angle	Non Surcharged	Surcharged
	45	0.27	0.47
	60	0.52	0.9
	90	1.02	1.77
	2 Laterals K coefficient Conversion		
	45	0.96	
	60	1.16	
	90	1.52	

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The proposed stormwater conveyance system was designed to convey the developed Sterling Ranch Filing 3 runoff to an existing (Filing 2) full spectrum water quality and detention pond via storm sewer and swale. 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 Engineering Manual County of El Paso, Colorado Appendix I, Section 7.2 this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes Employ Runoff Reduction Practices, Stabilize Drainageways, Provide Water Quality Capture Volume (WQCV), and Consider Need for Industrial and Commercial BMPs.

Step 1 – Employ Runoff Reduction Practices: The Sterling Ranch Filing 3 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 – Provide Water Quality Capture Volume (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 and swale. 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 – Consider Need for Industrial and Commercial BMPs: There are no commercial or industrial facilities on the Sterling Ranch Filing 3 site. Other erosion control BMPs include asphalt drives and parking, storm inlets and storm pipe, the full spectrum detention pond W-5 and permanent vegetation. The interim channel for Sterling Ranch Filing 3 will be accessible for maintenance with the access trail to the east. Maintenance responsibilities and plans for pond W5 were provided with Filing 2. A channel maintenance agreement for Sand Creek will be provided with Filing 3.

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

The Erosion Control Plan and Cost Estimate have been submitted in conjunction with the grading and erosion control plan and construction assurances will be 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. 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 FILING 3				
Impervious Acres (ac)	**Drainage Fee (Per Imp. Acre)**	**Bridge Fee (Per Imp. Acre)**	**Sterling Ranch Drainage Fee**	**Sterling Ranch Bridge Fee**
10.518	$20,387	$8,339	$214,430.47	$87,709.60

The developed condition of tract C was used to calculate the overall impervious area. The total area used was 20.9116 Acres and the net impervious value is 50.3%.

Construction Cost Opinion

The Drainage Criteria Manual specifies a Cost Estimate of proposed drainage facility improvements be submitted with the Final Drainage Report. A construction cost opinion has been provided below. The below cost opinion is only an estimate of facility and drainage infrastructure cost and may vary.

Sterling Ranch Filing No. 3 (Public Non-Reimbursable)

Item	Description	Quantity	Unit	Unit Price	Cost
1	18" RCP	1138	L.F.	$ 67	$ 76,246.00
2	24" RCP	126	L.F.	$ 81	$ 10,206.00
3	36" RCP	512	L.F.	$ 124	$ 63,488.00
4	36" FES	1	Ea.	$ 600	$ 600.00
5	15' CDOT Type R At-Grade	3	Ea.	$ 11,005	$ 33,015.00
6	10' CDOT Type R At-Grade	1	Ea.	$ 8,136	$ 8,136.00
7	CDOT TYPE C	5	Ea.	$ 4,802	$ 24,010.00
8	CDOT TYPE D	1	Ea.	$ 5,932	$ 5,932.00
9	Storm Sewer MH, box base	1	Ea.	$ 12,034	$ 12,034.00
				Sub-Total	$ 233,667.00

Sterling Ranch Filing No. 3 (Bridge - Reimbursable)

Item	Description	Quantity	Unit	Unit Price	Cost
1	58S Bridge (see FAE CDR 22-6	1	Ea.	$ 750,000	$ 750,000.00
				Sub-Total	$ 750,000.00

The approved Sterling Ranch Filing 2 Final Drainage Report identified reimbursable improvements for both the pond W-4 and W-5 major drainage facilities in lieu of DBPS Segment 159 and 164 identified improvements. These reimbursable improvements are to be built per the approved Sterling Ranch Filing 2 Storm Sewer plans (SF-2015). The anticipated cost of these reimbursable improvements exceeded the Drainage Fees associated with Sterling Ranch Filing 2.

Per LDC section 8.5.5.C.3.b(ii) Fee Reductions, Credits or Reimbursement for Facilities, this development requests that no cash drainage fees or bridge fees are due at platting as the value of reimbursable DBPS improvements for the Sand Creek Tributary segment 159 and 164 shown in the below table minus deferments taken previously for Sterling Ranch Filing 2 exceed the drainage fee estimate for Sterling Ranch Filing 3. Additionally, the reimbursable bridge structure estimated value is well in excess of the bridge fees due for this subdivision

Sterling Ranch Deferred Drainage Fees Analysis
Reimbursable Costs associated with DBPS Segment 159 and 164

From Sterling Ranch Filing 2 FDR (SF-2015)	
Reimbursable Cost estimate associated with Pond W-4 System	$1,218,336.00
Reimbursable Cost estimate associated with Pond W-5 System	$699,729.00
Subtotal Segment 159 and 164 E	$1,918,065.00
Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	$400,855.70
Excess Reimb. Costs associated with DBPS Segment 159 and 164	$1,517,209.30
Sterling Ranch Filing 3 Drainage Fee Deferment	
Excess Reimb. Costs associated with DBPS Segment 159 and 164	$1,517,209.30
Drainage Fees for Sterling Ranch Filing 3	$214,430.47

SUMMARY

The proposed Sterling Ranch Filing 3 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

1. Engineering Criteria Manual County of El Paso, Colorado, October, 14 2020

2. "Sand Creek Channel Design Report", prepared by JR Engineering, October, 2021 (under review)

3. "Master Development Drainage Plan for Sterling Ranch", (MMDP) prepared by M&S Civil Consultants, Inc., dated October 24, 2018.

4. "MDDP Amendment No. 1 for Sterling Ranch", prepared JR Engineering, October 2021 (under review)

5. "Sand Creek Drainage Basin Planning Study", prepared Kiowa Engineering Corporation, January 1993, revised March 1996.

6. "Sterling Ranch Filing 2 Final Drainage Report", prepared by JR Engineering, dated August 2021 (Approved in November)

7. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.

8. Sand Creek Stabilization at Aspen Meadows Subdivision Filing No. 1 – 100% Design Plans, April 2020

REFERENCES

1. Engineering Criteria Manual County of El Paso, Colorado, October, 14 2020

2. “Sand Creek Channel Design Report”, prepared by JR Engineering, October, 2021 (under review)

3. "Master Development Drainage Plan for Sterling Ranch", (MMDP) prepared by M&S Civil Consultants, Inc., dated October 24, 2018.

4. “MDDP Amendment No. 1 for Sterling Ranch”, prepared JR Engineering, October 2021 (under review)

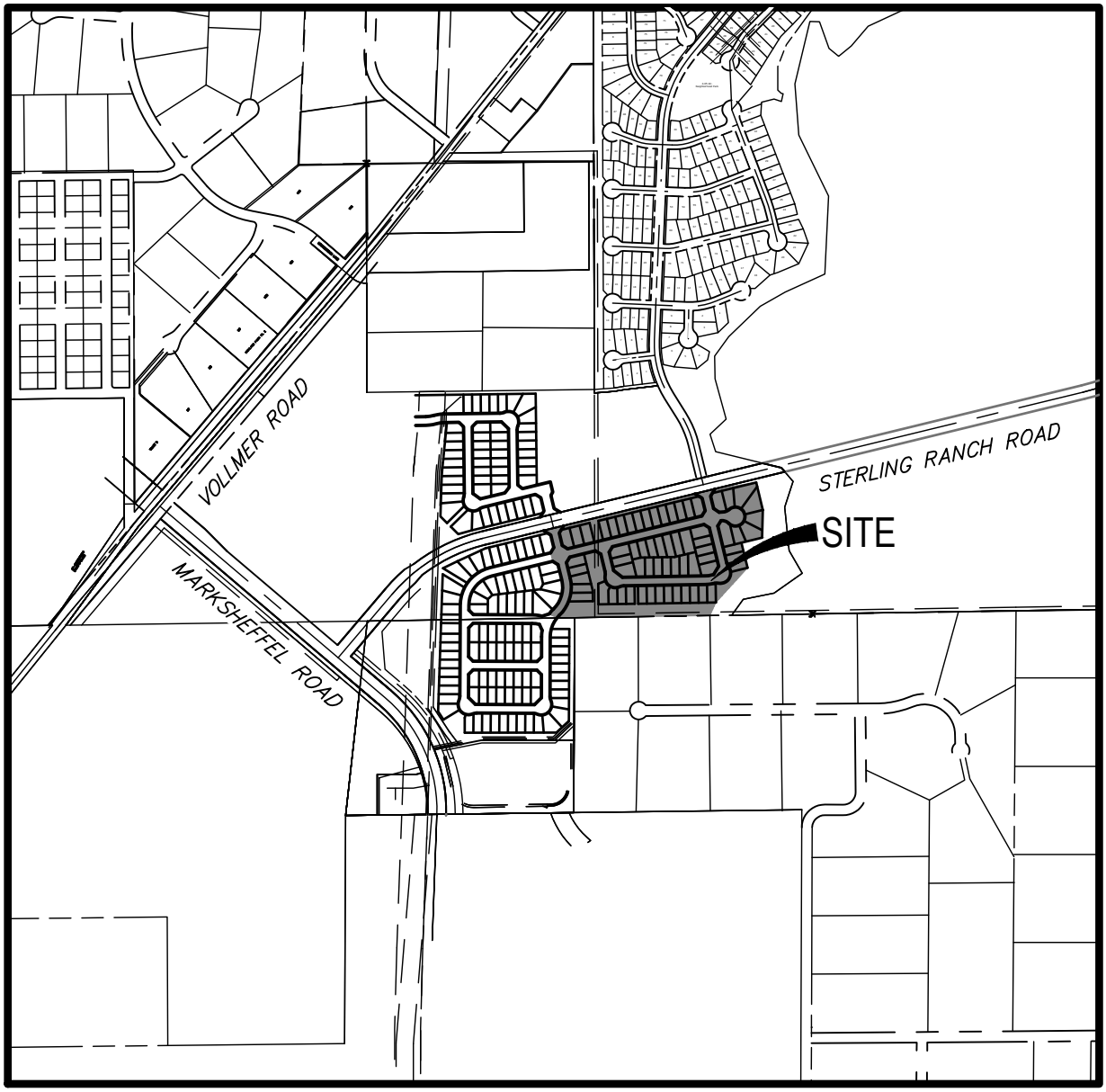
5. “Sand Creek Drainage Basin Planning Study”, prepared Kiowa Engineering Corporation, January 1993, revised March 1996.

6. “Sterling Ranch Filing 2 Final Drainage Report”, prepared by JR Engineering, dated August 2021 (Approved in November)

7. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.

8. 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

SCALE: 1" = 1000'

VICINITY MAP
STERLING RANCH FILING 3
JOB NO. 25188.02
06/09/21
SHEET 1 OF 1

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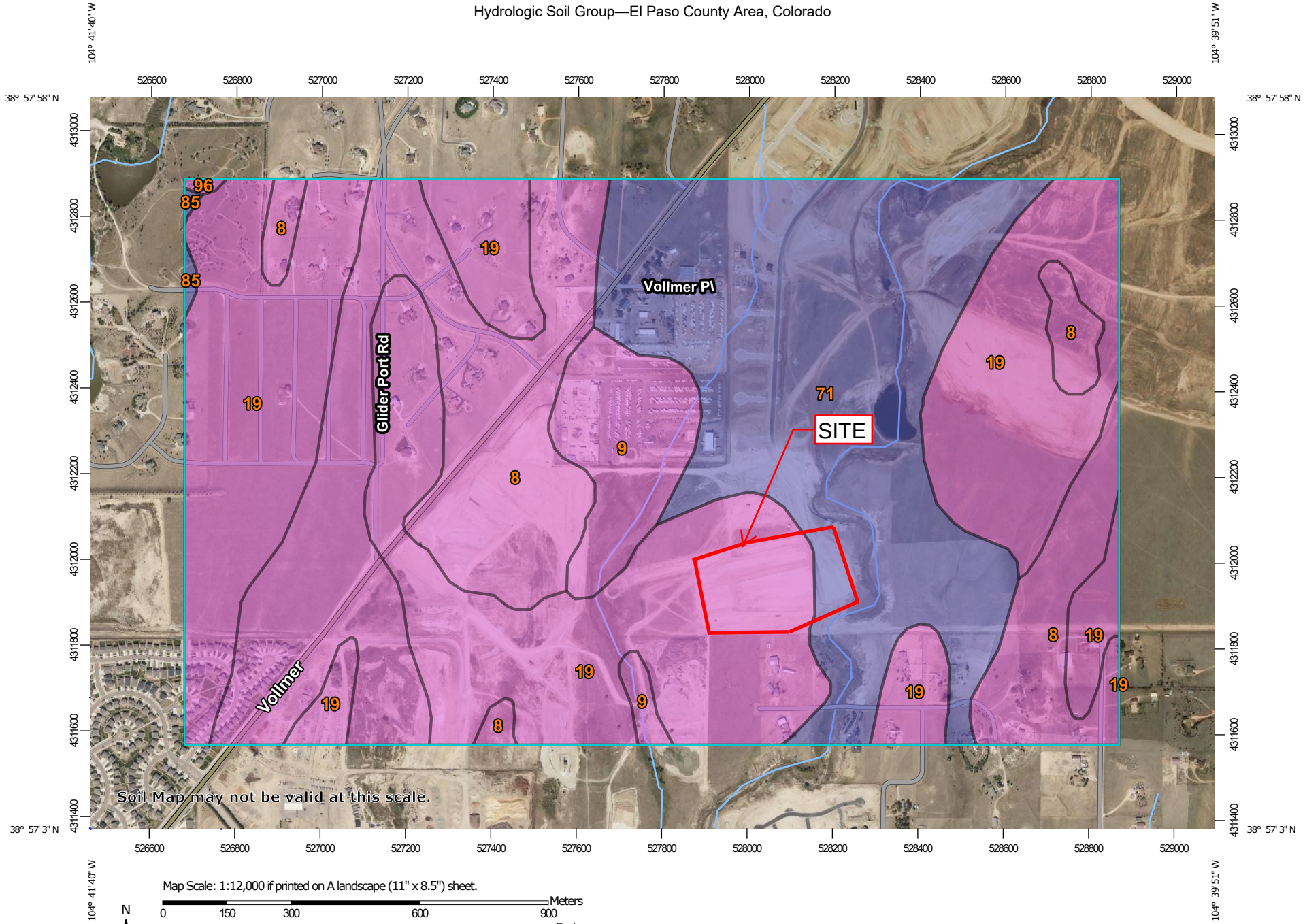
X:\2510000.all\2518800\Drawings\Blocks\Vicinity Map-SR PH2 (Early Grading-Utility).dwg, 8.5x11 Portrait, 6/9/2021 8:28:35 AM, FC



Map Scale: 1:12,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 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%
Totals for Area of Interest			**716.9**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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 zones used in the production of FIRMs 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, N/NGS12
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 (301) 713-3242 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 dates 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/.

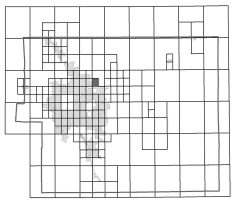
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

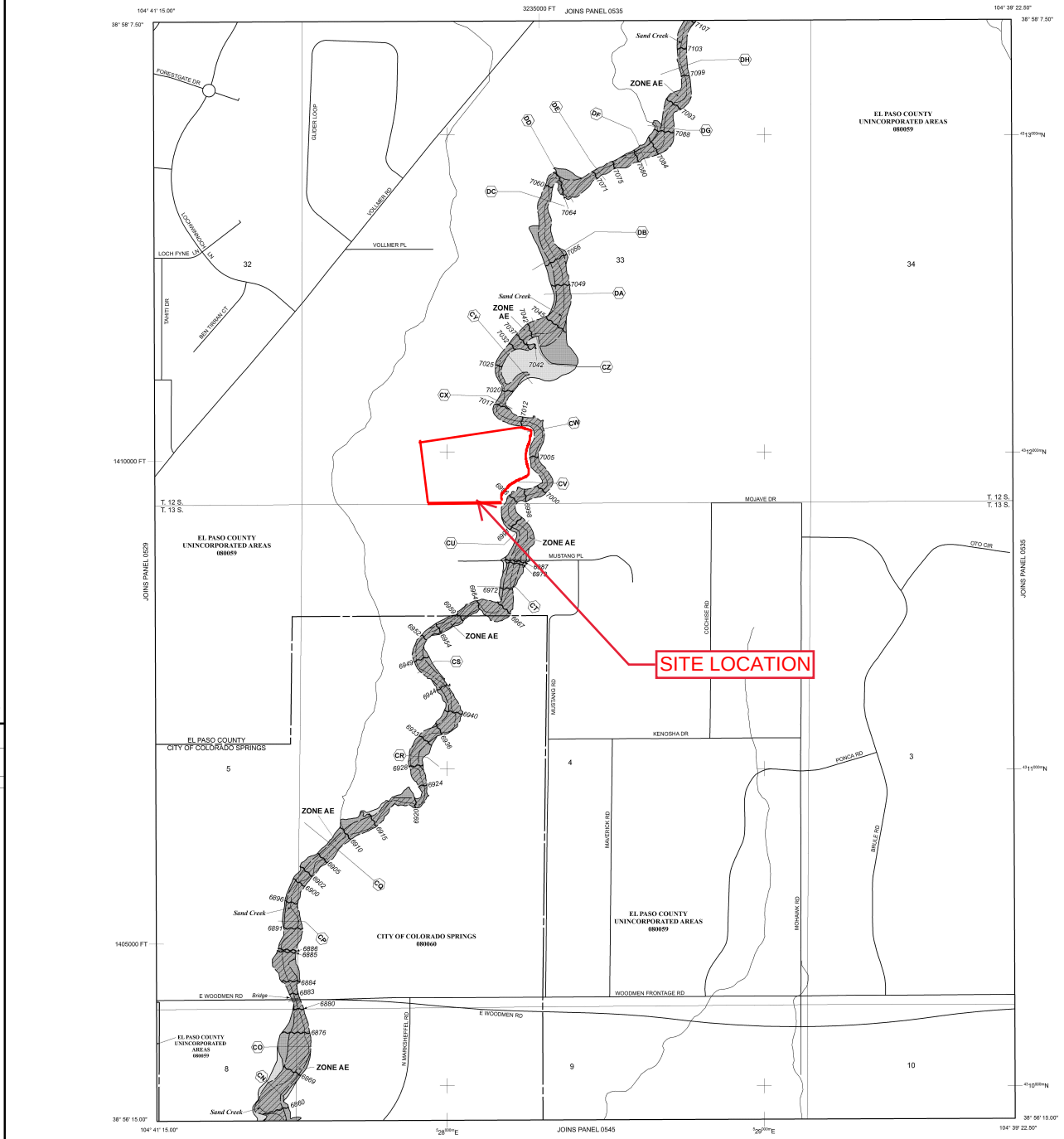
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
PANEL 0533G

NATIONAL FLOOD INSURANCE PROGRAM

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	080060	0533	G
EL PASO COUNTY	080059	0533	G

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

MAP NUMBER
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 Filing 3
Project No.: 25188.02
Calculated By: CJD
Checked By:
Date: 6/9/21

Basin ID	Total Area (ac)	Streets (100% Impervious)				Residential (65% Impervious) Neighborhood Area (70% Impervious)				1 Acre lot Rersidential (20% Impervious) Light Commercial (80% Impervious)				Lawns (0% Impervious) School (55% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
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%
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%
TOTAL (A1-B1)	44.43																			0.2%
TOTAL	53.70																			6.6%

EXISTING
STANDARD FORM SF-2
TIME OF CONCENTRATION

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

Project Name: Sterling Ranch Filing 3
Project No.: 25188.02
Calculated By: CJD
Checked By:
Date: 6/9/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (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
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

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = 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 Filing 3
Project No.: 25188.02
Calculated By: CJD
Checked By:
Date: 6/9/21

STREET	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)	tc (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	0.08	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	B1	11.78	0.08	25.2	0.94	2.74	2.6															Basin OS1

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 Filing 3
Project No.: 25188.02
Calculated By: CJD
Checked By:
Date: 6/9/21

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)	tc (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	B1	11.78	0.35	25.2	4.12	4.60	19.0															Basin OS1

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
Location: El Paso County

Project Name: Sterling Ranch Filing 3
Project No.: 25188.02
Calculated By: CJD
Checked By:
Date: 4/12/22

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_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A1	4.37	0.90	0.96	0.92	21.1%	0.45	0.59	2.86	42.5%	0.59	0.70	0.00	0.0%	0.08	0.35	0.59	0.0%	0.49	0.64	63.6%
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	24.50	0.90	0.96	0.26	1.1%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	24.24	0.0%	0.09	0.36	1.1%
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	1.28	34.2%	0.59	0.70	0.00	0.0%	0.08	0.35	0.12	0.0%	0.62	0.74	76.8%
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%
B6	0.79	0.90	0.96	0.00	0.0%	0.45	0.59	0.53	43.6%	0.59	0.70	0.00	0.0%	0.08	0.35	0.26	0.0%	0.33	0.51	43.6%
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	1.59	0.90	0.96	0.00	0.0%	0.45	0.59	1.36	55.6%	0.59	0.70	0.00	0.0%	0.08	0.35	0.23	0.0%	0.40	0.56	55.6%
B3	0.59	0.90	0.96	0.34	57.6%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.25	0.0%	0.55	0.70	57.6%
D1	0.38	0.90	0.96	0.07	17.6%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.31	0.0%	0.22	0.46	17.6%
D2	3.92	0.90	0.96	0.31	7.8%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	3.61	0.0%	0.14	0.40	7.8%
Impervious Area in Platted Filing 3	20.9116	0.90	0.96	3.99	19.1%	0.45	0.59	10.05	31.2%	0.59	0.70	0.00	0.0%	0.08	0.35	6.87	0.0%	0.41	0.58	50.3%
Basin A,B,D TOTAL	19.31																			53.4%
TOTAL	47.28																			22.4%

PROPOSED
STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Sterling Ranch Subdivision
Location: El Paso County

Project Name: Sterling Ranch Filing 3
Project No.: 25188.02
Calculated By: CJD
Checked By:
Date: 4/12/22

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A1	4.37	A	64%	0.49	0.64	79	1.7%	8.2	1007	3.7%	20.0	3.8	4.4	12.5	1086.0	20.1	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	24.50	A	1%	0.09	0.36	793	3.1%	35.4	627	3.7%	10.0	1.9	5.4	40.8	1420.0	31.8	31.8
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	77%	0.62	0.74	50	2.5%	4.5	1066	1.6%	20.0	2.5	7.1	11.6	1116.0	20.1	11.6
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
B6	0.79	A	44%	0.33	0.51	246	1.5%	19.2	0	1.0%	20.0	2.0	0.0	19.2	246.0	18.6	18.6
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	1.59	B	56%	0.40	0.56	222	11.0%	8.6	914	1.1%	20.0	2.1	7.4	16.0	1136.0	25.4	16.0
B3	0.59	A	58%	0.55	0.70	165	3.4%	8.5	612	2.7%	10.0	1.6	6.2	14.7	777.0	19.9	14.7
D1	0.38	A	18%	0.22	0.46	16	2.0%	5.0	570	6.0%	10.0	2.4	3.9	8.9	586.0	26.4	8.9
D2	3.92	A	8%	0.14	0.40	105	25.0%	6.1	975	50.0%	15.0	10.6	1.5	7.6	1080.0	26.9	7.6

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = 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 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

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

Project Name: Sterling Ranch Filing 3
Project No.: 25188.02
Calculated By: CJD
Checked By:
Date: 4/12/22

		DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (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)	REMARKS
	9	B3	0.59	0.55	14.7	0.33	3.55	1.2															Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road
	10	B4	1.59	0.40	16.0	0.63	3.43	2.2								2.2	0.63	1.0	12	380	4.7	1.4	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	0.80	3.30	2.6				2.6	0.80	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	0.62	11.6	1.52	3.91	5.9															Sump Inlet Piped to DP 13.1
	13.1								12.3	3.89	3.82	14.9				14.9	3.89	1.0	24	125	7.6	0.3	Piped to DP 14.1
	14	B6	0.79	0.33	18.6	0.26	3.20	0.8															Area Inlet Piped to DP 14.1
	14.1								18.6	4.95	3.20	15.8				15.8	4.95	1.0	24	415	7.7	0.9	Piped to DP 15.1
	15	A1	4.37	0.49	12.5	2.16	3.79	8.2					0.8	0.21	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								19.5	7.11	3.13	22.2				22.2	7.11	1.0	24	45	8.2	0.1	On-grade Inlet Captured Flows piped to DP 16.1
	16	A5	0.45	0.62	5.0	0.28	5.16	1.4															On-grade Inlet Captured Flows piped to DP 16.1
	16.1								19.6	7.39	3.12	23.1				23.1	7.39	1.0	24	125	8.2	0.3	FES release to drainage channel
	I1	I1	24.50	0.09	31.8	2.17	2.40	5.2															FES
	I1.1								31.8	9.56	2.40	22.9				22.9	9.56	0.4	42	62	6.1	0.2	Combined flow from DPI1 & DP16.1 Piped to Existing 84" RCP
	I2	I2	3.47	0.08	31.1	0.28	2.43	0.7															Piped to Existing 84" RCP
	28	D1	0.38	0.22	8.9	0.09	4.30	0.4															Sheet flow to Sand Creek
	29	D2	3.92	0.14	7.6	0.56	4.53	2.5															Sheet flow to 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
Location: El Paso County
Design Storm: 100-Year

Project Name: Sterling Ranch Filing 3
Project No.: 25188.02
Calculated By: CJD
Checked By:
Date: 4/12/22

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)	
	9	B3	0.59	0.70	14.7	0.41	5.96	2.4															Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road
	10	B4	1.59	0.56	16.0	0.88	5.75	5.1								5.1	0.88	1.0	12	380	6.5	1.0	Rear lot and area inlets 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								17.0	1.12	5.60	6.3				6.3	1.12	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	0.74	11.6	1.80	6.56	11.8															Sump Inlet Piped to DP 13.1
	13.1								12.3	4.70	6.42	30.2				30.2	4.70	1.0	24	125	9.6	0.2	Piped to DP 14.1
	14	B6	0.79	0.51	18.6	0.40	5.37	2.1															Area Inlet Piped to DP 14.1
	14.1								18.6	6.22	5.37	33.4				33.4	6.22	1.0	24	415	10.6	0.7	Piped to DP 15.1
	15	A1	4.37	0.64	12.5	2.78	6.37	17.7					10.3	1.618	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								19.2	9.00	5.28	47.6				47.6	9.00	1.0	24	45	15.2	0.0	On-grade Inlet Captured Flows piped to DP 16.1
	16	A5	0.45	0.73	5.0	0.33	8.66	2.9															On-grade Inlet Captured Flows piped to DP 16.1
	16.1								19.3	9.33	5.28	49.2				49.2	9.33	1.0	24	125	15.7	0.1	FES release to drainage channel
	I1	I1	24.50	0.36	31.8	8.73	4.02	35.1															FES
	I1.1								31.8	18.06	4.02	72.6				72.6	18.06	0.4	42	62	7.6	0.1	Combined flow from DPI1 & DP16.1 Piped to Existing 84" RCP
	I2	I2	3.47	0.35	31.1	1.21	4.07	4.9															Piped to Existing 84" RCP
	28	D1	0.38	0.46	8.9	0.17	7.22	1.2															Sheet flow to Sand Creek
	29	D2	3.92	0.40	7.6	1.56	7.61	11.9															Sheet flow to 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

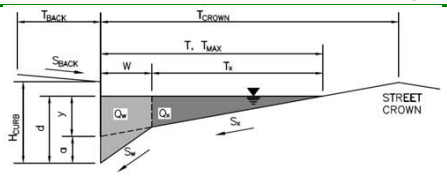
Version 4.05 Released March 2017

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	T_{BACK} =	5.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.033	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

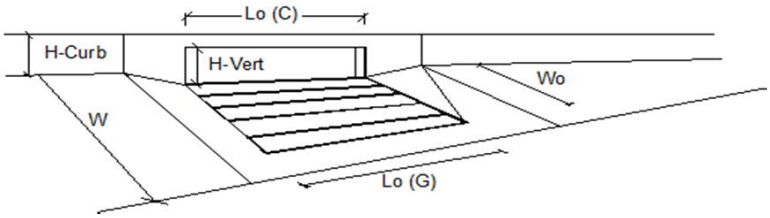
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**21.2**	**24.3**	**cfs**

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

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**7.8**	**12.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**5.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**96**	**71**	**%**

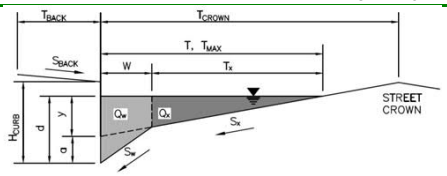
Version 4.05 Released March 2017

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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.8	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

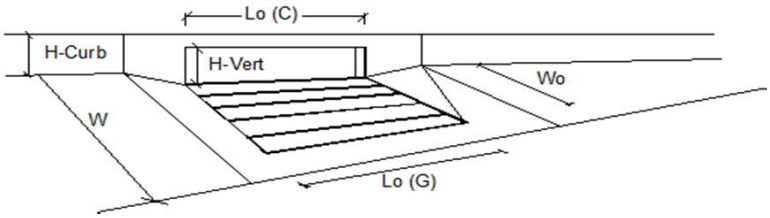
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.6**	**40.2**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

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_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**2.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

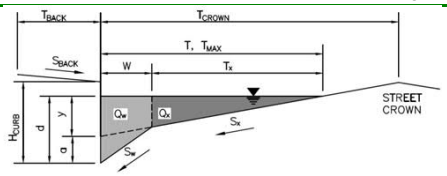
Version 4.05 Released March 2017

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 - DP13



Gutter Geometry (Enter data in the blue cells)

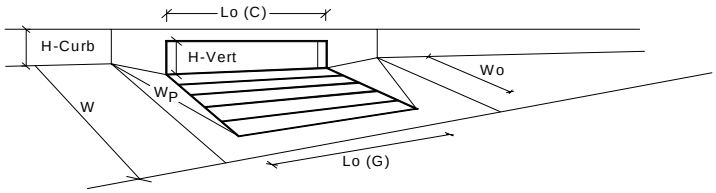
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

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' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.17	1.17	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.32	0.90	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.47	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.72	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**7.5**	**39.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.2	12.0	cfs

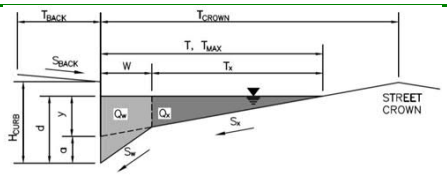
Version 4.05 Released March 2017

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 - DP12



Gutter Geometry (Enter data in the blue cells)

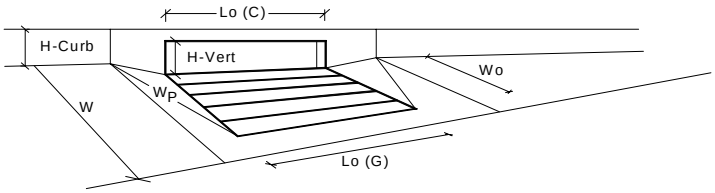
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

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' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	20.00	20.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.17	1.17	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.37	0.90	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.76	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**13.1**	**52.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.1	18.7	cfs

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 12 2022

DP 13.1 - Emergency Overflow

Trapezoidal

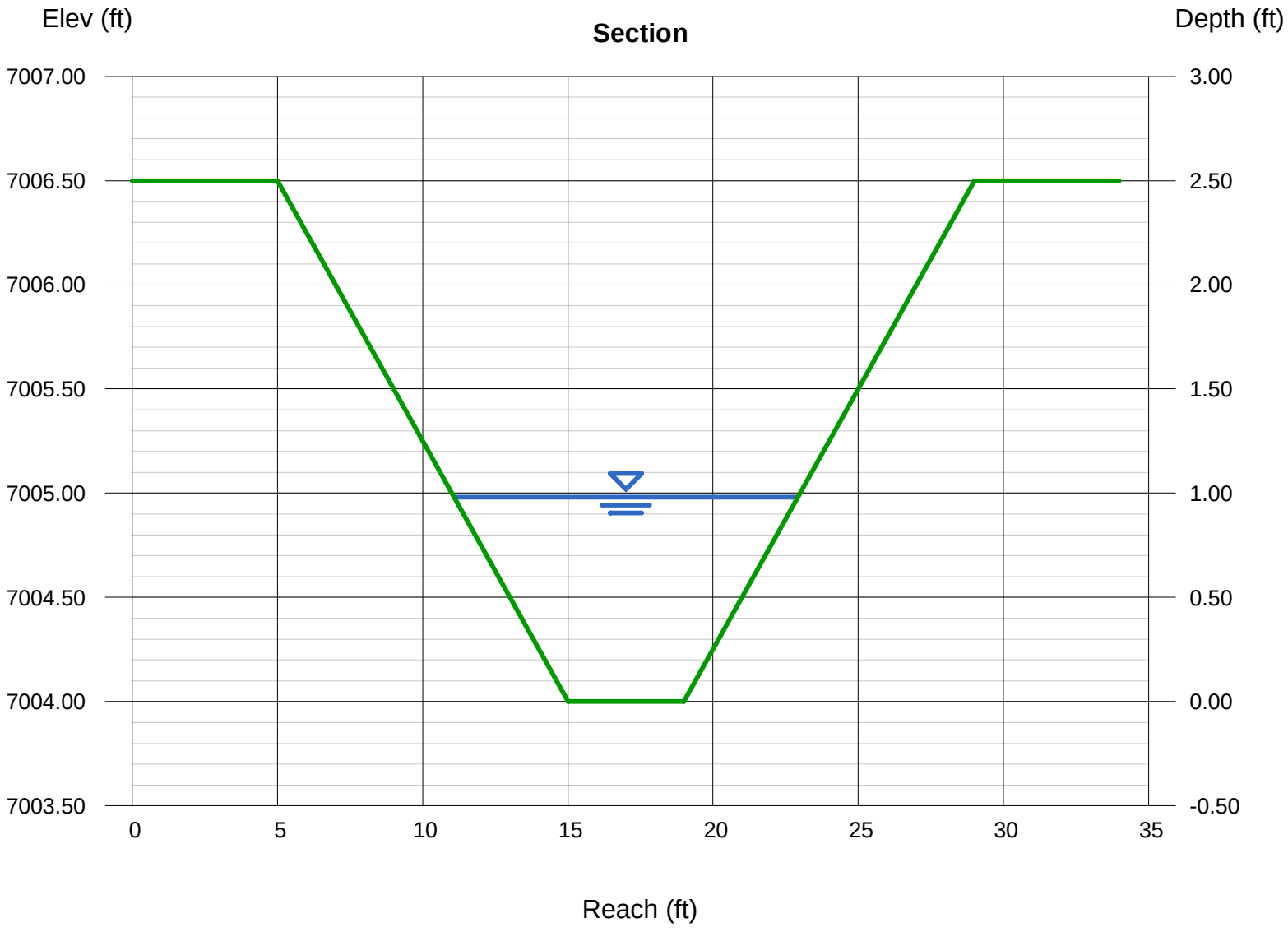
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.50
Invert Elev (ft)	= 7004.00
Slope (%)	= 2.00
N-Value	= 0.040

Calculations

Compute by:	Known Q
Known Q (cfs)	= 30.20

Highlighted

Depth (ft)	= 0.98
Q (cfs)	= 30.20
Area (sqft)	= 7.76
Velocity (ft/s)	= 3.89
Wetted Perim (ft)	= 12.08
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 11.84
EGL (ft)	= 1.22



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Apr 27 2021

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

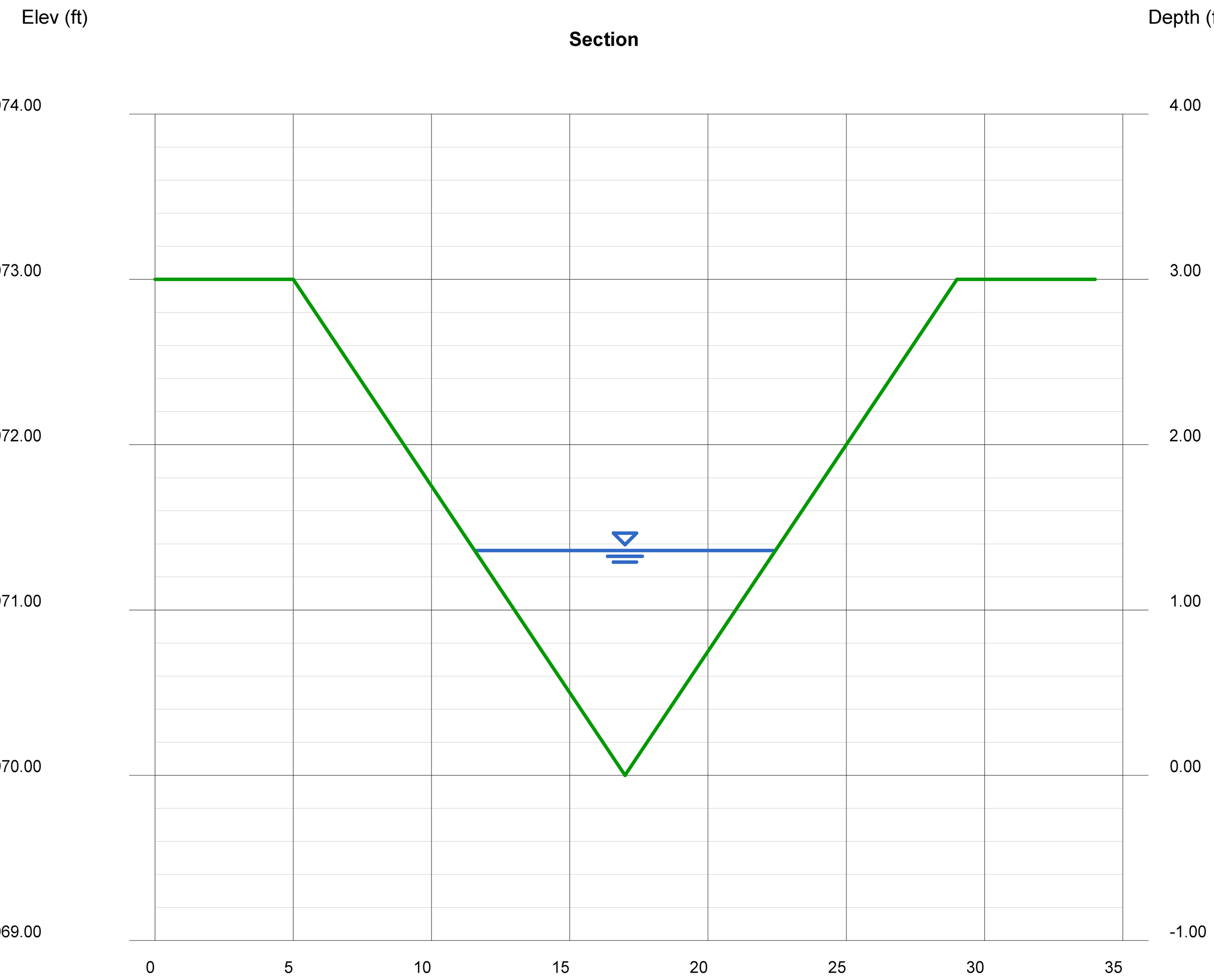
Calculations

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

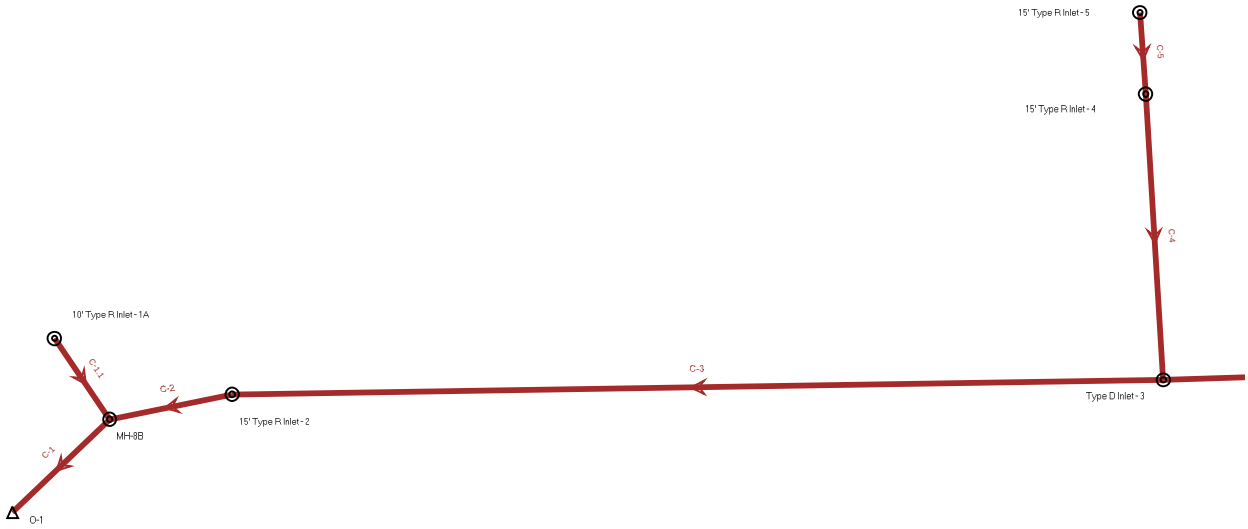
Highlighted

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

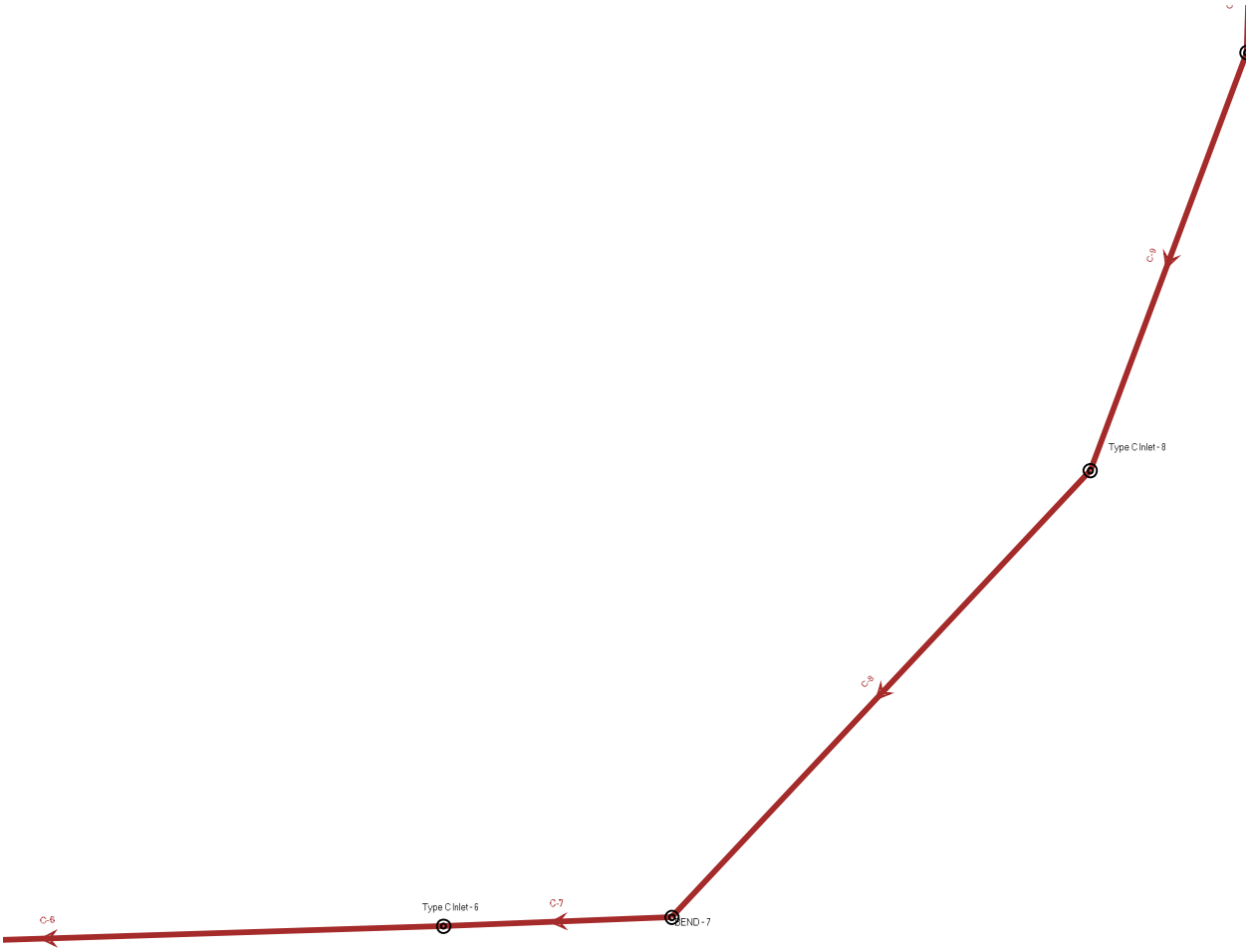
Section



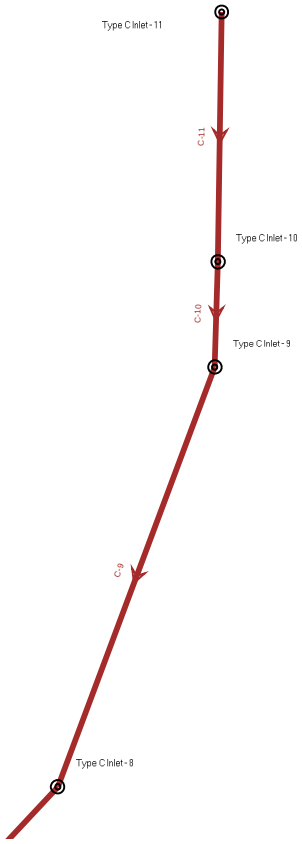
Scenario: 100 YR



Scenario: 100 YR



Scenario: 100 YR



Scenario: 100 YR
Current Time Step: 0.000 h
FlexTable: Conduit Table

Label	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Manning's n	Diameter (in)	Invert (Start) (ft)	Invert (Stop) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
C-1	49.40	37.31	6.99	0.013	36.0	6,988.01	6,987.84	6,994.06	6,992.27	6,990.69	6,990.13	6,991.55	6,991.26
C-1.1	2.90	13.02	5.93	0.013	18.0	6,990.73	6,990.46	6,994.34	6,994.06	6,991.38	6,991.12	6,991.62	6,991.35
C-2	47.70	39.41	6.75	0.013	36.0	6,989.10	6,988.96	6,995.37	6,994.06	6,991.65	6,991.21	6,992.51	6,992.30
C-3	33.50	47.91	7.33	0.013	36.0	6,991.35	6,989.20	7,001.33	6,995.37	6,993.23	6,992.08	6,994.03	6,992.44
C-4	30.20	39.85	13.95	0.013	24.0	7,000.31	6,996.45	7,005.49	7,001.33	7,002.18	6,997.78	7,003.70	7,000.66
C-5	18.70	10.47	10.58	0.013	18.0	7,001.26	7,000.91	7,005.49	7,005.49	7,004.07	7,002.94	7,005.81	7,004.68
C-6	6.30	5.74	3.57	0.013	18.0	6,992.52	6,991.46	7,000.51	7,001.33	6,995.23	6,993.95	6,995.43	6,994.15
C-7	5.10	10.65	2.89	0.013	18.0	6,993.68	6,992.64	7,003.48	7,000.51	6,995.57	6,995.33	6,995.70	6,995.46
C-8	5.10	10.65	5.97	0.013	18.0	6,996.51	6,993.68	7,004.33	7,003.48	6,997.38	6,995.65	6,997.74	6,995.78
C-9	5.10	19.67	9.35	0.013	18.0	7,004.48	6,997.50	7,013.09	7,004.33	7,005.35	6,998.02	7,005.71	6,999.38
C-10	5.10	18.20	8.84	0.013	18.0	7,008.83	7,007.48	7,013.34	7,013.09	7,009.70	7,008.04	7,010.06	7,009.16
C-11	5.10	16.84	8.35	0.013	18.0	7,011.95	7,009.13	7,015.87	7,013.34	7,012.82	7,009.70	7,013.18	7,010.78

Scenario: 5 YR
Current Time Step: 0.000 h
FlexTable: Conduit Table

Label	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Manning's n	Diameter (in)	Invert (Start) (ft)	Invert (Stop) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
C-1	23.10	37.31	5.56	0.013	36.0	6,988.01	6,987.84	6,994.06	6,992.27	6,989.69	6,989.39	6,990.19	6,990.00
C-1.1	1.40	13.02	4.81	0.013	18.0	6,990.73	6,990.46	6,994.34	6,994.06	6,991.17	6,990.80	6,991.33	6,991.14
C-2	22.30	39.41	5.75	0.013	36.0	6,989.10	6,988.96	6,995.37	6,994.06	6,990.71	6,990.48	6,991.23	6,991.08
C-3	15.80	47.91	6.08	0.013	36.0	6,991.35	6,989.20	7,001.33	6,995.37	6,992.62	6,990.97	6,993.10	6,991.17
C-4	14.90	39.85	11.77	0.013	24.0	7,000.31	6,996.45	7,005.49	7,001.33	7,001.71	6,997.30	7,002.34	6,999.45
C-5	9.10	10.47	6.67	0.013	18.0	7,001.26	7,000.91	7,005.49	7,005.49	7,002.43	7,001.99	7,003.02	7,002.68
C-6	2.60	5.74	3.17	0.013	18.0	6,992.52	6,991.46	7,000.51	7,001.33	6,993.30	6,993.05	6,993.42	6,993.08
C-7	2.20	10.65	4.75	0.013	18.0	6,993.68	6,992.64	7,003.48	7,000.51	6,994.24	6,993.36	6,994.45	6,993.46
C-8	2.20	10.65	4.75	0.013	18.0	6,996.51	6,993.68	7,004.33	7,003.48	6,997.07	6,994.37	6,997.28	6,994.49
C-9	2.20	19.67	7.35	0.013	18.0	7,004.48	6,997.50	7,013.09	7,004.33	7,005.04	6,997.84	7,005.25	6,998.68
C-10	2.20	18.20	6.96	0.013	18.0	7,008.83	7,007.48	7,013.34	7,013.09	7,009.39	7,007.83	7,009.60	7,008.58
C-11	2.20	16.84	6.58	0.013	18.0	7,011.95	7,009.13	7,015.87	7,013.34	7,012.51	7,009.50	7,012.72	7,010.17

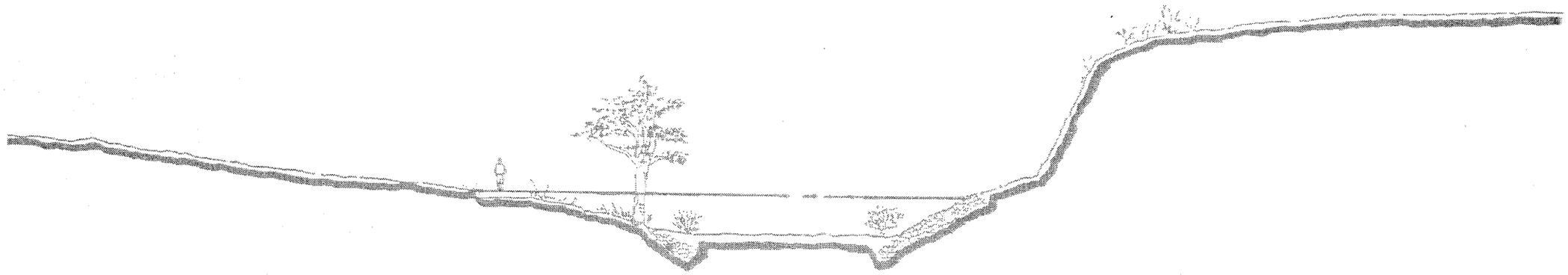
X:\2510000.all\2518800\StormCAD\Sterling ranch Phase 2 -Interim\Phase 2 - Interim.stsw

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 in 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

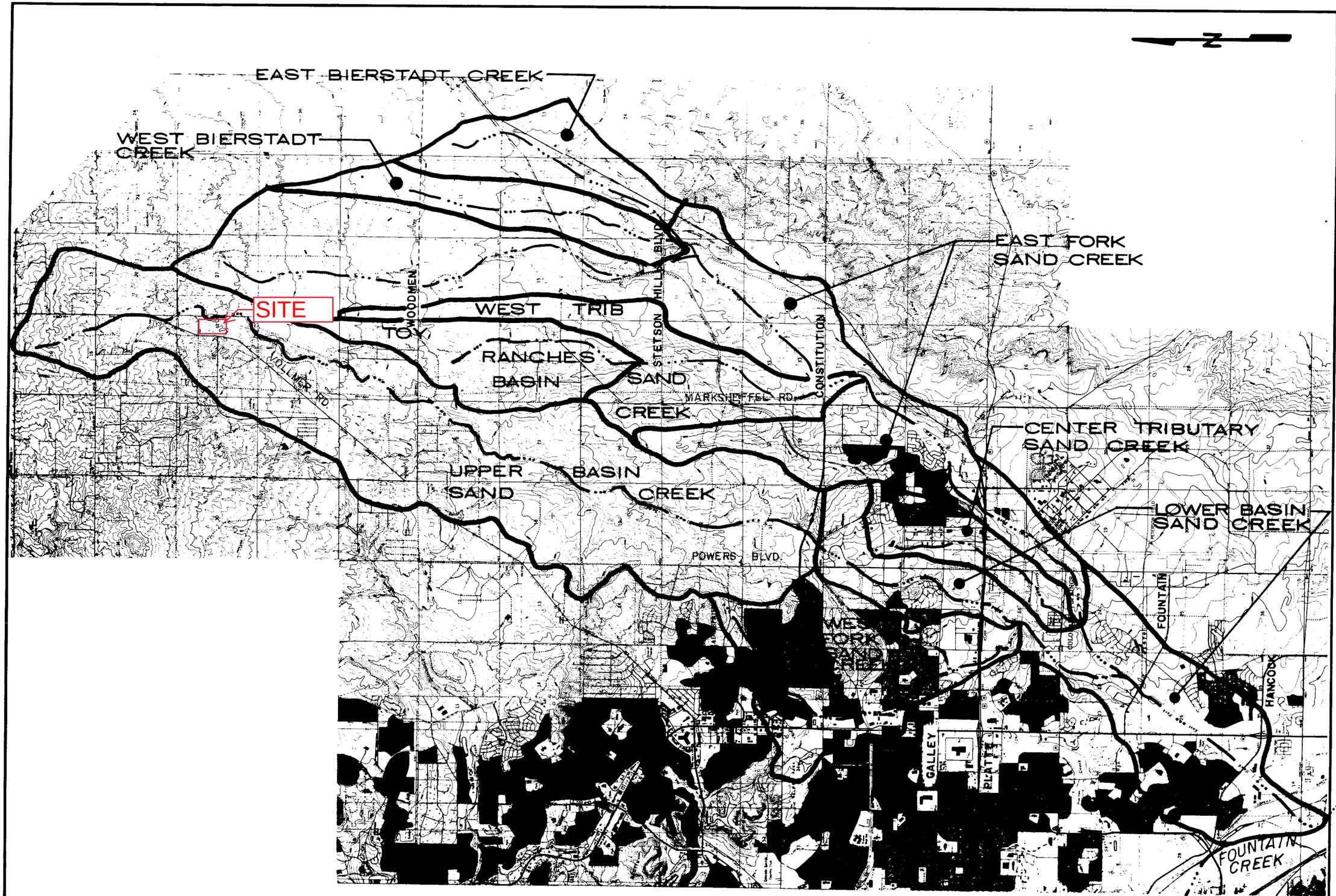
Soils within the Sand Creek basin vary between soil types A through D, as identified by the U. S. Department of Agriculture, Soil Conservation Service. The predominant soil groupings are in the Truckton and Bresser soil associations. The soils consist of deep, well drained soils that formed in alluvium and residium, 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

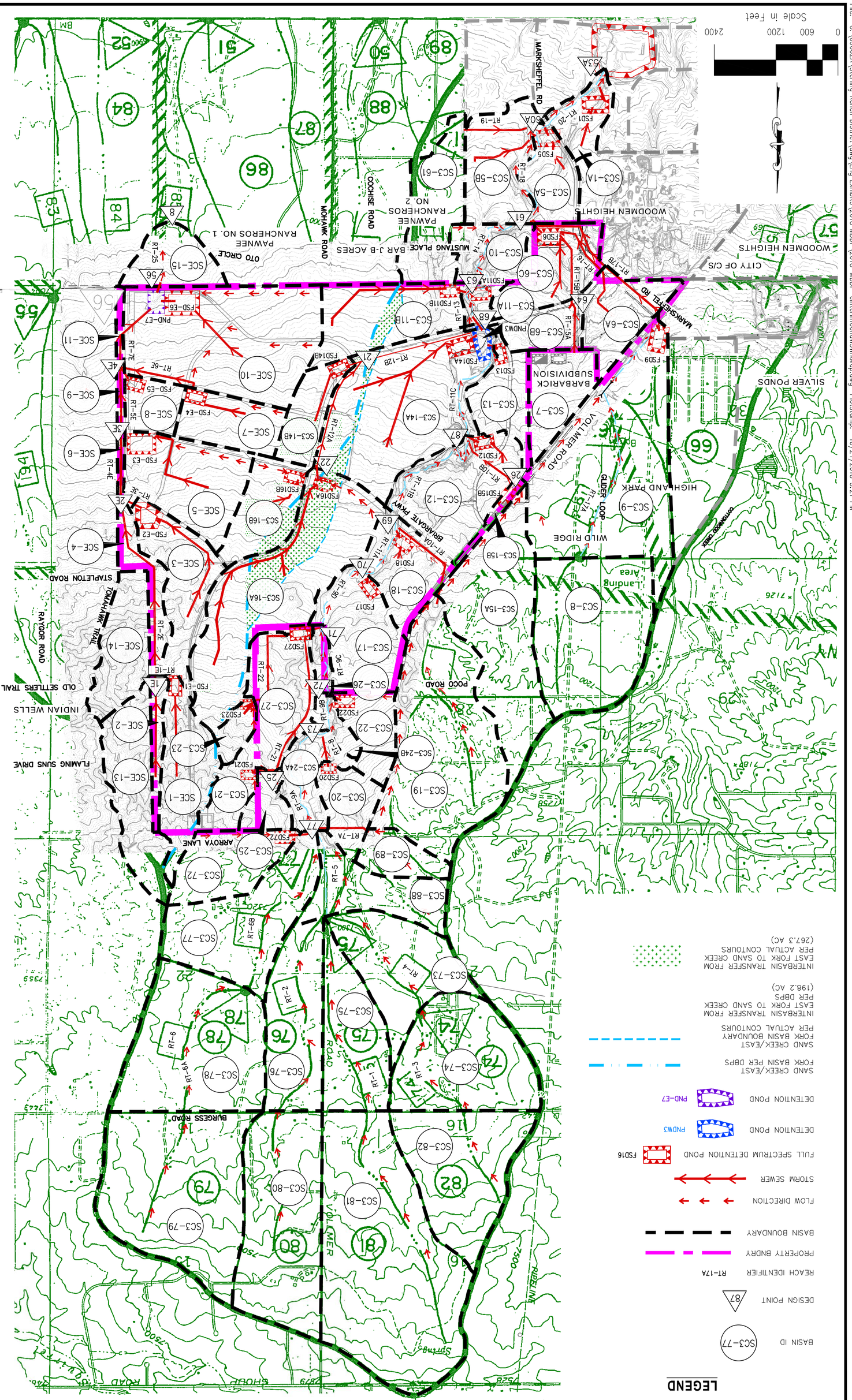
SAND CREEK DRAINAGE BASIN PLANNING STUDY

REGIONAL SUB-BASINS

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

11

FIG. III-1


LEGEND
BASIN ID
SC3-77
DESIGN POINT
87
REACH IDENTIFIER
R1-17A
PROPERTY BNDRY
BASIN BOUNDARY
FLOW DIRECTION
STORM SEWER
FULL SPECTRUM DETENTION POND
F5016
DETENTION POND
PND-E7
DETENTION POND
PND-J3
SAND CREEK/EAST FORK BASIN BOUNDARY PER ACTUAL CONTOURS
INTERBASIN TRANSFER FROM EAST FORK TO SAND CREEK PER ACTUAL CONTOURS (267.3 AC)
INTERBASIN TRANSFER FROM EAST FORK TO SAND CREEK PER DBPS (198.2 AC)
SAND CREEK/EAST FORK BASIN PER DBPS
Scale in Feet
0
600
1200
2400
MARKSHEFFEL RD
MOHAWK ROAD
COOSHISE ROAD
MUSTANG PLACE
BAR J-B ACRES
PAWNEE RANCHEROS NO. 2
PAWNEE RANCHEROS NO. 1
OTO CIRCLE
ARROYA LANE
WOODMEN HEIGHTS
CITY OF C/S
SILVER PONDS
BARBARICK SUBDIVISION
VOLLMER ROAD
HIGHLAND PARK
WILD RIDGE
POCO ROAD
STAPLETON ROAD
RAYDOR ROAD
OLD SETTLERS TRAIL
INDIAN WELLS
FLAMING SUNS DRIVE
BURGESS RANCH
Sterling Ranch
Landing Area
SC3-1A
SC3-1B
SC3-1C
SC3-1D
SC3-1E
SC3-2
SC3-3
SC3-4
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SC3-6B
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R1-28
R1-29
R1-30
R1-31
R1-32
R1-33
R1-34
R1-35
R1-36
R1-37
R1-38
R1-39
R1-40

Worksheet for FSD Outlet Orifice Plate

Project Description

Solve For	Diameter

Input Data

Discharge	45.90	ft³/s (16.5 Hs + 29.4 Pcc)
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	ft²
Velocity	10.43	ft/s

Worksheet for FSD Overflow - Pass

Project Description

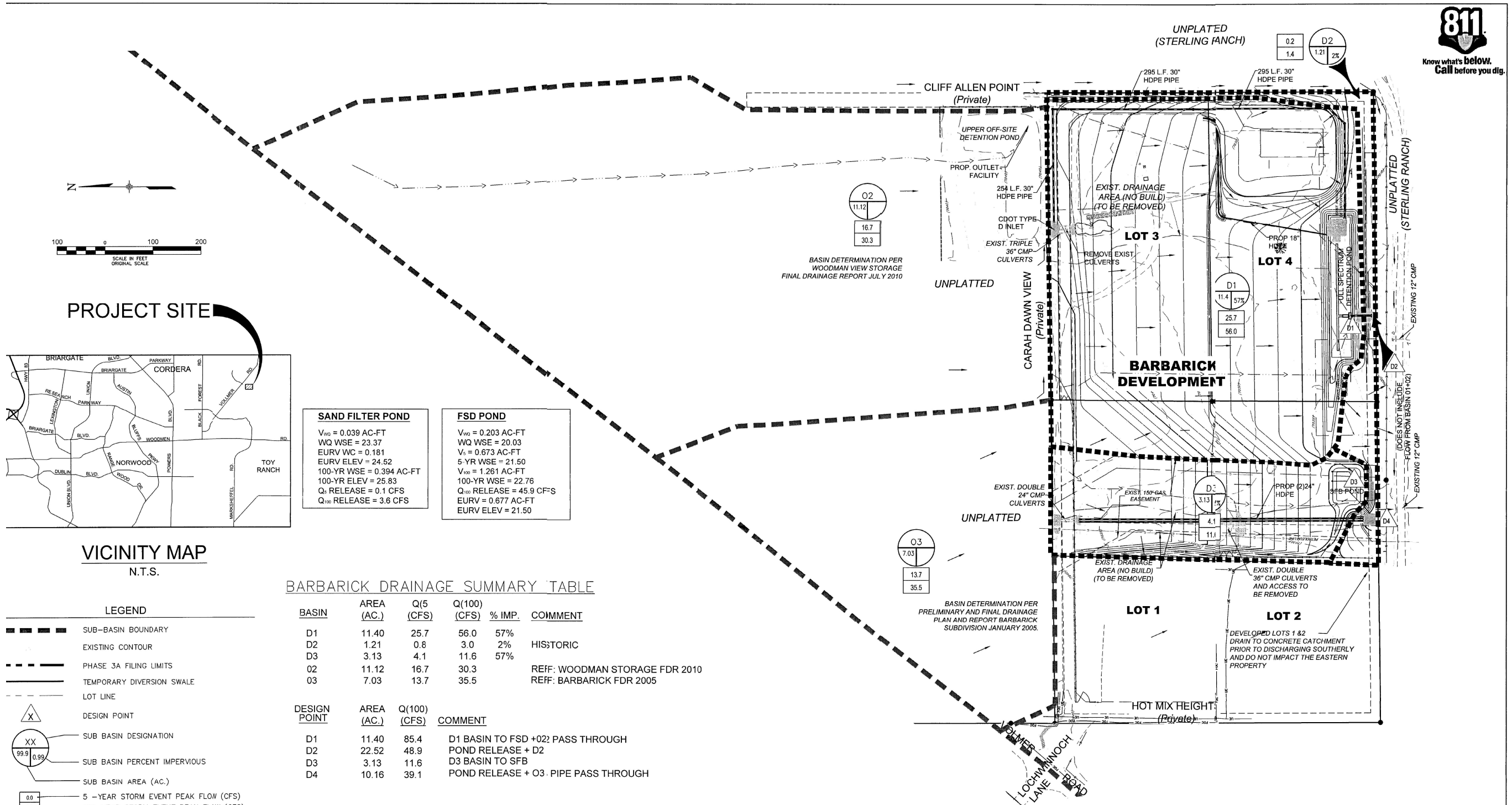
Solve For	Discharge

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	ft³/s (55 Dul + 29.4 pass = 84.4 cfs)
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	ft²
Velocity	2.66	ft/s
Wetted Perimeter	37.80	ft
Top Width	36.00	ft



PROJECT SITE

VICINITY MAP

N.T.S.

SAND FILTER POND

V_{WQ} = 0.039 AC-FT
WQ WSE = 23.37
EURV WC = 0.181
EURV ELEV = 24.52
100-YR WSE = 0.394 AC-FT
100-YR ELEV = 25.83
Q_5 RELEASE = 0.1 CFS
Q_{100} RELEASE = 3.6 CFS

FSD POND

V_{WQ} = 0.203 AC-FT
WQ WSE = 20.03
V_5 = 0.673 AC-FT
5-YR WSE = 21.50
V_{100} = 1.261 AC-FT
100-YR WSE = 22.76
Q_{100} RELEASE = 45.9 CFS
EURV = 0.677 AC-FT
EURV ELEV = 21.50

LEGEND

- SUB-BASIN BOUNDARY
- EXISTING CONTOUR
- PHASE 3A FILING LIMITS
- TEMPORARY DIVERSION SWALE
- LOT LINE
- DESIGN POINT
- SUB BASIN DESIGNATION
- SUB BASIN PERCENT IMPERVIOUS
- SUB BASIN AREA (AC.)
- 5 -YEAR STORM EVENT PEAK FLOW (CFS)
- 100-YEAR STORM EVENT PEAK FLOW (CFS)
- PROPOSED FLOW DIRECTION
- EXISTING FLOW DIRECTION

BARBARICK DRAINAGE SUMMARY TABLE

BASIN	AREA (AC.)	Q(5 (CFS)	Q(100) (CFS)	% IMP.	COMMENT
D1	11.40	25.7	56.0	57%	
D2	1.21	0.8	3.0	2%	HISTORIC
D3	3.13	4.1	11.6	57%	
02	11.12	16.7	30.3		REFF: WOODMAN STORAGE FDR 2010
03	7.03	13.7	35.5		REFF: BARBARICK FDR 2005

DESIGN POINT	AREA (AC.)	Q(100) (CFS)	COMMENT
D1	11.40	85.4	D1 BASIN TO FSD +02? PASS THROUGH
D2	22.52	48.9	POND RELEASE + D2
D3	3.13	11.6	D3 BASIN TO SFB
D4	10.16	39.1	POND RELEASE + O3 PIPE PASS THROUGH

NO.	DATE	DESCRIPTION	BY
		REVISIONS	

NAME: S:\15.789.001 Tri Lakes\Dwg\CD\Drainage\20160605-DP01.dwg
PCP: Matrix.ctb
PLOT DATE: Tue Jun 07, 2016 12:49pm

BENCHMARK DATA(ELEV.)
(DATUM)
(DESCRIPTION/LOCATION)

VERTICAL BENCHMARK:

THE VERTICAL INFORMATION ON THIS MAP IS BASED ON THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 AND THE 1960 SUPPLEMENTARY ADJUSTMENT BEING A FOUND 3.25" ALUMINUM CAP IN A ROAD BOX DESIGNATED AS FACILITIES INFORMATION MANAGEMENT SYSTEM (FIMS) MONUMENT "F_69" AND HAVING PUBLISHED ELEVATION OF 6975.62 FEET WAS USED TO REFERENCE THIS VERTICAL DATUM. THE BENCHMARK IS LOCATED ON THE WEST SIDE OF BLACK FOREST ROAD, ABOUT 1.95 MILES SOUTH OF OLD RANCH ROAD, JUST SOUTH OF THE SCHMIDT CONSTRUCTION COMPANY DRIVEWAY. A CORNER FENCE POST IS 28.1 FEET TO THE SOUTHWEST, AND THE MOST SOUTHERLY GUARD RAIL POST IS 25.7 FEET TO THE NORTH.

BASIS OF BEARINGS:

THE BASIS OF BEARINGS FOR THIS MAP IS THE NORTH LINE OF BARBARICK SUBDIVISION ACCORDING TO THE OFFICIAL MAP THEREOF RECORDED FEBRUARY 12, 2008 IN THE OFFICE OF THE EL PASO COUNTY CLERK AND RECORDER UNDER RECEPTION NUMBER 208712754, SAID LINE MONUMENTED ON THE WEST END BY A FOUND 5/8" REBAR AND ON THE EAST BY A FOUND 4/8" REBAR WITH 1" ALUMINUM CAP STAMPED "LS 2154" BEING A POINT ON THE NORTH LINE BEARING NORTH 89°12'41 EAST 1287.35 FEET FROM THE WEST END THEREOF

PREPARED UNDER MY DIRECT SUPERVISION, FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.

Matrix DESIGN GROUP
2435 Research Parkway, Suite
300 Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208

BARBARICK SUBDIVISION LOTS 1-4

PROPOSED DRAINAGE PLAN

DESIGNED B'	BJH	SCALE		DATE ISSUED:	April 2016
DRAWN BY:	BJH	HORIZ:	1"=100'		
CHECKED BY	ES	VERT:	N/A	SHEET NO. 1 OF 2 SHEETS	DP02

DESIGN POINT		
DP	Q5 Total	Q100 Total
1	4.4	9.4
2	1.9	3.9
3	11.1	24.7
4	3.7	7.4
5	4.1	19.6
6	3.3	6.7
6A	2.2	4.1
7	27.5	60.6
8	3.0	12.5
9	1.9	4.8
10	9.2	17.3
11	9.5	19.9
12	1.9	9.5
13	15.7	34.6
14	16.0	37.9
15	5.4	11.7
16	4.4	9.6
17	1.4	4.7
18	4.3	14.0
19	38.8	85.4
20	7.1	13.4
21	7.4	15.2
22	2.7	15.4
23	8.8	15.8
24	11.5	20.6
25	61.0	310.0
26	4.3	22.4
27	6.3	11.7
28	6.9	14.4
29	3.1	16.3
30	0.9	6.4
31	2.0	15.0
32	1.4	10.0
1.0	6.0	10.3
1.1	12.6	19.7
1.2	17.6	28.2
1.3	25.9	46.9
1.3A	5.0	8.7
1.4	52.5	105.9
1.5	55.1	103.9
1.6	56.4	107.7
1.7	17.3	25.3
1.8	68.8	125.0
2.0	23.2	74.5
2.1	38.1	106.6
2.2	56.9	138.7
2.3	9.6	17.2
2.4	63.7	151.9
2.5	96.6	250.7
2.6	97.8	250.4
2.7	162.0	336.8
2.8	189.8	424.4
2.9	14.2	22.5
3.0	189.8	424.4
3.1	14.2	22.5
3.2	187.5	428.2
4.0	18.4	26.1
4.1	56.2	264.7
4.2	12.7	26.0
4.3	49.1	291.2
4.4	3.1	3.1
4.5	51.1	51.1
4.6	56.5	245.8
4.7	58.4	248.6
4.8	59.8	320.3
OS2	13.8	39.1
OS3	17.6	48.9
OS4	2.6	8.5
D1	3.31	8.20
D2	1.63	2.97

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (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	1.53	100%	0.90	0.96	9.4	5.8	10.4
B4	1.50	100%	0.90	0.96	9.4	5.7	10.2
B5	2.91	0%	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	6%	0.13	0.40	68.9	61.0	310.0
OS21A	20.26	14%	0.13	0.40	52.3	4.3	22.4
OS21B	8.71	9%	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
D1	0.45	95%	0.81	0.88	7.0	1.7	3.1
D2	0.43	95%	0.81	0.88	7.0	1.6	3.0

NOTE

SEDIMENT CONTROL TO BE PROVIDED AT THE STUBS UNTIL THE TIME THOSE PARCELS DEVELOP

LEGEND:

- PROPOSED STORM SEWER
- 5000 FUTURE RD MAJOR CONTOUR
- FUTURE RD MINOR CONTOUR
- 5000 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
- 1 DESIGN POINT
- HP HIGH POINT
- LP LOW POINT
- DRAINAGE ARROW
- EXISTING DRAINAGE ARROW
- PROPOSED DRAINAGE SWALE

DRAINAGE MAP
STERLING RANCH FILING 2
JOB NO. 25188.01
8/18/21
SHEET 1 OF 7

ORIGINAL SCALE: 1" = 70'

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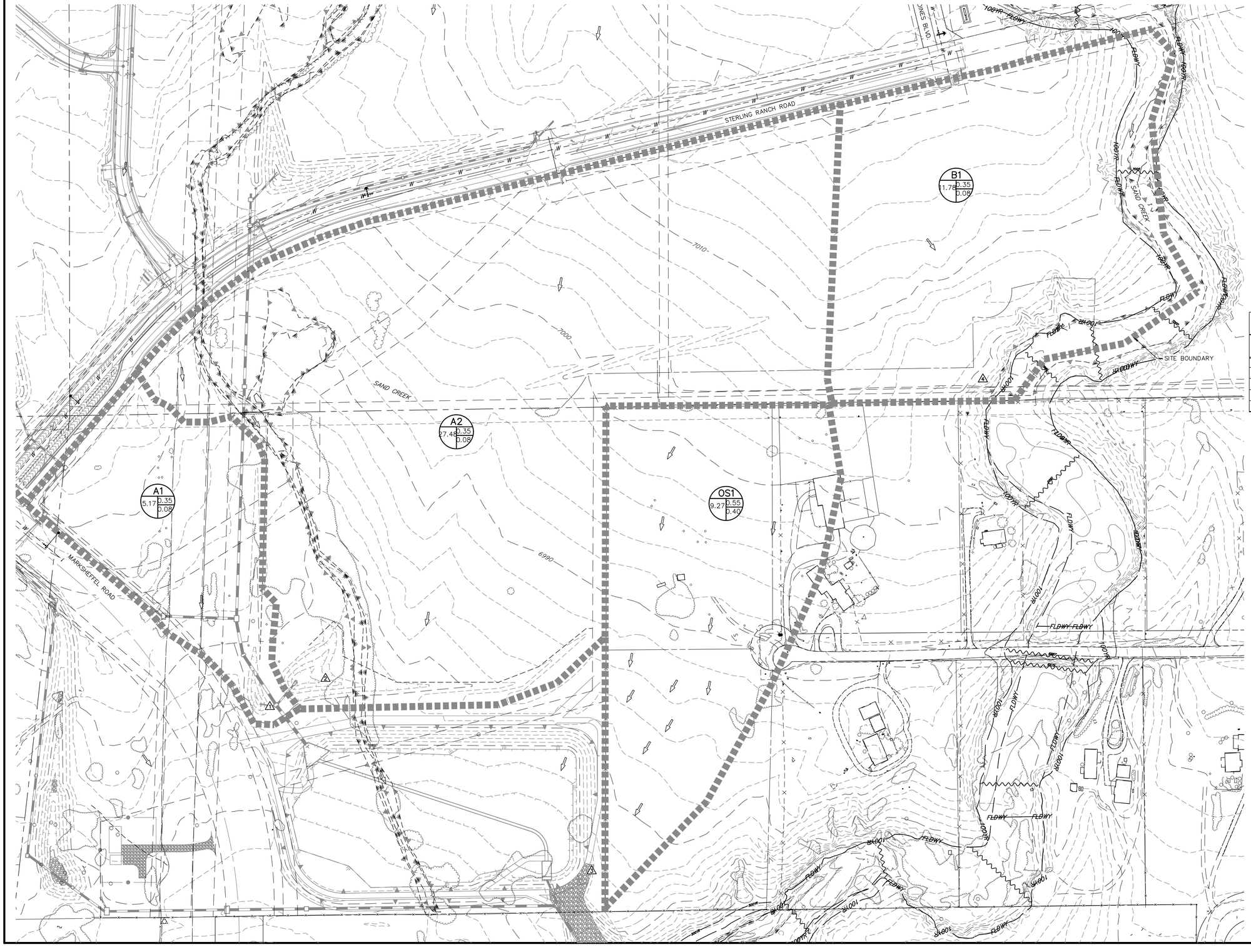
X:\25\10000_all\25188\01\Drawings\Sheet Dwgs\Drainage Maps\Proposed Map.dwg, 24x36 Title Landscape, 8/18/2021 11:20:55 AM, FC

Appendix E
Drainage Maps

STERLING RANCH FILING 3

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

6100

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (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
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

DESIGN POINT

DP	Q5 Total	Q100 Total
1	1.1	8.0
2	4.6	33.6
3	10.5	24.4
4	2.6	19.0

NOTE

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

N

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

STERLING RANCH FILING 3
EXISTING DRAINAGE MAP
JOB NO. 25188.02
04/12/22
SHEET 1 OF 1

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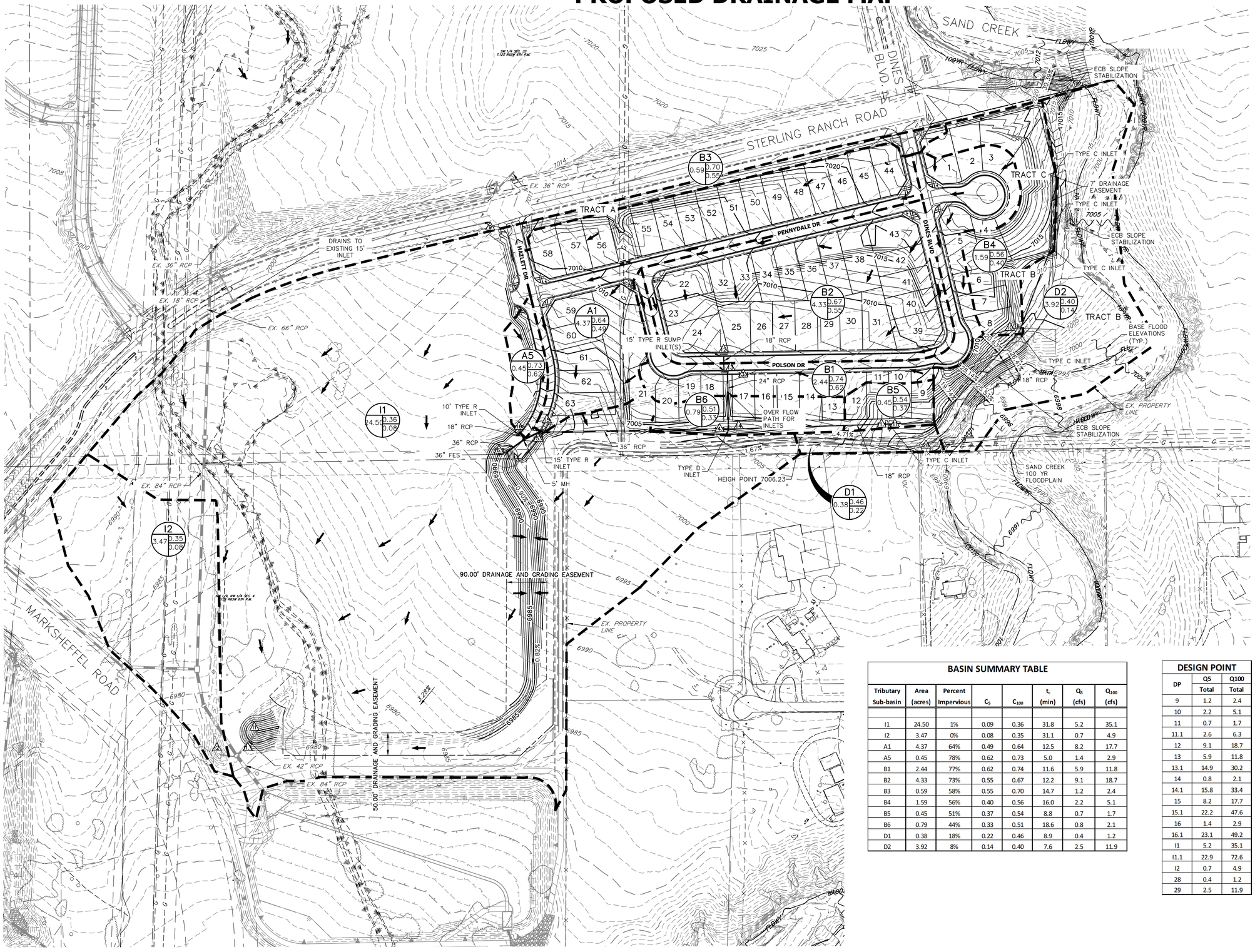
STERLING RANCH FILING 3
PROPOSED DRAINAGE MAP



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 6100

PROPOSED 6100

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
I1	24.50	1%	0.09	0.36	31.8	5.2	35.1
I2	3.47	0%	0.08	0.35	31.1	0.7	4.9
A1	4.37	64%	0.49	0.64	12.5	8.2	17.7
A5	0.45	78%	0.62	0.73	5.0	1.4	2.9
B1	2.44	77%	0.62	0.74	11.6	5.9	11.8
B2	4.33	73%	0.55	0.67	12.2	9.1	18.7
B3	0.59	58%	0.55	0.70	14.7	1.2	2.4
B4	1.59	56%	0.40	0.56	16.0	2.2	5.1
B5	0.45	51%	0.37	0.54	8.8	0.7	1.7
B6	0.79	44%	0.33	0.51	18.6	0.8	2.1
D1	0.38	18%	0.22	0.46	8.9	0.4	1.2
D2	3.92	8%	0.14	0.40	7.6	2.5	11.9

DESIGN POINT

DP	Q_5 Total	Q_{100} Total
9	1.2	2.4
10	2.2	5.1
11	0.7	1.7
11.1	2.6	6.3
12	9.1	18.7
13	5.9	11.8
13.1	14.9	30.2
14	0.8	2.1
14.1	15.8	33.4
15	8.2	17.7
15.1	22.2	47.6
16	1.4	2.9
16.1	23.1	49.2
I1	5.2	35.1
I1.1	22.9	72.6
I2	0.7	4.9
28	0.4	1.2
29	2.5	11.9

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

STERLING RANCH FILING 3
PROPOSED CONDITION DRAINAGE MAP
JOB NO. 25188.02
04/12/22
SHEET 1 OF 1

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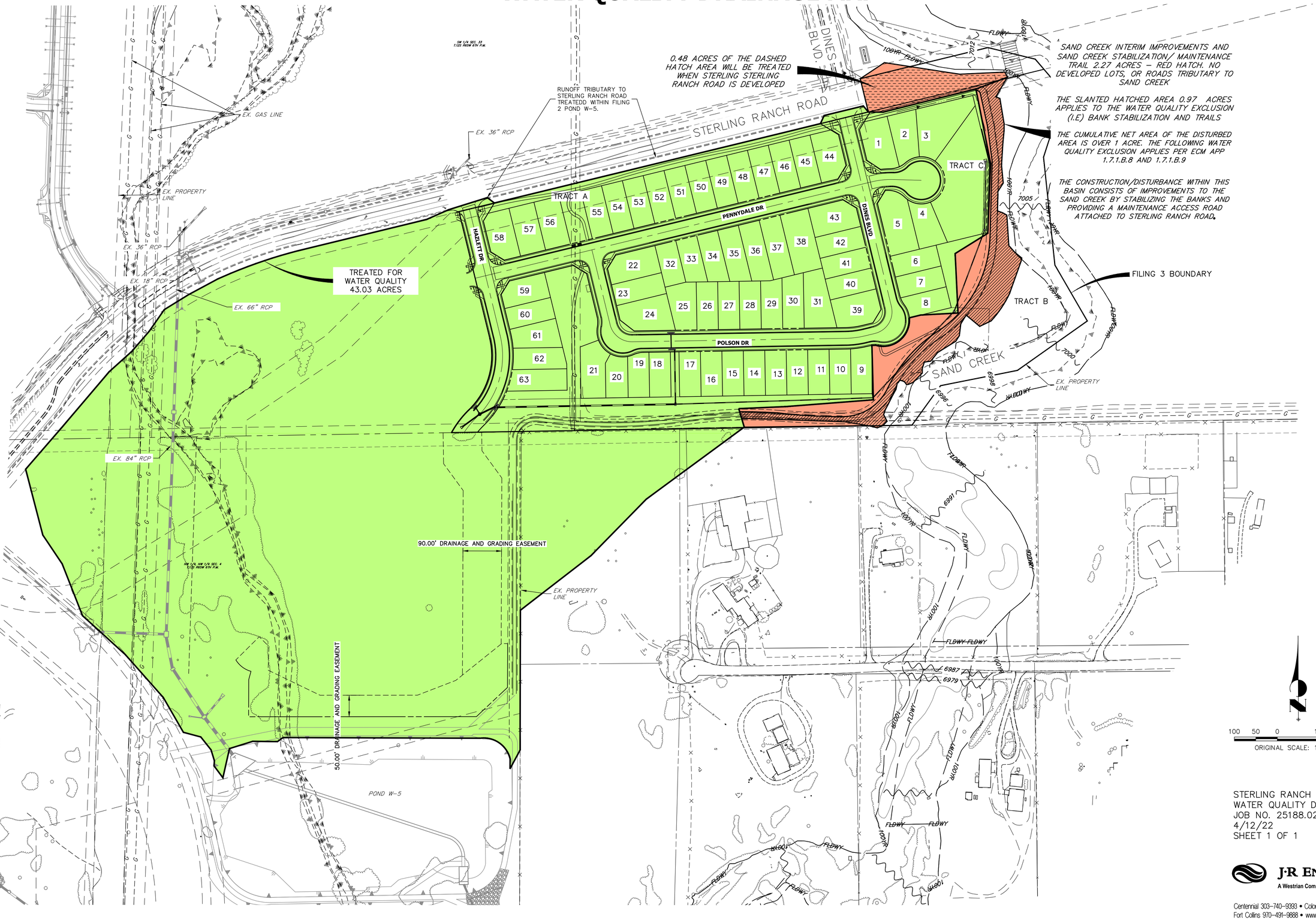
STERLING RANCH FILING 3
WATER QUALITY DRAINAGE MAP



100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

STERLING RANCH FILING 3
WATER QUALITY DRAINAGE MAP
JOB NO. 25188.02
4/12/22
SHEET 1 OF 1

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