

**FINAL DRAINAGE REPORT
FOR
STERLING RANCH FILING NO. 4**

Prepared For:

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**November 18th 2022
Project No. 25188.11**

**Prepared By:
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**PCD Filing No.:
SF-22-030**

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

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: _____

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.

Joshua Palmer, P.E.
County Engineer/ ECM Administrator

Date

Conditions: If any revisions are necessary due to changes or lack of construction in Filing No. 2, this report shall be revised.

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PURPOSE

This document is the Final Drainage Report for Sterling Ranch Filing Number 4. The purpose of this report is to identify on-site and off-site drainage patterns, storm sewer, culvert, inlet locations, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities. The proposed use is a permissible use within the residential service zoning criteria.

GENERAL SITE DESCRIPTION

GENERAL LOCATION

Sterling Filing Number 4 (hereby referred to as the “site”) is a proposed development within the Sterling Ranch master planned community with a total area of approximately 55 acres and includes a replat of tracts B and J of Sterling Ranch Filing No. 2 and the regional detention pond W-5 built during Sterling Ranch Filing No. 2. The site is currently being designed to accommodate approximately 157 single-family residential lots. West of the site adjacent to the pond W-5 Marksheffel road will be extended to a planned residential subdivision.

The site is located in portion a Portion of the Southwest Quarter Of Section 33, Township 12 South, Range 65 West Of The 6th Principal Meridian & A Portion Of The Northwest Quarter Of The Northwest Quarter Of Section 4, Township 13S South, Range 65 West Of The 6th Principal Meridian County Of El Paso, State Of Colorado. The site is separated by Sterling Ranch Road into a north and south region. Barbarick Subdivision borders the northern portion of the site to the north, to the west by Sterling Ranch Filing No. 2, and to the east, the site is bounded by unplatted vacant land that is currently undeveloped. The southern portion of the site is bounded by Sterling Ranch road to the north, Sterling Ranch Filing No. 3, and Pawnee Rancheros border the site directly to the east. To the west, the southern portion of the site borders the proposed extension of Marksheffel Road, and to the south, the site borders unplatted and undeveloped land that is planned for residential use.

DESCRIPTION OF PROPERTY

The property will be primarily be single-family residential development (approximately 55 acres), Open space and drainage tracts. The site is comprised of variable sloping grasslands that generally slope(s) downward to the southeast at 3 to 8% towards the Sand Creek tributary basin.

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

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



plans to address Sand Creek stabilization under PCD project number CDR-20-004 and is undergoing review.

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 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. FIRM Map is presented in Appendix A.

EXISTING DRAINAGE CONDITIONS

MAJOR BASIN DESCRIPTIONS

The site lies within the Sand Creek Drainage Basin based on the "Sand Creek Drainage Basin Planning Study" (DBPS) completed by Kiowa Engineering Corporation in January 1993, revised March 1996. The Sand Creek Drainage Basin covers approximately 54 square miles and is divided into major sub-basins. The site is within the respective sub-basins SC3-6C, SC3-11A, and SC3-6B. Information from Sand Creek DBPS is provided in Appendix D.

The Sand Creek DBPS assumed the Sterling Ranch Filing No. 4 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 Filing No. 4 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. The site currently has an existing channel that was built in the Sterling Ranch Filing No. 3 that conveys the Sterling Ranch Filing 3 runoff to drainage infrastructure on the southern portion of the site that was built in Homestead Filing No. 2; this infrastructure consists of pond W-5 and Existing storm pipe. Currently, the site is used as pastureland 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 W-5 and full-spectrum detention for the site was previously analyzed and can be found in the Final Drainage Report for Sterling Ranch Filing 2 as shown in Appendix D.



EXISTING SUB-BASIN DRAINAGE

The existing / predeveloped condition of the site was broken into four major basins: Basin A-1 A-2, A-3, and E-1, as well as several offsite basins. It is assumed Filing 2 storm structures are to be built before construction starts on Filing 4. If Filing 2 storm structures are not built, then flows will sheet flow down into the site and new calculations will be required. The basin and sub-basin delineation is shown in the existing drainage map in Appendix E and is described as follows:

Sub-basin A-1 ($Q_5= 1.1$ cfs, $Q_{100}=8.0$ cfs) is 5.17 acres and 0 percent impervious consists of the eastern portion of the proposed Sterling Filing No. 4 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 W-5 built with Filing 2 and outfalls to Sand Creek.

Sub-basin A-2 ($Q_5= 3.9$ cfs, $Q_{100}=28.6$ cfs) is 19.12 acres and 0 percent impervious and consists the central portion of Sterling Ranch Filing No. 4. 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 W-5 built with Filing 2 and outfalls to Sand Creek.

Sub-basin A-3 ($Q_5= 5.1$ cfs, $Q_{100}=33.3$ cfs) is 17.62 acres and 2 percent impervious and is located onsite in the northern part of Sterling Ranch Filing No. 4. Runoff from this basin drains to the assumed existing storm sewer built with Filing 2 just north of Sterling Ranch Road located at design point 5. Design Point 5.1 is a confluence of flows from basins A3, OS6 and OS7. Collected runoff is piped south to the existing detention pond W-5 with Filing 2 and outfalls to Sand Creek.

Basin E-1 ($Q_5= 1.3$ cfs, $Q_{100}=9.5$ cfs) is 5.15 acres and 0 percent impervious and is located on south west portion of the site. Runoff from this basin drains to design point O1. Improvements to this basin will be part of the proposed Marksheffel Road improvements. There are no current improvements to this basin.

Sub-basin OS1 ($Q_5= 9.5$ cfs, $Q_{100}=24.6$ cfs) is 9.27 acres is 37 percent impervious and is located to the east of the site. Runoff from this basin drains into the Sterling Ranch Filing 2 detention Pond W-5 in confluence with upstream flows from the eastern portion of Sub-basin A2. Collected runoff is piped south to design point 3 and joins into the existing detention pond built with Filing 2 before it outfalls to Sand Creek.

sheet flows and is conveyed via swale?



Sub-basin OS2 ($Q_5= 4.3\text{cfs}$, $Q_{100}=9.1\text{cfs}$) is 2.48 acres and 56 percent impervious and is comprised of the southern half street of Sterling Ranch Road. Runoff from this basin drains into the assumed existing storm sewer built with Filing 2 located at design point 7. Collected runoff is piped south to the existing detention pond W-5 built with Filing 2 and outfalls to Sand Creek.

Sub-basin OS3 ($Q_5= 5.0\text{cfs}$, $Q_{100}=12.1\text{cfs}$) is 3.50 acres and 42 percent impervious and is comprised of the northern half street of Sterling Ranch Road. Runoff from this basin drains into the assumed existing storm sewer built with Filing 2 located at design point 8. Collected runoff is piped south to the existing detention pond W-5 built with Filing 2 and outfalls to Sand Creek.

Sub-basin OS4 ($Q_5= 1.6\text{cfs}$, $Q_{100}=7.9\text{cfs}$) is 5.10 acres and 8 percent impervious and is located immediately north of Sterling Ranch Road and the eastern portion of the site. Runoff from this basin drains south into assumed existing storm sewer built with Filing 2 located at design point 9. Collected runoff is piped south to the existing detention pond W-5 built with Filing 2 and outfalls to Sand Creek.

Sub-basin OS5 ($Q_5= 0.7\text{cfs}$, $Q_{100}=5.0\text{cfs}$) is 3.46 acres and 0 percent impervious and is located to the east of the northern portion of the site. Runoff from this basin drains to a low point just north of Sterling Ranch Road located at Design Point 4 and will be collected in the assumed existing storm sewer built with Filing 2 and piped to the Filing 2 detention pond w-5 located south of the site and outfalls to Sand Creek.

Sub-basin OS6 ($Q_5= 25.4\text{cfs}$, $Q_{100}=76.8\text{cfs}$) is 18.18 acres and 46 percent impervious as is located northwest of the site in the Barbarick subdivision. Historic runoff from this basins drains south onto the site at design point 10. Detained flow from this basin will be piped through the site to the detention pond and will outfall to Sand Creek.

Sub-basin OS7 ($Q_5= 16.2\text{cfs}$, $Q_{100}=63.5\text{cfs}$) is 33.07 Acres and 19 percent impervious and is located directly north of the site in the Barbarick subdivision. Historic runoff from this site drains south onto the site at design point 11. Detained flow from this basin will be piped through the site to the detention pond and will outfall to Sand Creek.

If the assumed Filing 2 storm infrastructure is not in place when construction of Filing 4 begins, runoff will continue to sheet flow as in historic condition until the storm system is in place.

PROPOSED DRAINAGE CONDITIONS

PROPOSED SUB-BASIN DRAINAGE

The proposed site was broken into three major basins: Basin A (lower-portion), Basin B (mid and eastern -portion), Basin C (upper-portion) of the site and Basin, which consists of the proposed



improvements to Marksheffel Road. The proposed basin (and sub-basin) delineation is shown on the drainage basin map within Appendix E and is described as follows.

Basin A2 ($Q_5= 1.7\text{cfs}$, $Q_{100}=4.8\text{ cfs}$) is 1.38 acres and 32 percent impervious is comprised of single-family residential lots, open space, several trails, and a local road Hazlett Drive. Runoff from this basin drains to design point 17, a 10' type R on grade inlet on the southwest corner of the basin, in confluence with upstream by-pass flows from the Filing 3 development of 0.2 cfs in the 5 year event and 5.2 cfs in the 100 year event. Total flow at DP 17 is 1.6 cfs for a minor storm and 7.9 cfs in a major storm. DP 17 bypasses 0 cfs in the 5 year event and 0.2 cfs in the 100 year event downstream to DP 22.

Basin A3 ($Q_5= 7.0\text{cfs}$, $Q_{100}=14.9\text{cfs}$) is 3.68 acres and 65 percent impervious is comprised of single-family residential lots and a local road Pennydale Drive. Runoff from this basin drains to a 15' on grade type R inlet located at design point 20 and is not capturing any upstream by-pass flows. Total flow at DP 20 is 7.0 cfs for a minor storm and 14.9 cfs in a major storm. DP 20 bypasses 0cfs in the 5 year event and 3.2 cfs in the 100 year event downstream to DP 22.

Basin A4 ($Q_5= 6.3\text{cfs}$, $Q_{100}=15.1\text{cfs}$) is 4.53 acres and 48 percent impervious is comprised of single-family residential lots, open space a local road Moore Drive, Pennydale Drive, Hazlette Drive, and two urban knuckles. Runoff from this basin drains to a sump 15' type R inlet located at design point 22 in confluence with upstream by-pass flows from basins A1, A2, and A3. Total flow at DP 22 is 6.3 cfs for a minor storm and 18.3 cfs in a major storm. The runoff from this basin is piped to DP 23 where the runoff confluence with the entire southern portion of the Sterling Ranch Filing No. 4 site. From here on, the runoff is then piped into an existing 42" RCP and Structure associated with design point 23. The emergency overflow for this basins drains directly to pond W-5 south of the inlet. In the event the inlet at design point 22 clogs there is an overflow path to pond W-5 south west of the inlet.

Basin A5 ($Q_5= 1.4\text{cfs}$, $Q_{100}=2.9\text{cfs}$) is 0.45 acres and 79 percent impervious is comprised of single-family residential lots and a local road Hazelett Drive. Runoff from this basin drains to a 10' type R on grade inlet at design point 16. Total flow at DP 16 is 1.4 cfs for a minor storm and 2.9 cfs in a major storm. DP 16 bypasses 0 cfs in the 5 year event and 0 cfs in the 100 year event downstream to DP 18.

Basin A6.1 ($Q_5= 10\text{cfs}$, $Q_{100}=20.5\text{cfs}$) is 4.73 acres and 72 percent impervious is comprised of single-family residential lots, local roads Pennydale Drive, Trago Drive, and Hazelett.Drive. Runoff from this basin drains to an on grade 15' type R inlet at design point 12 and is not capturing any upstream by-pass flows. Total flow at DP 12 is 10.0 cfs for a minor storm and 20.5 cfs in a major storm. DP 12 bypasses 1cfs in the 5 year event and 6.9 cfs in the 100 year event downstream to DP 19.

Basin A6.2 ($Q_5= 5.6\text{cfs}$, $Q_{100}=11.3\text{cfs}$) is 2.56 acres and 74 percent impervious is comprised of single-family residential lots, local roads Pennydale Drive, Pendroy Street, and Hazelett.Drive. Runoff from this basin drains to an on grade 20' type R inlet at design point 19 in confluence with upstream by-pass



flows from DP12. Total flow at DP 19 is 6.4 cfs for a minor storm and 17.8 cfs in a major storm. DP 19 bypasses 0 cfs in the 5 year event and 4.9 cfs in the 100 year event downstream to DP 21.

Basin A7 ($Q_5= 4.2\text{cfs}$, $Q_{100}=8.5\text{cfs}$) is 1.76 acres and 73 percent impervious is comprised of single family residential lots and local roads Pennydale Drive, Moore Drive, and Hazelett Drive. The runoff from this basin drains to a 15' sump type R inlet located at design point 21, which receives up stream, by pass flow from the on grade 15' type R inlet at design point 19. Total flow at DP 21 is 4.2 cfs for a minor storm and 13.4 cfs in a major storm.

Basin A8 ($Q_5= 2.2\text{cfs}$, $Q_{100}=9.2\text{cfs}$) 4.23 acres and 13 percent impervious is comprised of a single family residential lots and open space. The runoff from this basin drains to a swale on western side of the site and into a type C inlet located at design point 24.

Basin A9 ($Q_5= 1.0\text{cfs}$, $Q_{100}=4.8\text{cfs}$) 2.02 acres and 8 percent impervious is comprised of a single family residential lots and open space. The runoff from this basin drains to a swale on the western side of the site and into an existing flared end section and pipe located at design point 25. From there on, the flow are piped to the existing detention pond W-5.

Basin A10 ($Q_5= 2.9\text{cfs}$, $Q_{100}=8.8\text{cfs}$) 2.67 acres and 26 percent impervious is comprised of a single family residential lots and open space. The runoff from this basin sheet flows to the south and into existing pond W-5 at design point 27.

Basin B3 ($Q_5= 3.8\text{cfs}$, $Q_{100}=7.9\text{cfs}$) is 2.38 acres and 63 percent impervious is comprised of open space, Sterling Ranch road and sidewalk. Runoff from basin B3 drains to a 15' type R on grade inlet located at design point 9 in existing Sterling Ranch Road. All of the runoff is captured in the 100 year event. Runoff from this on grade inlet and is piped and outfalls into pond W-5.

Basin C1 ($Q_5= 6.1\text{ cfs}$, $Q_{100}=12.7\text{ cfs}$) is 2.59 acres and 69 percent impervious is comprised of single family residential lots, local roads Clancy Drive, School House Drive, and Cordgrass Drive. Runoff from basin C1 drains to 15' a sump type R inlet located at design point 6. The combined runoff at DP 6.1 drains to the existing drainage structure DP 7.2.

Basin C2 ($Q_5= 12.0\text{cfs}$, $Q_{100}=25.9\text{cfs}$) is 6.75 acres and 63 percent impervious is comprised of local roads, Clancy Drive, School House Drive, Cordgrass Drive, single-family residential lots, open space, and paved walks. Runoff from basin C2 drains to a 15' type R sump inlet located at design point 5 and piped south west to DP6.1. The combined runoff at DP 6.1 drains to the existing drainage structure DP 7.2.

address flows
intercepted and
bypassed across
crown to DP6



Basin C3 ($Q_5= 3.5\text{cfs}$, $Q_{100}=12.8\text{cfs}$) is 4.18 acres and 19 percent impervious is comprised of single family residential lots, open space, and paved walks. Runoff from basin C3 drains to a swale on the western side of the site and into a type C area inlet located at design point 7 where it is piped to existing drainage structure DP 7.2.

Basin C4 ($Q_5= 6.1\text{ cfs}$, $Q_{100}=12.9\text{ cfs}$) is 4.41 acres and 62 percent impervious is comprised of open space, roads and rear yards of single family residential lots. Runoff from basin C4 drains to an on-grade 15' type R inlet located at design point 8 in existing Sterling Ranch Road. In the 100 year event, 0.8 cfs is by-passed to a sump inlet adjacent to the intersection of Sterling Ranch Road and Marksheffel Road. Collected runoff is piped south into pond W-5.

Basin OS6 ($Q_5= 22.3\text{cfs}$, $Q_{100}=55.6\text{cfs}$) is 18.38 acres, and 45 percent impervious is located near the northwest border of the site in the Barbarick subdivision. Runoff from the Barbarick, a portion of lots 3 and 4 for 3.13 acres site, is treated in this area with a sand filter. The other portion of the site is piped with two existing 24" HDPE. In the event, the sand filter clogs in the 100-year event, the emergency overflow from the sand filter will sheet flow across an open area of land i.e. tract B at 11.6 CFS, to sheet flow onto Ennis Drive. The total runoff from basin OS6 will be piped to throughout the Sterling Ranch Filing No. 4 site at design point 4 and will outfall in detention pond W-5 and will ultimately outfall to Sand Creek.

Basin OS7 ($Q_5= 14.6\text{cfs}$, $Q_{100}=52.8\text{cfs}$) is 33.07 Acres and 19 percent impervious and is located directly north of the site in the Barbarick subdivision. Runoff from the eastern portion of the basin travels overland towards design point 1. Historic runoff from this site drains south onto the site at design point 1. Detained flow from this basin will be piped through the site to the detention pond W-5 and will outfall to Sand Creek. Emergency overflow from this basin will be routed around the lots and into the open space east of the site to vacant land.

Basin I1 ($Q_5= 7.8\text{ cfs}$, $Q_{100}=17.9\text{ cfs}$) is 5.88 Acres and 54 percent imperious is located directly east of the upper half of Homestead Filing Four. Runoff from this basin drains into an existing draw. The runoff is then picked up by an interim swale and conveyed away from the Filing 4 lots adjacent to Greenough Drive. The undeveloped lot that makes up basin I1 will be developed into a residential development. The runoff is conveyed in the swale and then goes to the downstream design point 2.1i where it is ultimately conveyed into pond W-5 built-in Sterling Ranch Filing No. 2, as shown in Appendix D.

Basin I2 ($Q_5= 4.9\text{ cfs}$, $Q_{100}=9.9\text{ cfs}$) is 2.18 Acres and 71 percent imperious is located directly east of the upper half of Homestead Filing Four. Runoff from this basin sheet drains across existing native grass. The runoff is picked up by an interim swale, where it is collected by an interim FES at design point 2.1i. The runoff is ultimately conveyed into pond W-5 built-in Sterling Ranch Filing No. 2, as shown within Appendix D.

describe how pipe outflows will be captured

Are emergency overflow paths sized for ultimate imperviousness?

how? Describe swale design. to the east?

inlet or FES?

provide size



plans show
separate FES?

Basin I3 ($Q_5=7.1$ cfs, $Q_{100}=19.4$ cfs) is 2.94 Acres and 68 percent impervious is located north of Sterling Ranch Road in the unplatted parcel of land directly east of the northern portion of the site. Runoff from this basin drains into an interim swale at design point 3.1i and then ultimately drains to the interim FES at design point 2.1i. The runoff is ultimately conveyed into pond W-5 built in Sterling Ranch Filing No. 2, as shown within Appendix D.

and FES?

Basin E1 ($Q_5=3.4$ cfs, $Q_{100}=6.3$ cfs) is 0.88 Acres and 86 percent impervious is located directly west of Sterling Ranch Filing No. 4. Basin E1 is composed of the southwest portion of the proposed extension of Marksheffel Road. Runoff from basin E1 drains via curb and gutter in confluence with existing bypass runoff from the existing portion of Marksheffel Road. The runoff from this basin is capture into the 15' type R inlet on grade at design point 1e and is then piped to pond W-5 and the remaining runoff is then by passed to design point 3e downstream of 1e.

provide quantities

northeast?

Basin E2 ($Q_5=3.4$ cfs, $Q_{100}=6.4$ cfs) is 0.91 Acres and 83 percent impervious is located directly west of Sterling Ranch Filing No. 4. Basin E2 is composed of the northwest portion of the proposed extension of Marksheffel Road. Runoff from basin E2 drains via curb and gutter in confluence with existing bypass runoff from the existing portion of Marksheffel Road. The runoff from this basin is captured by a 15' on grade type R inlet at design point 2e. The runoff from the on grade inlet is bypassed downstream to design point 4e. The captured runoff is piped to pond W-5 built in Filing No. 2 along with upstream runoff from the Western portion of Marksheffel Road.

Basin E3 ($Q_5=1.4$ cfs, $Q_{100}=2.7$ cfs) is 0.35 acres and 89 percent impervious is located directly west of Sterling Ranch Filing No. 4. Basin E3 is composed the southwest portion of the proposed extension of Marksheffel road. Runoff from basin E3 will drain via curb and gutter and drain into an interim sediment pond built by Aspen Meadows Subdivision. The runoff will ultimately be treated in a downstream water quality pond that is being built with the Aspen Meadows subdivision to the south and will by conveyed by corresponding improvements to Marksheffel road that will be built the Aspen Meadows subdivision developed. Refer to Appendix D for excerpts from the Aspen Meadows drainage report.

provide status

Basin E4 ($Q_5=1.3$ cfs, $Q_{100}=3.1$ cfs) is 0.61 acres and 47 percent impervious is located directly west of Sterling Ranch Filing No. 4. Basin E4 is composed the northwest portion of the proposed extension of Marksheffel road. Runoff from basin E4 will drain to an interim sediment pond. The runoff will ultimately be treated in a downstream water quality pond that is being built with the Aspen Meadows subdivision to the south and will by conveyed by corresponding improvements to Marksheffel road that will be built the Aspen Meadows subdivision developed. Refer to Appendix D for excerpts from the Aspen Meadows drainage report.

Please show and
label sedimentation
pond on drainage
map



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 CSDCM. One hour point rainfall data for the storm events is identified in the chart below. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the CSDCM. Time of concentrations were developed using equations from CSDCM. All runoff calculations and applicable charts and graphs are included in the Appendices.

Table 2 - 1-hr Point Rainfall Data

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. StormCAD was used to model the proposed storm sewer system within the interim area and to analyze the proposed HGL calculations for the Construction Drawings. Autodesk Hydraflow express was used to size the overflow channel and drainage swales. 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 3 (below), this method is accurate for pipes 42” and smaller for larger pipes the Standard head-loss coefficients as recommended by Bentley were used as shown in table 4. StormCAD, Autodesk Hydraflow results, along with street and inlet capacities, are presented in Appendix C.



Table 3 Storm Head-loss Coefficients

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		

Include discussion of design criteria used for design of swales.

Table 4 Storm Head-loss Coefficients

Type of Manhole	Diagram	Headloss Coefficient
Trunkline only with no bend at the junction		0.5
Trunkline only with 45° bend at the junction		0.6
Trunkline only with 90° bend at the junction		0.8
Trunkline with one lateral		Small 0.6 Large 0.7
Two roughly equivalent entrance lines with angle < 90° between lines		0.8
Two roughly equivalent entrance lines with angle > 90° between lines		0.9
Three or more entrance lines		1.0

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The proposed stormwater conveyance system was designed to convey the developed Sterling Ranch Filing No. 4 runoff to an existing (Filing 2) full spectrum water quality and detention pond W-5 via storm sewer. The proposed pond was designed to release at less than historic rates to minimize adverse impacts downstream. Flows will be routed via overland flow, curb and gutter, swales, and storm pipes into a detention pond where it will be treated for water quality. Proposed storm structures convey flows to the existing storm pipe west of the site which leads south to the detention pond. 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.

FOUR STEP PROCESS TO MINIMIZE ADVERSE IMPACTS OF URBANIZATION

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

Step 1 – Reducing Runoff Volumes: The Sterling Ranch Filing No. 4 development project consists of single-family homes with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roof drains from the structures will discharge to lawn areas, where feasible, to allow for infiltration and runoff volume reduction.

Step 2 – Stabilize Drainageways: The site lies within the Sand Creek Drainage Basin. Basin and bridge fees will be due at time of platting. These funds will be used for the channel stabilization being designed by JR Engineering adjacent to the site and on future projects within the basin to stabilize drainageways. The site does not discharge directly into the open drainageway of Sand Creek, therefore no downstream stabilization will be accomplished with this project.

Step 3 – Treat the WQCV: Water Quality treatment for this site is provided in an existing full spectrum water quality detention pond (W-5). The runoff from this site will be collected within inlets and conveyed to the proposed ponds via storm sewer. Upon entrance to the ponds, flows will be captured in a forebay designed to promote settlement of suspended solids. A trickle channel is also incorporated into the ponds to minimize the amount of standing water. The outlet structure has been designed to detain the water quality capture volume (WQCV) for 40 hours, and the extended urban runoff volume (EURV) for 72 hours. All flows released from the ponds will be reduced to less than historic rates.

Step 4 –BMPs will be utilized to minimize off-site contaminants and to protect the downstream receiving waters. The Filing No. 4 site is residential. There is no proposed commercial or industrial use for the site. The permanent erosion control BMPs include asphalt drives, storm inlets and storm



pipe, the full spectrum detention pond W-5 and permanent vegetation. Maintenance responsibilities and plans will be defined at the time of final platting.

Include discussion of storm sewer systems & swales

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 W-5 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 W-5 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 and is releasing less than the MDDP values in the proposed design. A summary of Pond W-5 has been included below for reference. From the Filing No.2 drainage report, Pond W-5 accounted for Sterling Ranch Filing 4 area to have 65% (north of Sterling Ranch Road) and 67% (south of Sterling Ranch Road) imperviousness. The total imperviousness for the Filing 4 development is 50.6% imperviousness, and the total runoff is less than what was anticipated; therefore the existing pond W-5 will function as intended.

From my previous comment, I meant to do a site visit to confirm that the pond doesn't have an current/existing/known issues like sediment buildup, missing orifice plate, or something else that would inhibit normal operation/capacity of it.

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 W-5	18.217	18.441	3.29	11.71	2.7	137.1

EROSION CONTROL PLAN

It is the policy of the El Paso County, that a grading and erosion control plan be submitted with the drainage report. Proposed silt fence, vehicles traffic control, temporary sediment basins, seeding and mulching are proposed as erosion control measure.

OPERATION & MAINTENANCE

and O&M Manual

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 W-5 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 Marksheffel Road and wraps around the top of the pond providing access to the inflow pipe wingwalls and outlet structure for the pond.

Revise statement to address swales and other facilities to be maintained by the district. Please provide copy of O & M manual addressing these facilities with next submittal



DRAINAGE AND BRIDGE FEES

The site lies within the Sand Creek Drainage Basin. Anticipated drainage and bridge fees are presented below:

2022 Drainage and Bridge Fee – Sterling Ranch Filing 4				
Impervious Acres (Ac.)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	Sterling Ranch Drainage Fee	Sterling Ranch Bridge Fee
23.890	\$21,814	\$8,923	\$521,136.46	\$213,170.47

Sterling Ranch Filing 4 Impervious Area Calculation

Breakdown	Acres	% Impervious	Impervious Acres
ROW	6.2452	100%	6.25
Lots- minus Filing 2 replat	20.3321	60%	12.20
Tracts A-G, and J - Open space	20.9963	2%	0.42
Tract H- Future Industrial / Lift Station	4.9959	50%	2.50
Tract I- Marksheffel ROW	2.5244	100%	2.52
Total	55.0939		23.89

CONSTRUCTION COST OPINION

A construction cost opinion for the public storm drainage infrastructure 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. 4 (Public Non-Reimbursable)

Item	Description	Quantity	Unit	Unit Price	Cost
1	18" RCP	242	L.F.	\$ 70	\$ 16,940.00
2	24" RCP	436	L.F.	\$ 83	\$ 36,188.00
3	36" RCP	1547	L.F.	\$ 128	\$ 198,016.00
4	30" RCP	9	L.F.	\$ 104	\$ 936.00
5	42" RCP	339	L.F.	\$ 171	\$ 57,969.00
6	48" RCP	800	L.F.	\$ 209	\$ 167,200.00
7	18" FES	1	Ea.	\$ 400	\$ 400.00
8	24" FES	1	Ea.	\$ 500	\$ 500.00
9	10' Curb Inlet Type R < 5 ft.	1	Ea.	\$ 8,447	\$ 8,447.00
10	15' Curb Inlet Type R < 5 ft.	5	Ea.	\$ 10,984	\$ 54,920.00
11	15' Curb Inlet Type R < 10 ft.	4	Ea.	\$ 11,775	\$ 47,100.00
12	Grated Inlet CDOT TYPE C	2	Ea.	\$ 5,138	\$ 10,276.00
13	Storm Sewer MH, box base	12	Ea.	\$ 12,876	\$ 154,512.00
14	Storm Sewer MH, slab base	4	Ea.	\$ 7,082	\$ 28,328.00
Sub-Total					\$ 781,732.00

Per LDC section 8.5.5.C.3.b(ii) Fee Reductions, Credits or Reimbursement for Facilities, this development requests that no cash drainage or bridge fees are due at platting as the value of reimbursable DBPS improvements for the Sand Creek Tributary segment 159, 164, 169, 186, the Sand Creek Mainstem segments 170, 187 and 163 and the Briargate Bridge shown in the below table exceed the drainage and bridge fee estimate shown above.

Sterling Ranch Deferred Drainage Fees Analysis

Reimbursable Costs associated with DBPS Segment 159 and 164, Segment 169 and 186 and Main Channel Segment 159

Reimbursable Estimate Segment 159 and 164 from SR F2 FDR (SF-2015)	\$1,918,065.00
Reimbursable Estimate Segment 169 and 186 from HN F1 FDR (SF-2213)	\$611,628.00
Reimbursable Estimate Mainstem Segment 170, 187 and 163 from SC Plans (CDR 20-04)	<u>\$7,910,175.90</u>
Subtotal Reimb. Costs associated with DBPS Segments 159-164, 169-186 and Main Channel Segments 170, 187 and 163	\$10,439,868.90

Earlier Plats Deferred Drainage Fees (SR F1, Branding Iron F1 & Homestead F1)	\$451,616.32
SR F2 (SF-2015) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$400,855.70
SR F3 (SF-2132) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$214,430.47
* HN F1 (SF-2213) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$541,225.00
* HN F2 (SF-2218) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$310,413.22
* HN F3 (SF-2229) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$399,632.48
SR F4 (SF-2230) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	<u>\$521,136.46</u>
Subtotal Deferred Drainage Fees	\$2,839,309.65

Unused Reimb. Costs associated with DBPS Segments 159-164, 169-186 and Main Channel Segments 170, 187 and 163	\$7,600,559.25
------------------------------------------------------------------------------------------------------------------	----------------

Sterling Ranch Deferred Bridge Fees Analysis

Reimbursable Costs associated with DBPS Bridge at Briargate Parkway and Sterling Ranch Rd.

Reimbursable Estimate Briargate Parkway Bridge from CDR 2113	\$1,546,676.98
Reimbursable Estimate Sterling Ranch Road Bridge from CDR 226	<u>\$990,016.80</u>
Subtotal Reimb. Costs associated with BGP and SR Rd. Bridges	\$2,536,693.78

SR F3 (SF-2132) Bridge Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$87,709.60
* HN F1 (SF-2213) Bridge Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$221,388.00
* HN F2 (SF-2218) Bridge Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$126,974.29
* HN F3 (SF-2229) Bridge Fees Deferred per LDC section 8.5.5.C.3.b(ii)	\$163,469.36
SR F4 (SF-2230) Bridge Fees Deferred per LDC section 8.5.5.C.3.b(ii)	<u>\$213,170.47</u>
Subtotal Deferred Bridge Fees	\$812,711.72

Unused Reimb. Costs associated with Briargate Parkway and SR Road Bridges	\$1,723,982.06
---------------------------------------------------------------------------	----------------

* Filing is not yet approved, actual fee at time of approval may be different than shown here

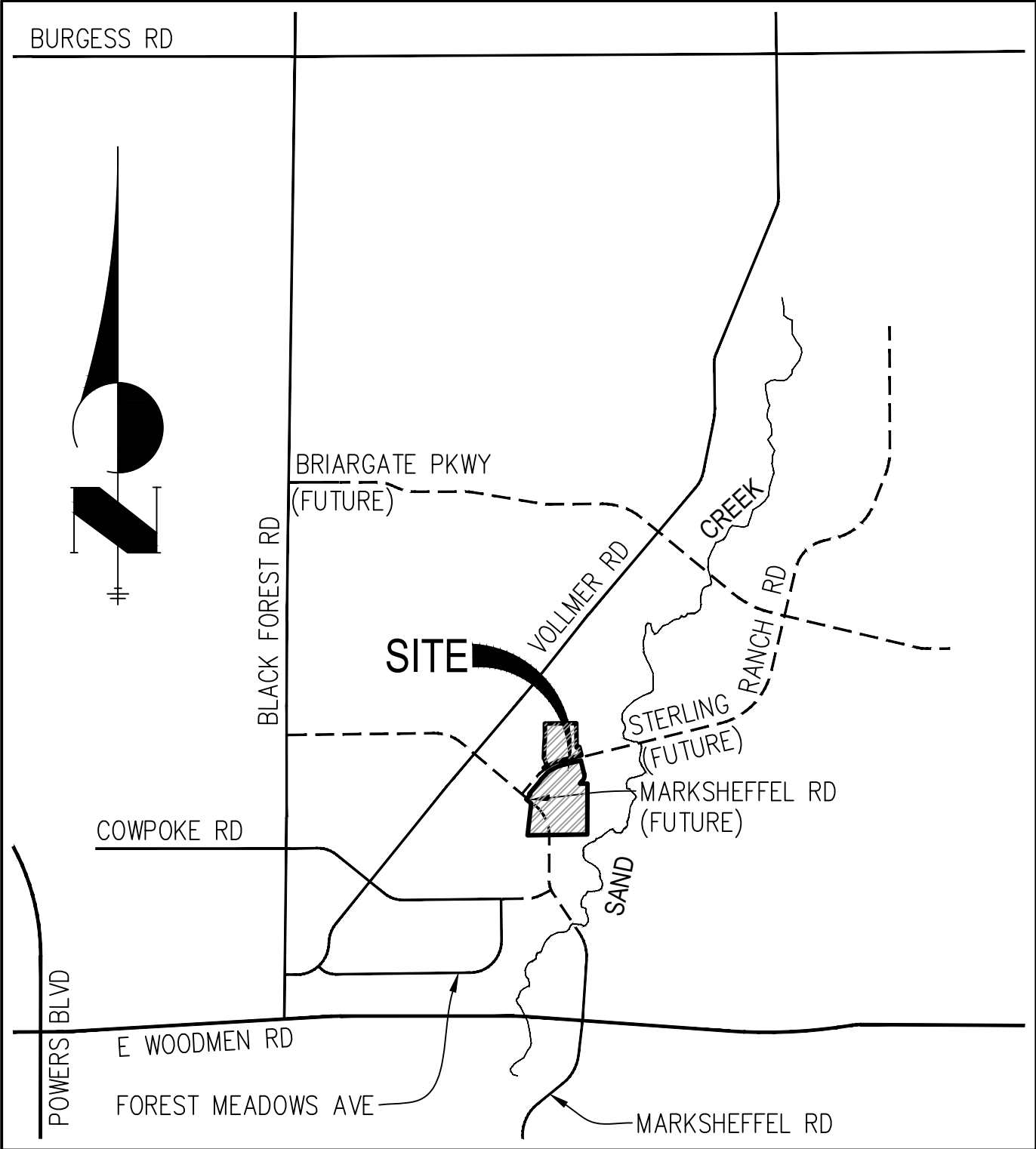
SUMMARY

The proposed Sterling Ranch Filing No. 4 drainage improvements were designed to meet or exceed the El Paso County Drainage Criteria. The proposed development will not adversely affect the offsite drainage-ways or surrounding development. The existing pond W-5 is to release less than 90% of the predeveloped runoff study associated with the subject site. The site is in continuity with the Sterling Ranch Filing No. 2 Drainage Report. This report is in conformance and meets the latest El Paso County Storm Drainage Criteria requirements for this site.

REFERENCES

1. "El Paso County and City of Colorado Springs Drainage Criteria Manual, Vol I & II".
 2. Sand Creek Channel Design Report, prepared by JR Engineering, May 19, 2021 (not yet approved)
 3. "Master Development Drainage Plan for Sterling Ranch", (MMDP) prepared by M&S Civil Consultants, Inc., dated October 24, 2018.
 4. Sand Creek Drainage Basin Planning Study, prepared Kiowa Engineering Corporation, January 1993, revised March 1996.
 5. "Sterling Ranch Filing 2 Final Drainage Report", prepared by JR Engineering, dated May 2021
 6. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.
 7. Sand Creek Stabilization at Aspen Meadows Subdivision Filing No. 1 – 100% Design Plans, April 2020
 8. Final Drainage Report For Barbarick Subdivision Portion Of Lots 1,2 And Lots 3 and 4, Prepared by Matrix Design Group, June 2016
 9. Preliminary Drainage Report And MDDP Addendum For Homestead North At Sterling Ranch Preliminary Plan", prepared by JR Engineering, dated January 2022
 10. Sand Creek Drainage Basin Planning Study, Stantec, January 2021
 12. Final Drainage Report for Aspen Meadows, Matrix Design, January 2019* pending approval
-

Appendix A
Vicinity Map, Soil Descriptions, FEMA Floodplain Map



VICINITY MAP

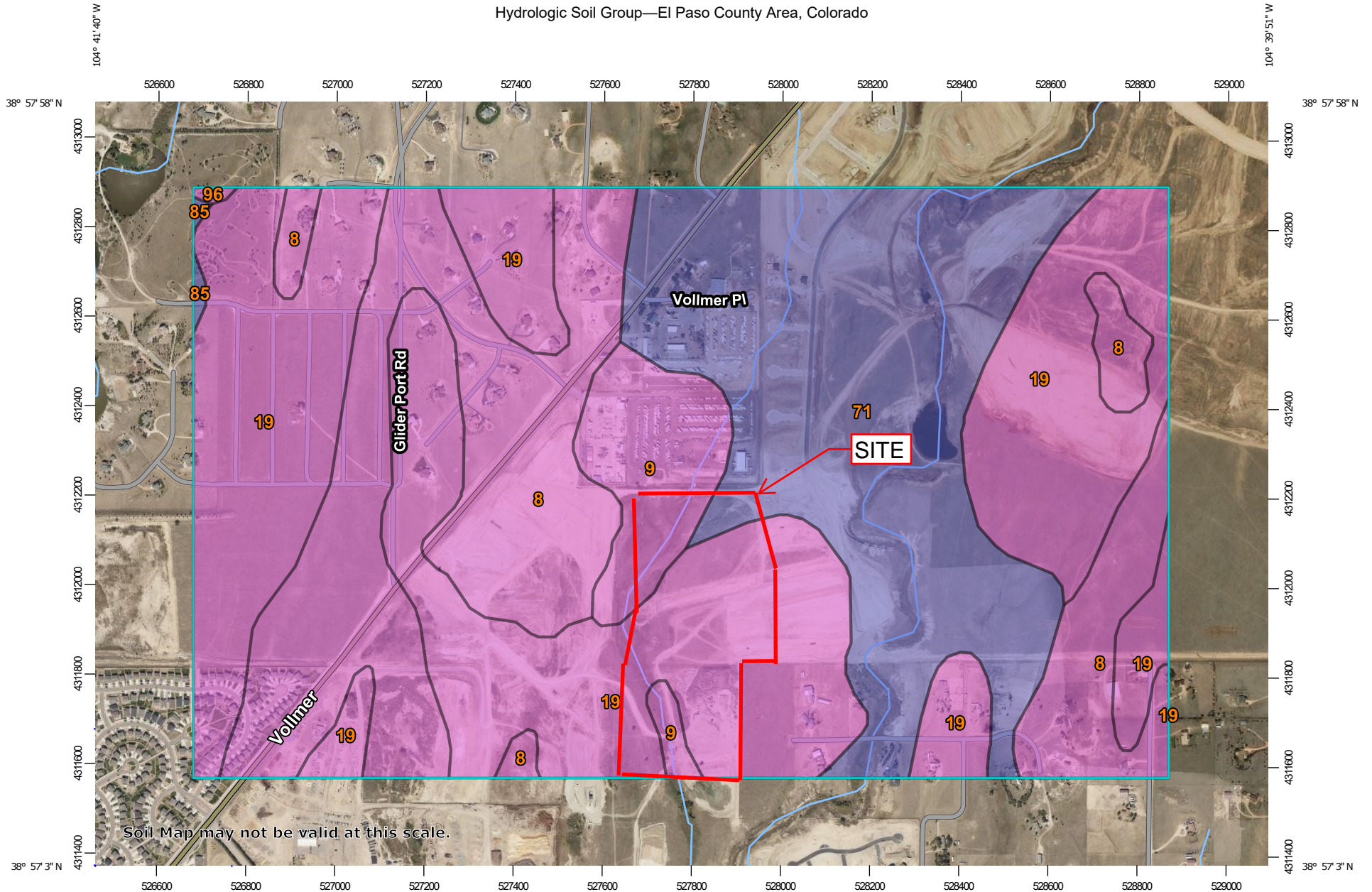
N.T.S.

VICINITY MAP
 STERLING RANCH FILING NO. 4
 JOB NO. 25188.11
 4/27/22
 SHEET 1 OF 1

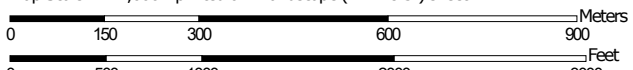


Centennial 303-740-9393 • Colorado Springs 719-593-2593
 Fort Collins 970-491-9888 • www.jrengineering.com

Hydrologic Soil Group—El Paso County Area, Colorado



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



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



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines

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

Soil Rating Points




-  A
-  A/D
-  B
-  B/D

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


Water Features

 Streams and Canals

Transportation

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

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 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 FIRI. Users should be aware that BFEs shown on the FIRI 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 FIRI 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 FIRI 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 FIRI.

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 across users in the production of FIRIs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRI.

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

NGS Information Services
 NOAA, NNGS12
 National Geodetic Survey
 SSMC-3, #9222
 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 (201) 713-3242 or visit its website at <http://www.ngs.noaa.gov/>.

Base Map information shown on this FIRI 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 FIRI for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRI 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 FIRI. 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 1-800-368-9620 and its website at <http://www.msc.fema.gov/>.

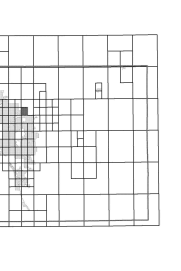
If you have questions about this map or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/inf>.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

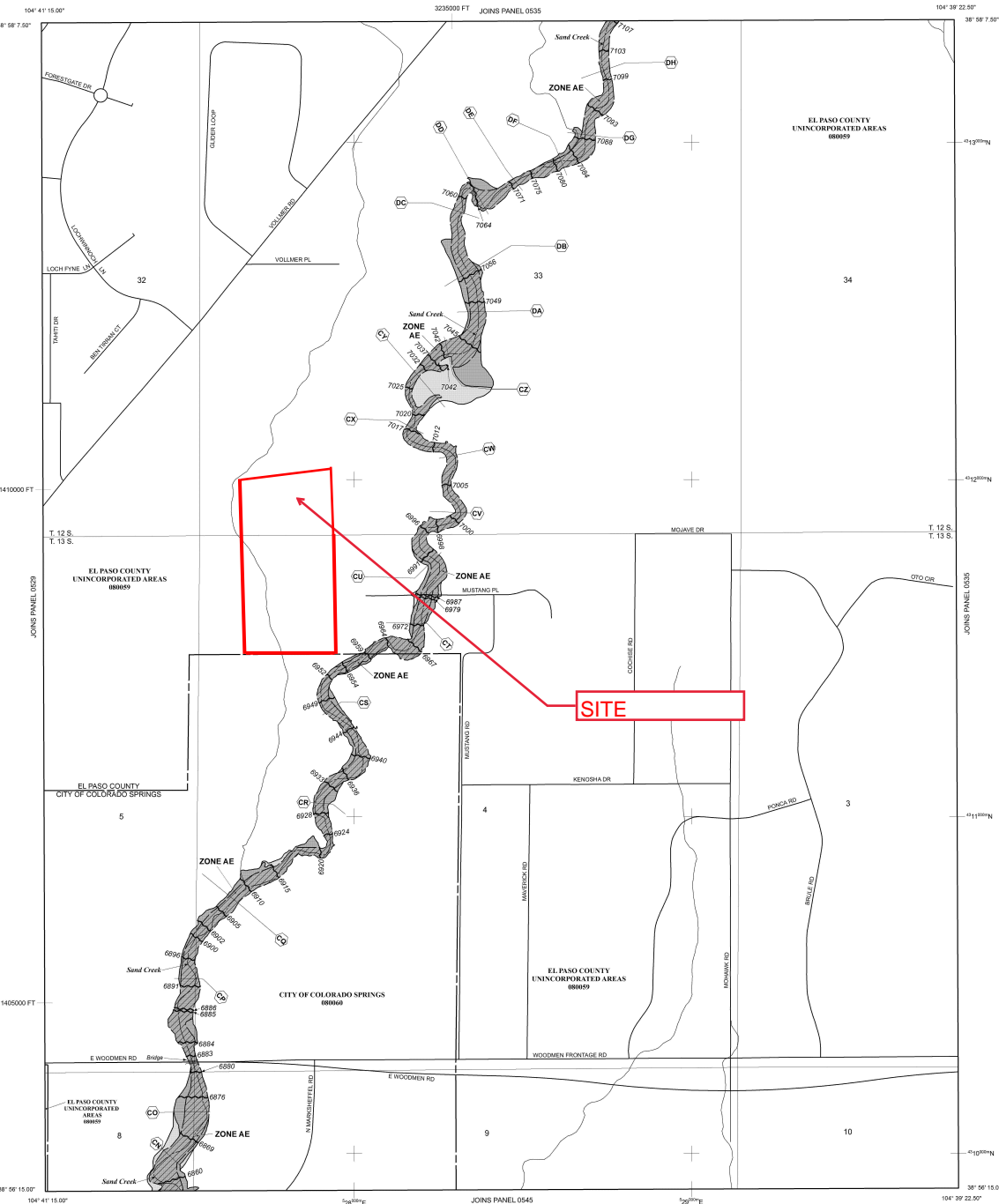
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM/STREAM VERTICAL DATUM CONVERSION INFORMATION.

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Plan (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.



LEGEND

- SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY 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 previously determined. Zone AR indicates that the former flood control system is being retained 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 increase in flood heights.

- OTHER FLOOD AREAS**
- ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with velocities less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS**
- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER PROTECTED SYSTEM (CBRS) AREAS**
- OTHERWISE PROTECTED AREAS (OPA)**

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

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Base Flood Elevation line and value, elevation in feet (EL 587)
- 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
- ⊙ — ⊙ Transsect line
- 97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 7197±M 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT 5000-foot grid ticks; Colorado State Plane coordinate system; central zone (SPROJCOE2)
- DXS510 Bench mark (see explanation in Notes to Users section of this FIRI report)
- M1.5 River file

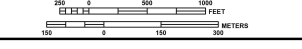
MAP REPOSITORIES
 Refer to Map Repository list on Map Index

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 cartographic information, 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 Change.

For community map revision history prior to cartographic 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.



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0533G

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

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

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS CITY OF	08008	0033	G
EL PASO COUNTY	08008	0033	G

MAP NUMBER
 08041C0533G

MAP REVISED
 DECEMBER 7, 2018

Federal Emergency Management Agency

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

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 4
 Project No.: 25188.02
 Calculated By: CJD
 Checked By: _____
 Date: 11/2/22

Basin ID	Total Area (ac)	Streets (100% Impervious)				Residential (65% Impervious)				1 Acre Lot Residential (20% Impervious)				Light Industrial (80% Impervious)				Lawns (0% 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	Area (ac)	Weighted % Imp.	C ₅	C ₁₀₀	
A-1	5.17	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.20	0.44	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	5.17	0.0%	0.08	0.35	0.0%
A-2	19.12	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.20	0.44	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	19.12	0.0%	0.08	0.35	0.0%
A-3	17.55	0.90	0.96	0.00	0.0%	0.45	0.59	0.62	2.3%	0.20	0.44	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	16.93	0.0%	0.09	0.36	2.3%
OS1	9.27	0.90	0.96	2.85	30.7%	0.45	0.59	0.00	0.0%	0.20	0.44	2.85	6.1%	0.59	0.70	0.00	0.0%	0.08	0.35	3.57	0.0%	0.37	0.57	36.9%
OS2	2.48	0.90	0.96	1.40	56.5%	0.45	0.59	0.00	0.0%	0.20	0.44	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	1.08	0.0%	0.54	0.69	56.5%
OS3	3.50	0.90	0.96	1.46	41.7%	0.45	0.59	0.00	0.0%	0.20	0.44	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	2.04	0.0%	0.42	0.60	41.7%
OS4	5.10	0.90	0.96	0.00	0.0%	0.45	0.59	0.65	8.3%	0.20	0.44	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	4.45	0.0%	0.13	0.38	8.3%
OS5	3.46	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.20	0.44	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	3.46	0.0%	0.08	0.35	0.0%
OS6	18.18	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.20	0.44	0.00	0.0%	0.59	0.70	10.40	45.8%	0.08	0.35	18.18	0.0%	0.42	0.75	45.8%
OS7	33.07	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.20	0.44	0.00	0.0%	0.59	0.70	7.51	19.1%	0.08	0.35	33.07	0.0%	0.22	0.52	19.1%
E-1	5.15	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.20	0.44	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	5.15	0.0%	0.08	0.35	0.0%
TOTAL (A1-A3)	41.84																							1.0%
TOTAL (OS1-OS7)	75.06																							28.4%
TOTAL	116.90																							18.6%

don't add up

EXISTING
STANDARD FORM SF-2
TIME OF CONCENTRATION

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

Project Name: Sterling Ranch Filing 4
Project No.: 25188.02
Calculated By: CJD
Checked By: _____
Date: 11/2/22

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					tc CHECK			FINAL
DATA						(T _i)			(T _t)					(URBANIZED BASINS)			
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)
A-1	5.17	A	0%	0.08	0.35	212	2.0%	21.4	517	2.1%	10.0	1.4	6.0	27.4	729.0	32.6	27.4
A-2	19.12	A	0%	0.08	0.35	297	2.5%	23.4	500	2.4%	10.0	1.6	5.3	28.7	797.0	31.9	28.7
A-3	17.55	A	2%	0.09	0.36	121	5.4%	11.4	784	2.7%	10.0	1.7	7.9	19.4	905.0	34.1	19.4
OS1	9.27	A	37%	0.37	0.57	298	2.7%	16.4	737	2.4%	10.0	1.5	8.0	24.4	1035.0	25.4	24.4
OS2	2.48	A	56%	0.54	0.69	117	3.1%	7.5	1745	1.6%	20.0	2.5	11.5	19.0	1862.0	30.0	19.0
OS3	3.50	A	42%	0.42	0.60	41	2.5%	5.8	1681	1.8%	20.0	2.7	10.5	16.2	1722.0	33.0	16.2
OS4	5.10	A	8%	0.13	0.38	491	1.4%	35.0	940	5.6%	10.0	2.4	6.6	41.6	1431.0	31.1	31.1
OS5	3.46	A	0%	0.08	0.35	298	3.0%	22.1	784	2.4%	10.0	1.6	8.4	30.4	1082.0	35.3	30.4
OS6	18.18	A	46%	0.42	0.75	165	3.4%	10.5	612	2.7%	10.0	1.6	6.2	16.8	777.0	22.3	16.8
OS7	33.07	A	19%	0.22	0.52	298	3.0%	19.1	1664	2.7%	10.0	1.6	16.9	35.9	1962.0	37.2	35.9
E-1	5.15	A	0%	0.08	0.35	60	3.0%	9.9	865	2.3%	10.0	1.5	9.5	19.4	925.0	36.5	19.4

NOTES:

$$t_c = t_i + t_t$$

Where:

- t_c = computed time of concentration (minutes)
- t_i = overland (initial) flow time (minutes)
- t_t = channelized flow time (minutes).

Equation 6-2

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

Where:

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

Equation 6-3

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.

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

Where:

- t_t = channelized flow time (travel time, min)
- L_t = waterway length (ft)
- S_s = waterway slope (ft/ft)
- V_t = travel time velocity (ft/sec) = K√S_s
- K = NRCS conveyance factor (see Table 6-2).

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

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_s = slope of the channelized flow path (ft/ft).

Equation 6-5

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 4
 Project No.: 25188.02
 Calculated By: CJD
 Checked By: _____
 Date: 11/2/22

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)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street/swale} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _t (min)				
	1	A-1	5.17	0.08	27.4	0.41	2.62	1.1																		
	16.2								19.6	7.39	3.12	23.1														Runoff from Sterling Ranch Filing no. 3 see attached report in appendix D
	2	A-2	19.12	0.08	28.7	1.53	2.55	3.9	28.7	8.92	2.55	22.7														Basin A2 + runoff from Sterling Ranch Filing No. 3
	3	OS1	9.27	0.37	24.4	3.42	2.79	9.5																		Basin OS1
	4	OS5	3.46	0.08	30.4	0.28	2.46	0.7																		Basin A4
	7	OS2	2.48	0.54	19.0	1.35	3.16	4.3																		Basin OS2
	8	OS3	3.50	0.42	16.2	1.48	3.40	5.0																		Basin OS3
	9	OS4	5.10	0.13	31.1	0.65	2.43	1.6																		Basin OS4
	10	OS6	18.18	0.42	16.8	7.59	3.35	25.4						7.6	3.4					998	1.8	9.1				Basin OS6 travel to design point 5.1
	11	OS7	33.07	0.22	35.9	7.31	2.21	16.2						7.31	3.2					936	1.8	8.7				Basin OS7 travel to design point 5.1
	5	A-3	17.55	0.09	19.4	1.63	3.14	5.1																		Basin A3
	5.1								35.9	14.90	2.21	32.9														Design point 5.1 fed by basins A3, OS6, and OS7
	O1	E-1	5.15	0.08	19.4	0.41	3.13	1.3																		Basin E-1

Notes:
 Street and Pipe C*A values are determined by Q/I using the catchment's intensity value.

COMPOSITE % IMPERVIOUS & COMPOSITE PROPOSED RUNOFF COEFFICIENT CALCULATIONS

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

Project Name: Sterling Ranch Filing No. 4
 Project No.: 25188.11
 Calculated By: ARJ
 Checked By: _____
 Date: 11/2/22

Basin ID	Total Area (ac)	Paved/Streets (100% Impervious)				Residential (65% Impervious)				Light Industrial (80% Impervious)				Lawns (0% 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	
A2	1.38	0.90	0.96	0.22	15.9%	0.45	0.59	0.34	16.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.82	0.0%	0.30	0.51	32.0%
A3	3.68	0.90	0.96	0.71	19.3%	0.45	0.59	2.59	45.7%	0.59	0.70	0.00	0.0%	0.08	0.35	0.38	0.0%	0.50	0.64	65.0%
A4	4.53	0.90	0.96	0.67	14.8%	0.45	0.59	2.35	33.7%	0.59	0.70	0.00	0.0%	0.08	0.35	1.51	0.0%	0.39	0.56	48.5%
A5	0.45	0.90	0.96	0.17	38.1%	0.45	0.59	0.28	40.8%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.63	0.73	79.0%
A6.1	4.73	0.90	0.96	1.02	21.6%	0.45	0.59	3.70	50.9%	0.59	0.70	0.00	0.0%	0.08	0.35	0.01	0.0%	0.55	0.67	72.5%
A6.2	2.56	0.90	0.96	0.66	25.7%	0.45	0.59	1.90	48.2%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.56	0.68	73.9%
A7	1.76	0.90	0.96	0.43	24.5%	0.45	0.59	1.32	48.8%	0.59	0.70	0.00	0.0%	0.08	0.35	0.01	0.0%	0.56	0.68	73.3%
A8	4.23	0.90	0.96	0.12	2.8%	0.45	0.59	0.68	10.5%	0.59	0.70	0.00	0.0%	0.08	0.35	3.42	0.0%	0.16	0.41	13.4%
A9	2.02	0.90	0.96	0.06	3.0%	0.45	0.59	0.15	4.8%	0.59	0.70	0.00	0.0%	0.08	0.35	1.81	0.0%	0.13	0.39	7.8%
A10	2.67	0.90	0.96	0.44	16.4%	0.45	0.59	0.40	9.8%	0.59	0.70	0.00	0.0%	0.08	0.35	1.83	0.0%	0.27	0.49	26.2%
B3	2.38	0.90	0.96	1.41	59.3%	0.45	0.59	0.12	3.3%	0.59	0.70	0.00	0.0%	0.08	0.35	0.85	0.0%	0.58	0.72	62.6%
C1	2.59	0.90	0.96	0.72	27.8%	0.45	0.59	1.66	41.7%	0.59	0.70	0.00	0.0%	0.08	0.35	0.21	0.0%	0.55	0.67	69.5%
C2	6.75	0.90	0.96	1.49	22.0%	0.45	0.59	4.21	40.5%	0.59	0.70	0.00	0.0%	0.08	0.35	1.06	0.0%	0.49	0.63	62.5%
C3	4.18	0.90	0.96	0.14	3.4%	0.45	0.59	1.00	15.5%	0.59	0.70	0.00	0.0%	0.08	0.35	3.04	0.0%	0.20	0.43	18.9%
C4	4.41	0.90	0.96	1.85	42.0%	0.45	0.59	1.35	19.9%	0.59	0.70	0.00	0.0%	0.08	0.35	1.21	0.0%	0.54	0.68	61.8%
I1	5.88	0.90	0.96	1.23	20.9%	0.45	0.59	2.98	32.9%	0.59	0.70	0.00	0.0%	0.08	0.35	1.67	0.0%	0.44	0.60	53.8%
I2	2.18	0.90	0.96	0.81	37.2%	0.45	0.59	1.13	33.7%	0.59	0.70	0.00	0.0%	0.08	0.35	0.24	0.0%	0.58	0.70	70.8%
I3	2.94	0.90	0.96	0.74	25.2%	0.45	0.59	1.94	42.9%	0.59	0.70	0.00	0.0%	0.08	0.35	2.94	0.0%	0.60	0.98	68.1%
OS6	18.38	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	10.40	45.3%	0.08	0.35	7.98	0.0%	0.37	0.55	45.3%
OS7	33.07	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	7.91	19.1%	0.08	0.35	25.16	0.0%	0.20	0.43	19.1%
E1	0.88	0.90	0.96	0.75	85.6%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.13	0.0%	0.78	0.87	85.6%
E2	0.91	0.90	0.96	0.76	83.1%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.15	0.0%	0.76	0.86	83.1%
E3	0.35	0.90	0.96	0.31	88.9%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.04	0.0%	0.81	0.89	88.9%
E4	0.61	0.90	0.96	0.29	46.9%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.32	0.0%	0.46	0.64	46.9%
TOTAL (A2-C4)	48.31																			50.6%
Total (C1-I3)	28.93																			56.2%
TOTAL (OS6 -OS7)	51.45																			28.5%
TOTAL (E1-E4)	2.75																			76.6%
TOTAL	113.51																			42.2%

seems low (ultimate development?)

**PROPOSED
STANDARD FORM SF-2
TIME OF CONCENTRATION**

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

Project Name: Sterling Ranch Filing No. 4
Project No.: 25188.11
Calculated By: ARJ
Checked By: _____
Date: 11/2/22

SUB-BASIN DATA						INITIAL/OVERLAND (T _i)			TRAVEL TIME (T _t)					t _c CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C _s	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)
A2	1.38	A	32%	0.30	0.51	100	3.7%	9.4	141	1.5%	20.0	2.4	1.0	10.3	241.0	22.0	10.3
A3	3.68	A	65%	0.50	0.64	100	3.7%	7.0	1008	2.4%	20.0	3.1	5.5	12.5	1108.2	21.0	12.5
A4	4.53	A	48%	0.39	0.56	100	2.1%	10.1	814	1.9%	20.0	2.8	4.9	15.0	914.0	24.0	15.0
A5	0.45	A	79%	0.63	0.73	54	3.7%	4.1	217	3.9%	20.0	4.0	0.9	5.0	271.0	13.5	5.0
A6.1	4.73	A	72%	0.55	0.67	100	2.0%	8.0	841	2.9%	20.0	3.4	4.1	12.1	941.0	18.0	12.1
A6.2	2.56	A	74%	0.56	0.68	100	2.0%	7.7	685	1.6%	20.0	2.6	4.5	12.1	785.0	18.1	12.1
A7	1.76	A	73%	0.56	0.68	100	3.4%	6.5	367	1.2%	20.0	2.2	2.8	9.4	467.0	16.5	9.4
A8	4.23	A	13%	0.16	0.41	233	4.9%	15.3	307	0.9%	15.0	1.4	3.6	18.9	540.0	28.7	18.9
C1	2.59	A	69%	0.55	0.67	100	4.3%	6.2	393	1.8%	20.0	2.7	2.5	8.7	493.0	16.8	8.7
C2	6.75	A	63%	0.49	0.63	99	1.8%	9.1	796	1.7%	20.0	2.6	5.1	14.2	895.0	21.1	14.2
C3	4.18	A	19%	0.20	0.43	100	9.6%	7.7	255	3.5%	15.0	2.8	1.5	9.3	355.0	24.7	9.3
A9	2.02	A	8%	0.13	0.39	100	2.4%	13.1	108	2.6%	20.0	3.2	0.6	13.6	208.0	25.8	13.6
A10	2.67	A	26%	0.27	0.49	100	2.8%	10.7	0	1.0%	20.0	2.0	0.0	10.7	100.0	21.5	10.7
B3	2.38	A	63%	0.58	0.72	37	3.4%	3.8	1595	1.5%	10.0	1.2	21.7	25.5	1632.0	27.6	25.5
C4	4.41	A	62%	0.54	0.68	100	3.0%	7.1	1664	1.5%	10.0	1.2	22.6	29.7	1764.0	28.3	28.3
OS6	18.38	A	45%	0.37	0.55	165	3.4%	11.3	612	2.7%	10.0	1.6	6.2	17.5	777.0	22.4	17.5
OS7	33.07	A	19%	0.20	0.43	298	3.0%	19.5	1664	2.7%	10.0	1.6	16.9	36.4	1962.0	37.2	36.4
I1	5.88	A	54%	0.44	0.60	180	1.4%	14.3	497	1.6%	10.0	1.3	6.5	20.9	677.0	20.8	20.8
I2	2.18	A	71%	0.58	0.70	125	1.6%	9.1	385	5.2%	10.0	2.3	2.8	11.9	510.0	15.4	11.9
I3	2.94	A	68%	0.60	0.98	80	1.7%	6.7	385	2.5%	10.0	1.6	4.1	10.8	465.0	16.6	10.8
E1	0.88	A	86%	0.78	0.87	30	2.0%	2.5	730	2.9%	20.0	3.4	3.6	6.1	760.0	14.9	6.1
E2	0.91	A	83%	0.76	0.86	30	2.0%	2.7	675	2.9%	20.0	3.4	3.3	6.0	705.0	15.1	6.0
E3	0.35	A	89%	0.81	0.89	30	2.0%	2.3	280	1.9%	20.0	2.8	1.7	4.0	310.0	12.5	5.0
E4	0.61	A	47%	0.46	0.64	30	2.0%	5.0	260	1.9%	20.0	2.8	1.6	6.6	290.0	20.1	6.6

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)

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

Equation 6-4

Where:

t_t = channelized flow time (travel time, min)

L_t = waterway length (ft)

S_o = waterway slope (ft/ft)

F_t = travel time velocity (ft/sec) = K√S_o

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

$$t_i = \frac{0.395(1 - C_s)\sqrt{L}}{S_o}$$

Where:

t_i = overland (initial) flow time (minutes)

C_s = runoff coefficient for 5-year frequency (from Table 6-4)

L = length of overland flow (ft)

S_o = average slope along the overland flow path (ft/ft)

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

Equation 6-3

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

Where:

t_c = minimum time of concentration for first design point when less than t_i from Equation 6-1.

L_c = length of channelized flow path (ft)

f = imperviousness (expressed as a decimal)

S_o = slope of the channelized 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.

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

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

Project Name: Sterling Ranch Filing No. 4
 Project No.: 25188.11
 Calculated By: ARJ
 Checked By:
 Date: 11/2/22

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)	t _c (min)	C* A (ac)	I (in/hr)	Q (cfs)	Q _{street/swale} (cfs)	C* A (ac)	Slope (%)	Q _{pipe} (cfs)	C* A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)		t _t (min)
	1	OS7	33.07	0.20	36.4	6.68	2.19	14.6							14.6	6.68	1.0	36	430	7.5	1.0	detained	
	4	OS6	18.38	0.37	17.5	6.77	3.29	22.3														Offsite Barbarrick Subdivision pond release Piped to DP 4.1	
	4.1							37.3	13.45	2.15	29.0				29.0	13.45	1.0	48	775	8.9	1.4	Offsite sub-division pond release Confluent at DP 4.1	
	5	C2	6.75	0.49	14.2	3.32	3.61	12.0							12.0	3.32	1.0	24	63	7.3	0.1	Offsite flow confluent from basins OS7 and OS6 w/ bypass flows Piped to DP 7.1	
	6	C1	2.59	0.55	8.7	1.41	4.34	6.1														Sump Inlet Piped to DP 6.1	
	6.1							14.3	4.73	3.59	17.0				17.0	4.73	1.0	36	245	7.8	0.5	Sump Inlet Piped to DP 6.1	
	7	C3	4.18	0.20	9.3	0.82	4.24	3.5														Area Inlet Piped to DP 7.1	
	7.1							38.8	14.27	2.10	29.9				29.9	14.27	1.0	36	40	9.2	0.1	Structure piped to 7.2	
	7.2							38.8	19.00	2.09	39.8											Piped to existing storm sewer in Sterling Ranch Road	
	8	C4	4.41	0.54	28.3	2.37	2.57	6.1														Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road	
	9	B3	2.38	0.58	25.5	1.39	2.73	3.8														Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road	
	1.1	I1	5.88	0.44	20.8	2.58	3.03	7.8														Runoff drains into into swale	
	3.1	I3	2.94	0.60	10.8	1.77	4.01	7.1														Runoff drains into swale	
	2.1	I2	2.18	0.58	11.9	1.26	3.87	4.9	20.8	5.61	3.03	17.0										Sum of flows from DP7.2, 8, 9, and 2.1	
	10							38.8	28.37	2.09	59.4	0.4	0.11	1.6									Existing runoff piped from Sterling Ranch Filing 3 subdivision by-passed to DP 17/ curb and gutter flow to DP17
	15							8.2							7.8								On-grade Inlet from overland flow on Filing 3 subdivision
	15.1							19.5	6.71	3.13	21.0				21.0	6.71	1.0	24	45	8.2	0.1	Captured Flows piped to DP 16.1	
	16	A5	0.45	0.63	5.0	0.28	5.17	1.4						0.0	0	2.9						Existing On-grade Inlet from Sterling Ranch Filing 3 Captured Flows piped to DP 16.1, by pass flow to DP12	
	16.1							19.6	6.88	3.12	21.5				21.5	6.88	1.0	24	280	8.2	0.6	Piped to DP 18.1	
	17	A2	1.38	0.30	10.3	0.42	4.08	1.7	20.2	0.53	3.08	1.6	0.0	0								On-grade Inlet, includes by pass flow from DP15/ Sterling Ranch Filing 3 Piped to DP 18.1	
	17.1														1.6							Captured runoff from on Grade inlet at DP 17, FLOWS TO DP 18.1	
	18.1							20.3	7.41	3.07	22.7				22.7	0.00	1.0	36	600	8.5	1.2	Piped to DP18.2	
	12	A6.1	4.73	0.55	12.1	2.59	3.85	10.0					0.9	0.23	1.0							On-grade Inlet, includes by pass flow from DP16 Captured Flows piped to DP 18.2, Bypass flow to DP 19	
	12.1														9.1							Captured flow into on grade inlet at DP12.1	
	18.2							21.4	9.77	2.99	29.2				29.2	9.77	1.0	42	50	9.1	0.1	Piped to DP20.2	

36" on plan?

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

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

Project Name: Sterling Ranch Filing No. 4
 Project No.: 25188.11
 Calculated By: ARJ
 Checked By:
 Date: 11/2/22

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)	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)
	19	A6.2	2.56	0.56	12.1	1.45	3.84	5.6	12.3	1.68	3.82	6.4	0.0	0	1.0	6.4	1.67	1.0	18	30	6.2	0.1	On-grade Inlet, includes by pass flow from DP12 Captured Flows piped to DP 20.1, Bypass flow to DP 21
	19.1															6.4							Captured flow from on grade inlet from DP 19
	20	A3	3.68	0.50	12.5	1.84	3.79	7.0					0.0	0	1.0	7.0	1.84	1.0	18	4	6.3	0.0	On-grade Inlet Captured Flows piped to DP 20.1
	20.1															7.0							Captured flow from on grade inlet from DP 20
	20.2								21.5	13.28	2.98	39.6				39.6	13.28	1.0	42	220	9.8	0.4	Piped to DP23
	21	A7	1.76	0.56	9.4	0.99	4.23	4.2	12.2	0.99	3.83	3.8				3.8	0.99	1.0	24	60	5.3	0.2	Sump Inlet, includes by pass flow from DP19 Piped to DP21.1
	21.1								21.5	14.27	2.98	42.5				42.5	14.27	1.0	42	90	10.0	0.2	MH Piped to DP23
	22	A4	4.53	0.39	15.0	1.78	3.52	6.3	15.0	1.78	3.52	6.3											Sump Inlet, includes by pass flow from DP17 and DP20 Piped to DP22.1
	22.1								15.0	1.78	3.52	6.3				6.3	1.78	1.0	24	10	6.2	0.0	Piped to DP23
	23								21.9	16.05	2.95	47.4				47.4	16.05	1.0	42	145	10.3	0.2	Piped to DP26
	24	A8	4.23	0.16	18.9	0.69	3.17	2.2															Area Inlet Piped to EX 84" Storm Line Built w/ SR Filing 2 First Phase
	25	A9	2.02	0.13	13.6	0.27	3.66	1.0								1.0	0.27	1.0	18	30	3.6	0.1	EX FES Piped to EX 84" Storm Line Built w/ SR Filing 2 First Phase
	27	A10	2.67	0.27	10.7	0.72	4.03	2.9															Pervious area sheet flows into EX Pond W5
	e11												0.7										By pass runoff from upstream existing 15' type R inlet built in Sterling Ranch Filing No. 2
	1e	E1	0.88	0.78	6.1	0.69	4.87	3.4				4.1	0.0										Runoff from up stream + runoff from by pass flow
	1.1e															4.1							Captured and Piped runoff from 15' type R inlet
	e10												0.6										By pass runoff from up stream existing 15' type R inlet built in Sterling Ranch Filing No. 2
	2e	E2	0.91	0.76	6.0	0.70	4.90	3.4				4.0											Total Runoff from up stream + runoff from by pass flow
	2.1e															8.1							Total runoff piped from basin E1 + upstream bypass and runoff from basin E2 + runoff from upstream bypass
	3e	E3	0.35	0.81	5.0	0.28	5.17	1.4	6.1	0.28	4.87	1.4	0.0										Total runoff from basin E3 and bypass runoff from basin E1
	4e	E4	0.61	0.46	6.6	0.28	4.76	1.3	6.6	0.28	4.76	1.3											Total runoff from basin E4 and bypass runoff from basin E2

Notes:
 Street and Pipe C* A values are determined by Q/i using the catchment's intensity value.

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

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

Project Name: Sterling Ranch Filing No. 4
 Project No.: 25188.11
 Calculated By: ARJ
 Checked By:
 Date: 11/2/22

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)	
	1	OS7	33.07	0.43	36.4	14.34	3.68	52.8							52.8	14.34	1.0	36	725	10.5	1.2	Offsite Barbarick Subdivision pond release Piped to DP 4.1	
	4	OS6	18.38	0.55	17.5	10.07	5.52	55.6														Offsite subdivision pond release Confluent at DP 4.1	
	4.1								37.5	24.41	3.60	87.9			87.9	24.41	1.0	48	775	12.0	1.1	Offsite flow confluent from basins OS7 and OS6 w/ bypass flows Piped to DP 7.1	
	5	C2	6.75	0.63	14.2	4.28	6.06	25.9							25.9	4.28	1.0	24	63	8.3	0.1	Sump Inlet Piped to DP 6.1	
	6	C1	2.59	0.67	8.7	1.74	7.29	12.7														Sump Inlet Piped to DP 6.1	
	6.1								14.3	6.02	6.03	36.3			36.3	6.02	1.0	36	245	9.6	0.4	Piped to DP 7.2	
	7	C3	4.18	0.43	9.3	1.79	7.12	12.8														Area Inlet Piped to DP 7.1	
	7.1								38.6	26.20	3.53	92.5			92.5	26.20	1.0	36	40	13.1	0.1	Structure piped to 7.2	
	7.2								38.6	32.22	3.53	113.6										Piped to existing storm sewer in Sterling Ranch Road	
	8	C4	4.41	0.68	28.3	3.00	4.31	12.9														Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road	
	9	B3	2.38	0.72	25.5	1.72	4.58	7.9														Offsite flow to existing inlet in Sterling Ranch Road Piped to existing storm sewer in Sterling Ranch Road	
	1.i	I1	5.88	0.60	20.8	3.52	5.09	17.9														Runoff drains into into swale	
	3.i	I3	2.94	0.98	10.8	2.88	6.74	19.4														Runoff drains into swale	
	2.i	I2	2.18	0.70	11.9	1.53	6.50	9.9	20.8	7.93	5.09	40.3											
	10								38.6	44.87	3.53	158.2										Sum of flows from DP7.2, 8, 9, and 2.1	
	15							17.7				4.7	0.817	1.5				12.5				Existing runoff piped from Sterling Ranch Filing 3 subdivision by-passed to DP 17 curb and gutter flow to DP17	
	15.1								19.2	8.18	5.28	43.2			43.2	8.18	1.0	24	45	13.8	0.1	On-grade Inlet from overland flow on Filing 3 subdivision Captured Flows piped to DP 16.1	
	16	A5	0.45	0.73	5.0	0.33	8.68	2.9				0.0	0	2.9								Existing On-grade Inlet from Sterling Ranch Filing 3 Captured Flows piped to DP 16.1, by pass flow to DP12	
	16.1								19.3	8.51	5.28	44.9			44.9	8.51	1.0	24	280	14.3	0.3	Piped to DP 18.1	
	17	A2	1.38	0.51	10.3	0.70	6.85	4.8	19.6	1.52	5.23	7.9	0.2	0.029	7.7	1.49	1.0	18	27	6.5	0.1	On-grade Inlet, includes by pass flow from DP15/ Sterling Ranch Filing 3 Piped to DP 18.1	
	17.1														7.7							Captured runoff from on Grade inlet at DP 17, FLOWS TO DP 18.1	
	18.1								19.7	10.03	5.23	52.4			52.4	10.03	1.0	36	600	10.5	1.0	Piped to DP18.2	
	12	A6.1	4.73	0.67	12.1	3.17	6.46	20.5				6.6	1.022	1.0	13.9	2.15	1.0	24	100	7.6	0.2	On-grade Inlet, includes by pass flow from DP16 Captured Flows piped to DP 18.2, Bypass flow to DP 19	
	12.1														13.9							Captured flow into on grade inlet at DP12.1	
	18.2								20.6	12.18	5.11	62.2			62.2	12.18	1.0	42	50	11.0	0.1	Piped to DP20.2	

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

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

Project Name: Sterling Ranch Filing No. 4
 Project No.: 25188.11
 Calculated By: ARJ
 Checked By:
 Date: 11/2/22

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)	
	19	A6.2	2.56	0.68	12.1	1.75	6.44	11.3	12.3	2.77	6.41	17.8	4.9	0.761	1.0	12.9	2.00	1.0	18	30	7.3	0.1	On-grade Inlet, includes by pass flow from DP12 Captured Flows piped to DP 20.1, Bypass flow to DP 21
	19.1														12.9								Captured flow from on grade inlet from DP 19
	20	A3	3.68	0.64	12.5	2.34	6.37	14.9					3.2	0.502	1.0	11.7	1.84	1.0	18	4	6.6	0.0	On-grade Inlet Captured Flows piped to DP 20.1
	20.1														11.7								Captured flow from on grade inlet from DP 20
	20.2								20.7	16.01	5.10	81.6			81.6	16.01	1.0	42	220	11.7	0.3	Piped to DP23	
	21	A7	1.76	0.68	9.4	1.20	7.10	8.5	12.2	1.96	6.43	12.6			12.6	1.96	1.0	24	60	7.4	0.1	Sump Inlet, includes by pass flow from DP19 Piped to DP21.1	
	21.1								20.7	17.97	5.10	91.6			91.6	17.97	1.0	42	90	11.9	0.1	MH Piped to DP23	
	22	A4	4.53	0.56	15.0	2.56	5.91	15.1	15.0	3.09	5.91	18.3											Sump Inlet, includes by pass flow from DP17 and DP20 Piped to DP22.1
	22.1								15.0	3.09	5.91	18.3			18.3	3.09	1.0	24	10	8.0	0.0	Piped to DP23	
	23								21.0	21.07	5.06	106.6			106.6	21.07	1.0	42	145	11.8	0.2	Piped to DP26	
	24	A8	4.23	0.41	18.9	1.72	5.32	9.2															Area Inlet Piped to EX 84" Storm Line Built w/ SR Filing 2 First Phase
	25	A9	2.02	0.39	13.6	0.78	6.15	4.8							4.8	0.78	1.0	18	30	5.7	0.1	EX FES Piped to EX 84" Storm Line Built w/ SR Filing 2 First Phase	
	27	A10	2.67	0.49	10.7	1.30	6.77	8.8															Pervious area sheet flows into EX Pond W5
	e11												6.2										By pass runoff from upstream existing 15' type R Inlet built in Sterling Ranch Filing No. 2
	1e	E1	0.88	0.87	6.1	0.77	8.18	6.3				12.5	1.9	0.232	2.8	10.6							Runoff from up stream + runoff from by pass flow
	1.1e														10.6								Captured and Piped runoff from 15' type R inlet
	e10												4.6										By pass runoff from up stream existing 15' type R Inlet built in Sterling Ranch Filing No. 2
	2e	E2	0.91	0.86	6.0	0.78	8.22	6.4				11.0	1.2	0.146	2.8	9.8							Total Runoff from up stream + runoff from by pass flow
	2.1e														20.4								Total runoff piped from basin E1 + upstream bypass and runoff from basin E2 + runoff from upstream bypass
	3e	E3	0.35	0.89	5.0	0.31	8.68	2.7	6.1	0.54	8.18	4.4											Total runoff from basin E3 and bypass runoff from basin E1
	4e	E4	0.61	0.64	6.6	0.39	7.99	3.1	6.6	0.54	7.99	4.3											Total runoff from basin E4 and bypass runoff from basin E2

Notes:
 Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

Appendix C

Hydraulic Calculations



MILE HIGH FLOOD DISTRICT STREET AND INLET HYDRAULICS WORKBOOK

MHFD-Inlet, Version 5.02 (August 2022)
Mile High Flood District
Denver, Colorado
www.mhfd.org

Purpose: This workbook can be used to size a variety of inlets based on allowable spread and depth in a street or swale.

Function:

1. To calculate peak discharge for the tributary area to each inlet.
2. To calculate allowable half-street capacity based on allowable depth and spread.
3. To determine the inlet capacity for selected inlet types.
4. To manage inlet information and connect inlets in series to account for bypass flow.

Content: The workbook consists of the following sheets:

Q-Peak Calculates the peak discharge for the inlet tributary area based on the Rational Method for the minor and major storm events. Alternatively, the user can enter a known flow. Information from this sheet is then exported to the *Inlet Management* sheet.

Inlet Management Imports information from the *Q-Peak* sheet and *Inlet [#]* sheets and can be used to connect inlets in series so that bypass flow from an upstream inlet is added to flow calculated for the next downstream inlet. This sheet can also be used to modify design information from the Q-peak sheet.

Inlet [#] *Inlet [#]* sheets are created each time the user exports information from the *Q-Peak* sheet to the *Inlet Management* sheet. The *Inlet [#]* sheets calculate allowable half-street capacity based on allowable depth and allowable spread for the minor and major storm events. This is also where the user selects an inlet type and calculates the capacity of that inlet.

Inlet Pictures Contains a library of photographs of the various types of inlets contained in MHFD-Inlet and referenced in the USDCM.

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Professor, Department of Civil Engineering, University of Colorado at Denver

Comments?
Revisions?

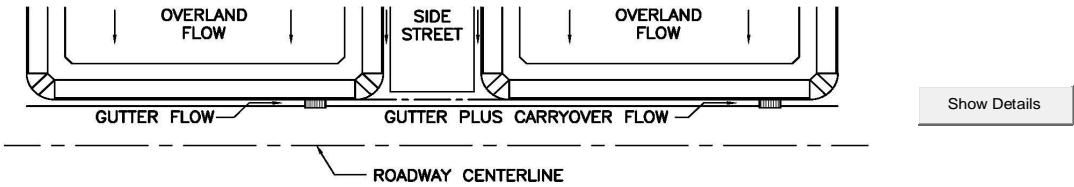
Direct all comments regarding this spreadsheet workbook to:
Check for revised versions of this or any other workbook at:

[MHFD E-mail](#)
[Downloads](#)

DESIGN PEAK FLOW FOR SWALE OR ONE-HALF OF STREET BY THE RATIONAL METHOD

MHFD-Inlet, Version 5.02 (August 2022)

Project: Sterling Ranch Filing 4



Design Flow: ONLY if already determined through other methods (local peak flow for 1/2 of street OR grass-lined channel): *Q _{known} = <input type="text"/> Minor Storm <input type="text"/> Major Storm cfs *If you enter flows in Row 14, select "Street Inlet" or "Area Inlet" button, skip the rest of this sheet, and click "Add New Inlet" at bottom.		FILL IN THIS SECTION <--- OR... FILL IN THE SECTIONS BELOW. <---																																								
Geographic Information: Enter data in the blue cells																																										
Subcatchment Area = <input type="text"/> acres Percent Imperviousness = <input type="text"/> % NRCS Soil Type = <input type="text"/> A, B, C, or D	Slope (ft/ft) <input type="text"/> Length (ft) <input type="text"/> Overland Flow = <input type="text"/> Gutter Flow = <input type="text"/>																																									
Site Type: <input checked="" type="radio"/> Site is Urban <input type="radio"/> Site is Rural	Flows Developed For: <input checked="" type="radio"/> Street Inlet <input type="radio"/> Area Inlet in a Swale																																									
Rainfall Information: Intensity, I (inch/hr) = C1 * P1 / (C2 + Tc) ^ C3 Design Storm Return Period <input type="text"/> 1-Hour Rainfall Depth <input type="text"/> User-Defined Storm Runoff Coefficient (leave blank to accept calculated value) User-Defined 5-yr. Runoff Coefficient (leave blank to accept calculated value) Bypass (Carry-Over) Flow from upstream Subcatchments <input type="text"/>		Select MHFD location from the pu																																								
Total Design Peak Flow <input type="text"/>																																										
		<table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td>T_r =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td>years</td> </tr> <tr> <td>P₁ =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td>inches</td> </tr> <tr> <td>C₁ =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td></td> </tr> <tr> <td>C₂ =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td></td> </tr> <tr> <td>C₃ =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td></td> </tr> <tr> <td>C =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td></td> </tr> <tr> <td>C₅ =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td></td> </tr> <tr> <td>Q_b =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td>cfs</td> </tr> <tr> <td>Q =</td> <td><input type="text"/></td> <td><input type="text"/></td> <td>cfs</td> </tr> </tbody> </table>		Minor Storm	Major Storm		T _r =	<input type="text"/>	<input type="text"/>	years	P ₁ =	<input type="text"/>	<input type="text"/>	inches	C ₁ =	<input type="text"/>	<input type="text"/>		C ₂ =	<input type="text"/>	<input type="text"/>		C ₃ =	<input type="text"/>	<input type="text"/>		C =	<input type="text"/>	<input type="text"/>		C ₅ =	<input type="text"/>	<input type="text"/>		Q _b =	<input type="text"/>	<input type="text"/>	cfs	Q =	<input type="text"/>	<input type="text"/>	cfs
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Q =	<input type="text"/>	<input type="text"/>	cfs																																							

INLET MANAGEMENT

Worksheet Protected

see calculation sheets

INLET NAME	Inlet DP5	Inlet DP6	Inlet DP7
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	AREA
Hydraulic Condition	In Sump	In Sump	Swale
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type C

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{known} (cfs)	12.0	6.1	3.5
Major Q_{known} (cfs)	25.9	12.7	12.8

Bypass (Carry-Over) Flow from Upstream [Inlets must be organized from upstream \(left\) to downstream \(right\) in order for bypass flows to be linked.](#)

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	12.0	6.1	3.5
Major Total Design Peak Flow, Q (cfs)	25.9	12.7	12.8
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	0.0

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Ex Inlet DP8	Ex Inlet DP9	Ex Inlet DP15
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{known} (cfs)	6.1	3.8	8.2
Major Q_{known} (cfs)	13.0	7.9	17.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	6.1	3.8	8.2
Major Total Design Peak Flow, Q (cfs)	13.0	7.9	17.7
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.2
Major Flow Bypassed Downstream, Q_b (cfs)	2.2	0.2	4.7

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Ex Inlet DP16	Inlet DP12	Inlet DP17
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows			
Minor Q_{known} (cfs)	1.4	10.0	1.6
Major Q_{known} (cfs)	2.9	20.5	7.9

Bypass (Carry-Over) Flow from Upstream			
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics			
Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile			
Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input			
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input			
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	1.4	10.0	1.6
Major Total Design Peak Flow, Q (cfs)	2.9	20.5	7.9
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.9	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	6.6	0.2

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet DP19	Inlet DP20	Inlet DP21
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows			
Minor Q_{known} (cfs)	6.4	7.0	3.8
Major Q_{known} (cfs)	17.8	14.9	12.6
Bypass (Carry-Over) Flow from Upstream			
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Watershed Characteristics			
Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			
Watershed Profile			
Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			
Minor Storm Rainfall Input			
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			
Major Storm Rainfall Input			
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	6.4	7.0	3.8
Major Total Design Peak Flow, Q (cfs)	17.8	14.9	12.6
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	4.9	3.2	N/A

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet DP22	Inlet DP24	Ex Inlet DPe10
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	AREA	STREET
Hydraulic Condition	In Sump	Swale	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type C	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows			
Minor Q_{known} (cfs)	6.3	2.2	9.2
Major Q_{known} (cfs)	18.3	9.2	17.3
Bypass (Carry-Over) Flow from Upstream			
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Watershed Characteristics			
Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			
Watershed Profile			
Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			
Minor Storm Rainfall Input			
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			
Major Storm Rainfall Input			
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	6.3	2.2	9.2
Major Total Design Peak Flow, Q (cfs)	18.3	9.2	17.3
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.6
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	4.6

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Ex Inlet DPe11	Inlet DP1e	Inlet DP2e
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows			
Minor Q_{known} (cfs)	9.5	4.1	4.0
Major Q_{known} (cfs)	19.9	12.5	11.0
Bypass (Carry-Over) Flow from Upstream			
Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Watershed Characteristics			
Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			
Watershed Profile			
Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			
Minor Storm Rainfall Input			
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			
Major Storm Rainfall Input			
Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

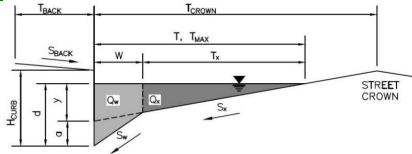
Minor Total Design Peak Flow, Q (cfs)	9.5	4.1	4.0
Major Total Design Peak Flow, Q (cfs)	19.9	12.5	11.0
Minor Flow Bypassed Downstream, Q_b (cfs)	0.7	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	6.2	1.9	1.2

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

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

Project: Sterling Ranch Filing 4

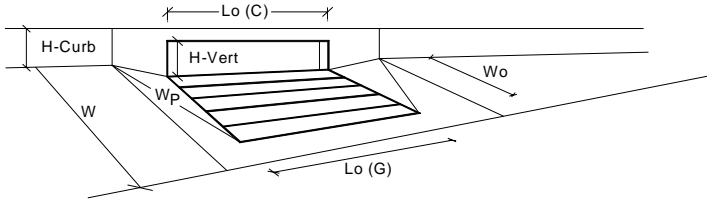
Inlet ID: Inlet DP5



Gutter Geometry:										
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = $ <input style="width: 50px;" type="text" value="8.0"/> ft									
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = $ <input style="width: 50px;" type="text" value="0.020"/> ft/ft									
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = $ <input style="width: 50px;" type="text" value="0.016"/>									
Height of Curb at Gutter Flow Line	$H_{CURB} = $ <input style="width: 50px;" type="text" value="6.00"/> inches									
Distance from Curb Face to Street Crown	$T_{CROWN} = $ <input style="width: 50px;" type="text" value="17.0"/> ft									
Gutter Width	$W = $ <input style="width: 50px;" type="text" value="2.00"/> ft									
Street Transverse Slope	$S_x = $ <input style="width: 50px;" type="text" value="0.020"/> ft/ft									
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = $ <input style="width: 50px;" type="text" value="0.083"/> ft/ft									
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = $ <input style="width: 50px;" type="text" value="0.000"/> ft/ft									
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = $ <input style="width: 50px;" type="text" value="0.016"/>									
Max. Allowable Spread for Minor & Major Storm	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 2px;">Minor Storm</td> <td style="text-align: center; padding: 2px;">Major Storm</td> <td style="padding: 2px;"></td> </tr> <tr> <td style="padding: 2px;">$T_{MAX} =$ <input style="width: 50px;" type="text" value="17.0"/></td> <td style="padding: 2px;"><input style="width: 50px;" type="text" value="17.0"/></td> <td style="padding: 2px;">ft</td> </tr> </table>	Minor Storm	Major Storm		$T_{MAX} = $ <input style="width: 50px;" type="text" value="17.0"/>	<input style="width: 50px;" type="text" value="17.0"/>	ft			
Minor Storm	Major Storm									
$T_{MAX} = $ <input style="width: 50px;" type="text" value="17.0"/>	<input style="width: 50px;" type="text" value="17.0"/>	ft								
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 2px;">Minor Storm</td> <td style="text-align: center; padding: 2px;">Major Storm</td> <td style="padding: 2px;"></td> </tr> <tr> <td style="padding: 2px;">$d_{MAX} =$ <input style="width: 50px;" type="text" value="6.0"/></td> <td style="padding: 2px;"><input style="width: 50px;" type="text" value="7.0"/></td> <td style="padding: 2px;">inches</td> </tr> <tr> <td style="text-align: center; padding: 2px;"><input type="checkbox"/></td> <td style="text-align: center; padding: 2px;"><input type="checkbox"/></td> <td></td> </tr> </table>	Minor Storm	Major Storm		$d_{MAX} = $ <input style="width: 50px;" type="text" value="6.0"/>	<input style="width: 50px;" type="text" value="7.0"/>	inches	<input type="checkbox"/>	<input type="checkbox"/>	
Minor Storm	Major Storm									
$d_{MAX} = $ <input style="width: 50px;" type="text" value="6.0"/>	<input style="width: 50px;" type="text" value="7.0"/>	inches								
<input type="checkbox"/>	<input type="checkbox"/>									
Check boxes are not applicable in SUMP conditions										
MINOR STORM Allowable Capacity is not applicable to Sump Condition										
MAJOR STORM Allowable Capacity is not applicable to Sump Condition										
Allowable Capacity	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 2px;">Minor Storm</td> <td style="text-align: center; padding: 2px;">Major Storm</td> <td style="padding: 2px;"></td> </tr> <tr> <td style="padding: 2px;">$Q_{allow} =$ <input style="width: 50px;" type="text" value="SUMP"/></td> <td style="padding: 2px;"><input style="width: 50px;" type="text" value="SUMP"/></td> <td style="padding: 2px;">cfs</td> </tr> </table>	Minor Storm	Major Storm		$Q_{allow} = $ <input style="width: 50px;" type="text" value="SUMP"/>	<input style="width: 50px;" type="text" value="SUMP"/>	cfs			
Minor Storm	Major Storm									
$Q_{allow} = $ <input style="width: 50px;" type="text" value="SUMP"/>	<input style="width: 50px;" type="text" value="SUMP"/>	cfs								

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



road will overtop at ~4"?

Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a' from above)	a _{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	9.8	inches
Grate Information				
Length of a Unit Grate	L _o (G) =	N/A	N/A	feet
Width of a Unit Grate	W _o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A _{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C _r (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				
Length of a Unit Curb Opening	L _o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H _{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H _{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W _p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C _r (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)				
Depth for Grate Midwidth	d _{grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d _{curb} =	0.33	0.65	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF _{grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF _{curb} =	0.79	0.96	
Combination Inlet Performance Reduction Factor for Long Inlets	RF _{combination} =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)				
	Q _a =	7.8	26.1	cfs
	Q _{PEAK REQUIRED} =	12.0	25.9	cfs

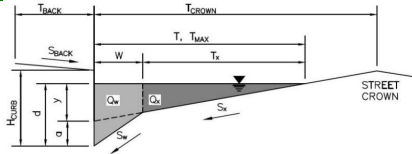
WARNING: Inlet Capacity < Q Peak for Minor Storm

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

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

Project: Sterling Ranch Filing 4

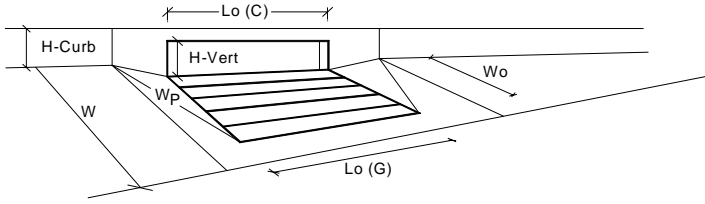
Inlet ID: Inlet DP6



Gutter Geometry:													
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft												
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft												
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$												
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	$W = 2.00$ ft												
Street Transverse Slope	$S_x = 0.020$ ft/ft												
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft												
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft												
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$												
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th>ft</th> </tr> <tr> <td>$T_{MAX} =$</td> <td>17.0</td> <td>17.0</td> <td></td> </tr> </table>		Minor Storm	Major Storm	ft	$T_{MAX} =$	17.0	17.0					
	Minor Storm	Major Storm	ft										
$T_{MAX} =$	17.0	17.0											
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th>inches</th> </tr> <tr> <td>$d_{MAX} =$</td> <td>6.0</td> <td>7.0</td> <td></td> </tr> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td></td> </tr> </table>		Minor Storm	Major Storm	inches	$d_{MAX} =$	6.0	7.0			<input type="checkbox"/>	<input type="checkbox"/>	
	Minor Storm	Major Storm	inches										
$d_{MAX} =$	6.0	7.0											
	<input type="checkbox"/>	<input type="checkbox"/>											
Check boxes are not applicable in SUMP conditions													
MINOR STORM Allowable Capacity is not applicable to Sump Condition													
MAJOR STORM Allowable Capacity is not applicable to Sump Condition													
	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th>cfs</th> </tr> <tr> <td>$Q_{allow} =$</td> <td>SUMP</td> <td>SUMP</td> <td></td> </tr> </table>		Minor Storm	Major Storm	cfs	$Q_{allow} =$	SUMP	SUMP					
	Minor Storm	Major Storm	cfs										
$Q_{allow} =$	SUMP	SUMP											

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

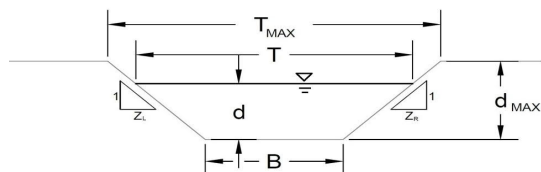


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	5.6	7.4	inches
Grate Information			
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information			
Length of a Unit Curb Opening	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.30	0.45	ft
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	0.76	0.86	
Combination Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	6.5	13.5	cfs
Q _{PEAK REQUIRED}	6.1	12.7	cfs

plus flow from DP5?

AREA INLET IN A SWALE

Sterling Ranch Filing 4
Inlet DP7



This worksheet uses the NRCS vegetall retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)

Manning's n (Leave cell D16 blank to manually enter an n value)

Channel Invert Slope

Bottom Width

Left Side Slope

Right Side Slope

Check one of the following soil types:

Soil Type:	Max. Velocity (V _{MAX})	Max. Froude No. (F _{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

A, B, C, D, or E =

D

n = see details below

S₀ = 0.0280 ft/ft

B = 0.00 ft

Z1 = 4.00 ft/ft

Z2 = 4.00 ft/ft

Choose One:

Non-Cohesive

Cohesive

Paved

Maximum Allowable Top Width of Channel for Minor & Major Storm

Maximum Allowable Water Depth in Channel for Minor & Major Storm

	Minor Storm	Major Storm	
T _{MAX} =	8.00	12.00	ft
d _{MAX} =	2.00	3.00	ft

Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Top Width Criterion

MAJOR STORM Allowable Capacity is based on Top Width Criterion

	Minor Storm	Major Storm	
Q _{allow} =	12.3	49.0	cfs
d _{allow} =	1.00	1.50	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow

Water Depth

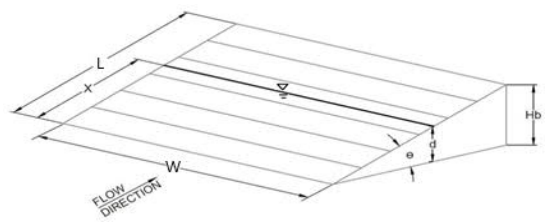
Q _o =	3.5	12.8	cfs
d =	0.72	1.01	ft

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'

MHFD-Inlet, Version 5.02 (August 2022)
AREA INLET IN A SWALE

Sterling Ranch Filing 4
 Inlet DP7

Inlet Design Information (Input)																					
Type of Inlet	CDOT Type C																				
Inlet Type =	CDOT Type C																				
Angle of Inclined Grate (must be ≤ 30 degrees)	$\theta = 0.00$ degrees																				
Width of Grate	$W = 3.00$ ft																				
Length of Grate	$L = 3.00$ ft																				
Open Area Ratio	$A_{RATIO} = 0.70$																				
Height of Inclined Grate	$H_B = 0.00$ ft																				
Clogging Factor	$C_f = 0.50$																				
Grate Discharge Coefficient	$C_d = 0.96$																				
Orifice Coefficient	$C_o = 0.64$																				
Weir Coefficient	$C_w = 2.05$																				
	<table border="1"> <thead> <tr> <th></th> <th>MINOR</th> <th>MAJOR</th> <th></th> </tr> </thead> <tbody> <tr> <td>$d =$</td> <td>0.72</td> <td>1.01</td> <td></td> </tr> <tr> <td>$Q_a =$</td> <td>11.3</td> <td>16.3</td> <td>cfs</td> </tr> <tr> <td>$Q_b =$</td> <td>0.0</td> <td>0.0</td> <td>cfs</td> </tr> <tr> <td>$C\% =$</td> <td>100</td> <td>100</td> <td>%</td> </tr> </tbody> </table>		MINOR	MAJOR		$d =$	0.72	1.01		$Q_a =$	11.3	16.3	cfs	$Q_b =$	0.0	0.0	cfs	$C\% =$	100	100	%
	MINOR	MAJOR																			
$d =$	0.72	1.01																			
$Q_a =$	11.3	16.3	cfs																		
$Q_b =$	0.0	0.0	cfs																		
$C\% =$	100	100	%																		
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)																					
Total Inlet Interception Capacity (assumes clogged condition)																					
Bypassed Flow																					
Capture Percentage = Q_a/Q_o																					

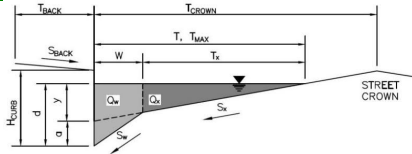


ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: Sterling Ranch Filing 4

Inlet ID: Ex Inlet DP8



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 10.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.016$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 30.0$ ft
 $W = 2.00$ ft
 $S_x = 0.020$ ft/ft
 $S_y = 0.083$ ft/ft
 $S_o = 0.015$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
$T_{MAX} =$	15.0	30.0	ft
$d_{MAX} =$	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

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

$Q_{allow} =$

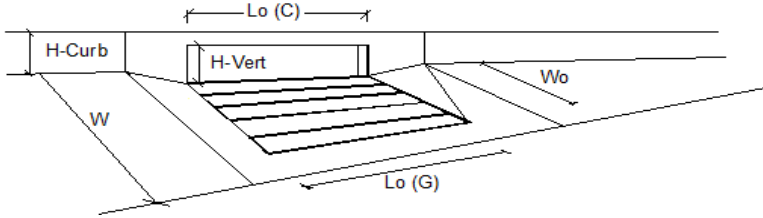
Minor Storm	Major Storm
9.8	16.9

 cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 6.10 cfs on sheet 'Inlet Management'
 Major storm max. allowable capacity GOOD - greater than the design peak flow of 13.00 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



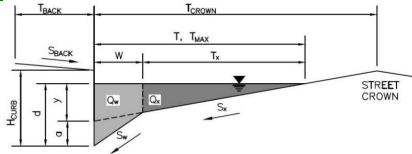
Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1		
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: OK - Q < Allowable Street Capacity				
Total Inlet Interception Capacity	6.1	10.8	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	2.2	cfs	
Capture Percentage = Q_i/Q_o	100	83	%	

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

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

Project: Sterling Ranch Filing 4

Inlet ID: Ex Inlet DP9



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 10.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.016$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 30.0$ ft
 $W = 2.00$ ft
 $S_x = 0.020$ ft/ft
 $S_w = 0.083$ ft/ft
 $S_o = 0.015$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
$T_{MAX} =$	15.0	30.0	ft
$d_{MAX} =$	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

Minor Storm	Major Storm
9.8	16.9

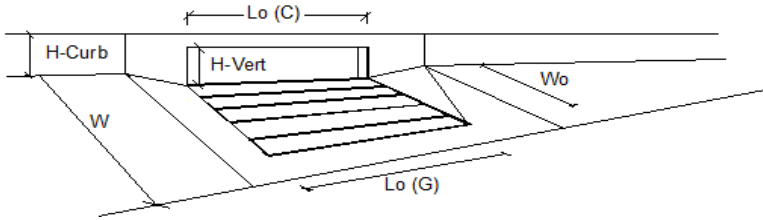
 cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 3.80 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.90 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)

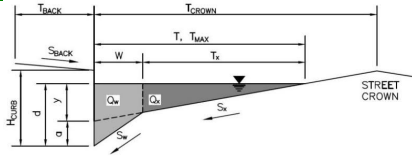


Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1		
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: OK - Q < Allowable Street Capacity				
Total Inlet Interception Capacity	3.8	7.7	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.2	cfs	
Capture Percentage = Q_i/Q_s	100	98	%	

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

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

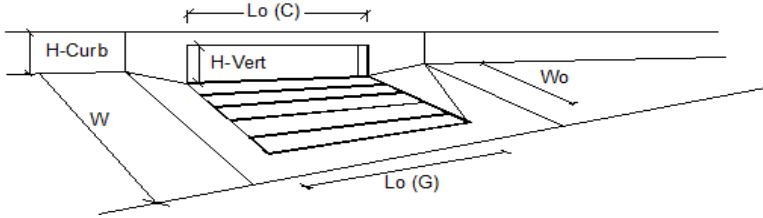
Project: Sterling Ranch Filing 4
 Inlet ID: Ex Inlet DP15



Gutter Geometry:							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$						
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	$W = 2.00$ 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)	$n_{STREET} = 0.016$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> <td style="text-align: right;">ft</td> </tr> <tr> <td style="text-align: center;">$T_{MAX} = 17.0$</td> <td style="text-align: center;">$T_{MAX} = 17.0$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = 17.0$	$T_{MAX} = 17.0$	
Minor Storm	Major Storm	ft					
$T_{MAX} = 17.0$	$T_{MAX} = 17.0$						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> <td style="text-align: right;">inches</td> </tr> <tr> <td style="text-align: center;">$d_{MAX} = 6.0$</td> <td style="text-align: center;">$d_{MAX} = 7.0$</td> <td></td> </tr> </table>	Minor Storm	Major Storm	inches	$d_{MAX} = 6.0$	$d_{MAX} = 7.0$	
Minor Storm	Major Storm	inches					
$d_{MAX} = 6.0$	$d_{MAX} = 7.0$						
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> <td></td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> </tr> </table>	Minor Storm	Major Storm		<input type="checkbox"/>	<input type="checkbox"/>	
Minor Storm	Major Storm						
<input type="checkbox"/>	<input type="checkbox"/>						
MINOR STORM Allowable Capacity is based on Depth Criterion							
MAJOR STORM Allowable Capacity is based on Spread Criterion							
Minor storm max. allowable capacity GOOD - greater than the design peak flow of 8.20 cfs on sheet 'Inlet Management'	$Q_{allow} = 17.2$ cfs						
Major storm max. allowable capacity GOOD - greater than the design peak flow of 17.70 cfs on sheet 'Inlet Management'	$Q_{allow} = 19.7$ cfs						

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)

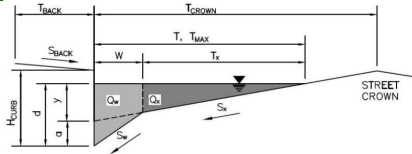


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity			
Total Inlet Interception Capacity	8.0	13.0	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.2	4.7	cfs
Capture Percentage = Q_i/Q_o	97	73	%

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

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

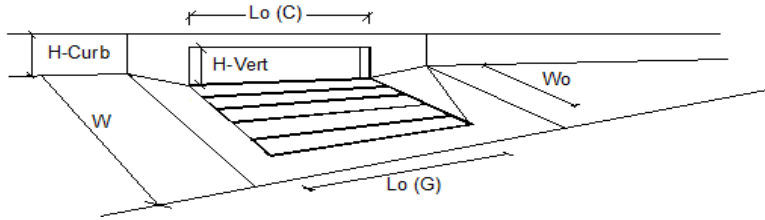
Project: Sterling Ranch Filing 4
 Inlet ID: Ex Inlet DP16



Gutter Geometry:					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$				
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	$W = 2.00$ ft				
Street Transverse Slope	$S_x = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_y = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.033$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$				
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;">17.0</td> <td style="padding: 2px; text-align: center;">17.0</td> </tr> </table> ft	Minor Storm	Major Storm	17.0	17.0
Minor Storm	Major Storm				
17.0	17.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;">6.0</td> <td style="padding: 2px; text-align: center;">6.0</td> </tr> </table> inches	Minor Storm	Major Storm	6.0	6.0
Minor Storm	Major Storm				
6.0	6.0				
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> </tr> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input type="checkbox"/>
Minor Storm	Major Storm				
<input type="checkbox"/>	<input type="checkbox"/>				
MINOR STORM Allowable Capacity is based on Depth Criterion					
MAJOR STORM Allowable Capacity is based on Depth Criterion					
Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.40 cfs on sheet 'Inlet Management'					
Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.90 cfs on sheet 'Inlet Management'					
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;">17.2</td> <td style="padding: 2px; text-align: center;">17.2</td> </tr> </table> cfs	Minor Storm	Major Storm	17.2	17.2
Minor Storm	Major Storm				
17.2	17.2				

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



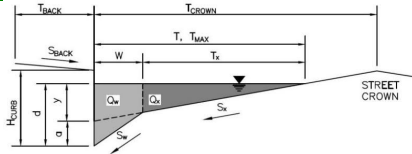
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity			
Total Inlet Interception Capacity	1.4	2.9	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.0	cfs
Capture Percentage = Q_i/Q_s	100	100	%

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

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

Project: Sterling Ranch Filing 4

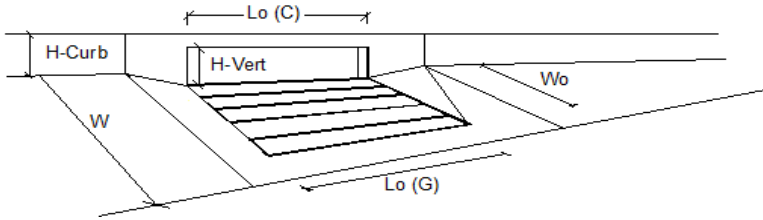
Inlet ID: Inlet DP12



Gutter Geometry:					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$				
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	$W = 2.00$ ft				
Street Transverse Slope	$S_X = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_Y = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_O = 0.010$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$				
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;">17.0</td> <td style="padding: 2px; text-align: center;">17.0</td> </tr> </table> ft	Minor Storm	Major Storm	17.0	17.0
Minor Storm	Major Storm				
17.0	17.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;">6.0</td> <td style="padding: 2px; text-align: center;">7.0</td> </tr> </table> inches	Minor Storm	Major Storm	6.0	7.0
Minor Storm	Major Storm				
6.0	7.0				
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> <td style="padding: 2px; text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Minor Storm	Major Storm				
<input type="checkbox"/>	<input checked="" type="checkbox"/>				
MINOR STORM Allowable Capacity is based on Spread Criterion					
MAJOR STORM Allowable Capacity is based on Depth Criterion					
Minor storm max. allowable capacity GOOD - greater than the design peak flow of 10.00 cfs on sheet 'Inlet Management'					
Major storm max. allowable capacity GOOD - greater than the design peak flow of 20.50 cfs on sheet 'Inlet Management'					
$Q_{allow} =$	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;">10.9</td> <td style="padding: 2px; text-align: center;">22.6</td> </tr> </table> cfs	Minor Storm	Major Storm	10.9	22.6
Minor Storm	Major Storm				
10.9	22.6				

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)

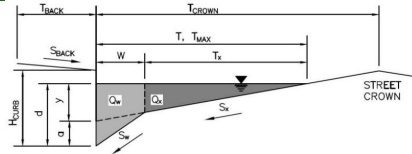


Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1		
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: OK - Q < Allowable Street Capacity				
Total Inlet Interception Capacity	9.1	13.9	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.9	6.6	cfs	
Capture Percentage = Q_i/Q_o	91	68	%	

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

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

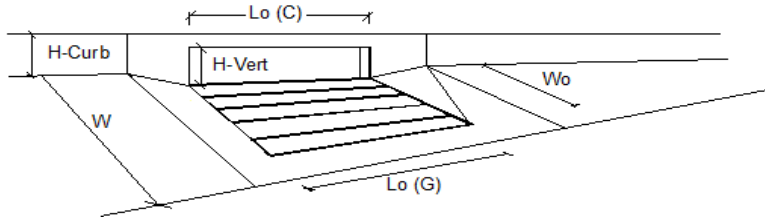
Project: Sterling Ranch Filing 4
 Inlet ID: Inlet DP17



Gutter Geometry:					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$				
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	$W = 2.00$ ft				
Street Transverse Slope	$S_X = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_Y = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_O = 0.026$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$				
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;">17.0</td> <td style="padding: 2px; text-align: center;">17.0</td> </tr> </table> ft	Minor Storm	Major Storm	17.0	17.0
Minor Storm	Major Storm				
17.0	17.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;">6.0</td> <td style="padding: 2px; text-align: center;">6.0</td> </tr> </table> inches	Minor Storm	Major Storm	6.0	6.0
Minor Storm	Major Storm				
6.0	6.0				
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> </tr> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input type="checkbox"/>
Minor Storm	Major Storm				
<input type="checkbox"/>	<input type="checkbox"/>				
MINOR STORM Allowable Capacity is based on Spread Criterion					
MAJOR STORM Allowable Capacity is based on Spread Criterion					
Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.60 cfs on sheet 'Inlet Management'					
Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.90 cfs on sheet 'Inlet Management'					

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)

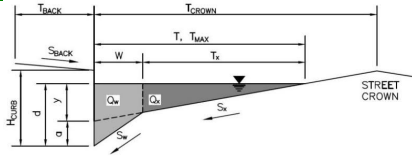


Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1		
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: OK - Q < Allowable Street Capacity				
Total Inlet Interception Capacity	1.6	7.7	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.2	cfs	
Capture Percentage = Q_i/Q_o	100	98	%	

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

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

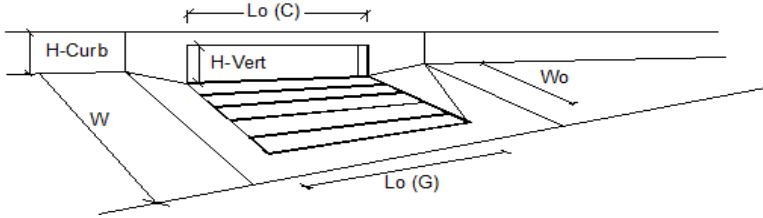
Project: Sterling Ranch Filing 4
 Inlet ID: Inlet DP19



Gutter Geometry:							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$						
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	$W = 2.00$ ft						
Street Transverse Slope	$S_X = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_Y = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_Z = 0.010$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">ft</th> </tr> <tr> <td style="padding: 2px;">17.0</td> <td style="padding: 2px;">17.0</td> <td style="padding: 2px;"></td> </tr> </table>	Minor Storm	Major Storm	ft	17.0	17.0	
Minor Storm	Major Storm	ft					
17.0	17.0						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">inches</th> </tr> <tr> <td style="padding: 2px;">6.0</td> <td style="padding: 2px;">7.0</td> <td style="padding: 2px;"></td> </tr> </table>	Minor Storm	Major Storm	inches	6.0	7.0	
Minor Storm	Major Storm	inches					
6.0	7.0						
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> <td style="padding: 2px; text-align: center;"><input checked="" type="checkbox"/></td> </tr> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Minor Storm	Major Storm						
<input type="checkbox"/>	<input checked="" type="checkbox"/>						
MINOR STORM Allowable Capacity is based on Spread Criterion							
MAJOR STORM Allowable Capacity is based on Depth Criterion							
Minor storm max. allowable capacity GOOD - greater than the design peak flow of 6.40 cfs on sheet 'Inlet Management'							
Major storm max. allowable capacity GOOD - greater than the design peak flow of 17.80 cfs on sheet 'Inlet Management'							
$Q_{allow} =$	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">cfs</th> </tr> <tr> <td style="padding: 2px;">10.9</td> <td style="padding: 2px;">22.6</td> <td style="padding: 2px;"></td> </tr> </table>	Minor Storm	Major Storm	cfs	10.9	22.6	
Minor Storm	Major Storm	cfs					
10.9	22.6						

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



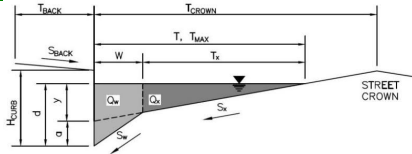
Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1		
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: OK - Q < Allowable Street Capacity				
Total Inlet Interception Capacity	6.4	12.9	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	4.9	cfs	
Capture Percentage = Q_i/Q_s	100	72	%	

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

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

Project: Sterling Ranch Filing 4

Inlet ID: Inlet DP20



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 8.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.016$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 17.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_Y = 0.083$ ft/ft
 $S_O = 0.010$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	7.0	inches
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

[MINOR STORM Allowable Capacity is based on Spread Criterion](#)
[MAJOR STORM Allowable Capacity is based on Depth Criterion](#)

$Q_{allow} =$

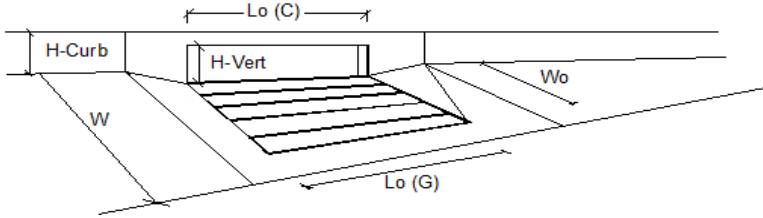
Minor Storm	Major Storm
10.9	22.6

 cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 7.00 cfs on sheet 'Inlet Management'
 Major storm max. allowable capacity GOOD - greater than the design peak flow of 14.90 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)

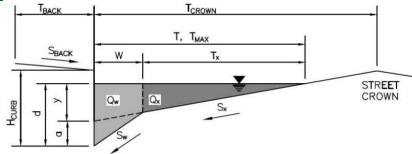


Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1		
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: OK - Q < Allowable Street Capacity				
Total Inlet Interception Capacity	7.0	11.7	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	3.2	cfs	
Capture Percentage = Q_i/Q_o	99	78	%	

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

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

Project: Sterling Ranch Filing 4
 Inlet ID: Inlet DP21



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} = 8.0$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.016$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 17.0$ ft
 $W = 2.00$ ft
 $S_x = 0.020$ ft/ft
 $S_y = 0.083$ ft/ft
 $S_o = 0.000$ ft/ft
 $n_{STREET} = 0.016$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	7.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

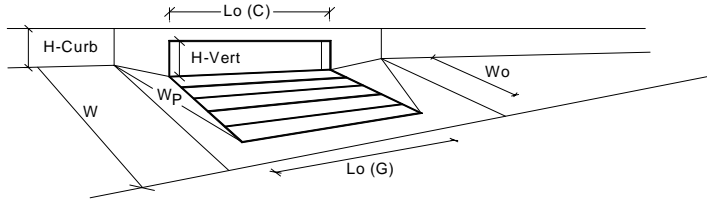
MINOR STORM Allowable Capacity is not applicable to Sump Condition
 MAJOR STORM Allowable Capacity is not applicable to Sump Condition

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

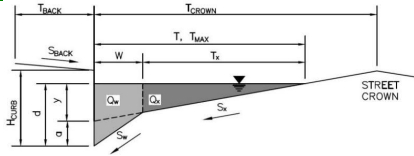


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	5.6	7.3	inches
Grate Information			
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information			
Length of a Unit Curb Opening	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.30	0.44	ft
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	0.76	0.86	
Combination Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	6.5	13.1	cfs
Q _{PEAK REQUIRED}	3.8	12.6	cfs

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

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

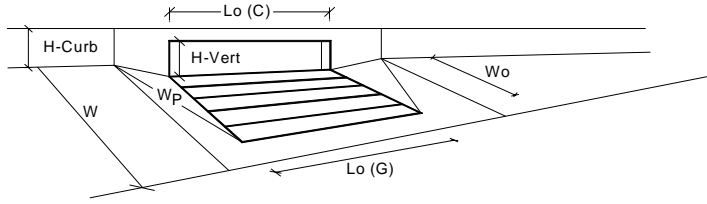
Project: Sterling Ranch Filing 4
 Inlet ID: Inlet DP22



Gutter Geometry:													
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 8.0$ ft												
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft												
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$												
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	$W = 2.00$ ft												
Street Transverse Slope	$S_x = 0.020$ ft/ft												
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_y = 0.083$ ft/ft												
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft												
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$												
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th>ft</th> </tr> <tr> <td>$T_{MAX} =$</td> <td>17.0</td> <td>17.0</td> <td></td> </tr> </table>		Minor Storm	Major Storm	ft	$T_{MAX} =$	17.0	17.0					
	Minor Storm	Major Storm	ft										
$T_{MAX} =$	17.0	17.0											
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th>inches</th> </tr> <tr> <td>$d_{MAX} =$</td> <td>6.0</td> <td>7.0</td> <td></td> </tr> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td></td> </tr> </table>		Minor Storm	Major Storm	inches	$d_{MAX} =$	6.0	7.0			<input type="checkbox"/>	<input type="checkbox"/>	
	Minor Storm	Major Storm	inches										
$d_{MAX} =$	6.0	7.0											
	<input type="checkbox"/>	<input type="checkbox"/>											
Check boxes are not applicable in SUMP conditions													
MINOR STORM Allowable Capacity is not applicable to Sump Condition													
MAJOR STORM Allowable Capacity is not applicable to Sump Condition													
	<table border="1"> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th>cfs</th> </tr> <tr> <td>$Q_{allow} =$</td> <td>SUMP</td> <td>SUMP</td> <td></td> </tr> </table>		Minor Storm	Major Storm	cfs	$Q_{allow} =$	SUMP	SUMP					
	Minor Storm	Major Storm	cfs										
$Q_{allow} =$	SUMP	SUMP											

INLET IN A SUMP OR SAG LOCATION

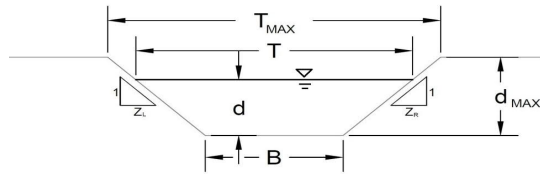
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	5.6	8.5	inches
Grate Information			
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information			
Length of a Unit Curb Opening	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.30	0.54	ft
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	0.76	0.91	
Combination Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	6.5	18.9	cfs
Q _{PEAK REQUIRED}	6.3	18.3	cfs

AREA INLET IN A SWALE

Sterling Ranch Filing 4
Inlet DP24



This worksheet uses the NRCS vegetall retardance method to determine Manning's n.
For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E) A, B, C, D, or E =

D

Manning's n (Leave cell D16 blank to manually enter an n value) n =

see details below

Channel Invert Slope S₀ =

0.0158	ft/ft
--------	-------

Bottom Width B =

2.00	ft
------	----

Left Side Slope Z1 =

5.00	ft/ft
------	-------

Right Side Slope Z2 =

5.00	ft/ft
------	-------

Check one of the following soil types:

Soil Type:	Max. Velocity (V _{max})	Max. Froude No. (F _{max})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:

Non-Cohesive

Cohesive

Paved

	Minor Storm	Major Storm	
T _{MAX} =	24.00	24.00	ft
d _{MAX} =	2.00	2.00	ft

Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Depth Criterion Q_{allow} =

136.9	136.9	cfs
-------	-------	-----

MAJOR STORM Allowable Capacity is based on Depth Criterion d_{allow} =

2.00	2.00	ft
------	------	----

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow Q_o =

2.2	9.2	cfs
-----	-----	-----

Water Depth d =

0.55	0.81	ft
------	------	----

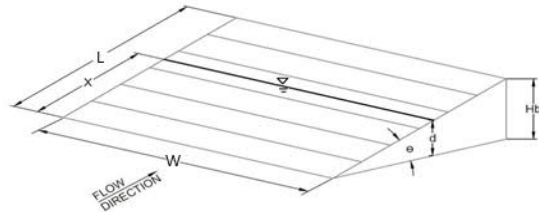
Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

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

MHFD-Inlet, Version 5.02 (August 2022)
AREA INLET IN A SWALE

Sterling Ranch Filing 4
 Inlet DP24

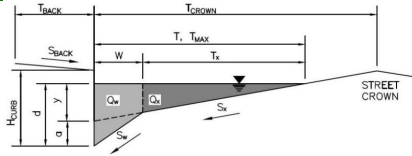
Inlet Design Information (Input)																					
Type of Inlet	CDOT Type C																				
Inlet Type =	CDOT Type C																				
Angle of Inclined Grate (must be ≤ 30 degrees)	$\theta = 0.00$ degrees																				
Width of Grate	$W = 3.00$ ft																				
Length of Grate	$L = 3.00$ ft																				
Open Area Ratio	$A_{RATIO} = 0.70$																				
Height of Inclined Grate	$H_B = 0.00$ ft																				
Clogging Factor	$C_f = 0.50$																				
Grate Discharge Coefficient	$C_d = 0.96$																				
Orifice Coefficient	$C_o = 0.64$																				
Weir Coefficient	$C_w = 2.05$																				
	<table border="1"> <thead> <tr> <th></th> <th>MINOR</th> <th>MAJOR</th> <th></th> </tr> </thead> <tbody> <tr> <td>$d =$</td> <td>0.55</td> <td>0.81</td> <td></td> </tr> <tr> <td>$Q_a =$</td> <td>7.6</td> <td>13.5</td> <td>cfs</td> </tr> <tr> <td>$Q_b =$</td> <td>0.0</td> <td>0.0</td> <td>cfs</td> </tr> <tr> <td>$C\% =$</td> <td>100</td> <td>100</td> <td>%</td> </tr> </tbody> </table>		MINOR	MAJOR		$d =$	0.55	0.81		$Q_a =$	7.6	13.5	cfs	$Q_b =$	0.0	0.0	cfs	$C\% =$	100	100	%
	MINOR	MAJOR																			
$d =$	0.55	0.81																			
$Q_a =$	7.6	13.5	cfs																		
$Q_b =$	0.0	0.0	cfs																		
$C\% =$	100	100	%																		
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)																					
Total Inlet Interception Capacity (assumes clogged condition)																					
Bypassed Flow																					
Capture Percentage = Q_a/Q_o																					



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

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

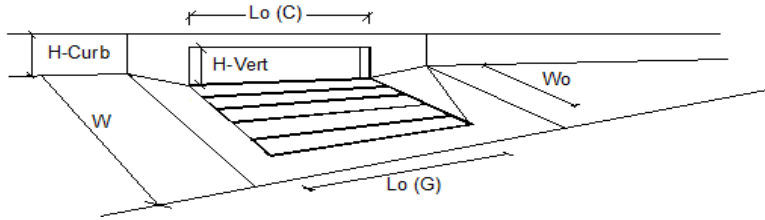
Project: Sterling Ranch Filing 4
 Inlet ID: Ex Inlet DPe10



Gutter Geometry:					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.016$				
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches				
Distance from Curb Face to Street Crown	$T_{CROWN} = 30.0$ ft				
Gutter Width	$W = 2.00$ ft				
Street Transverse Slope	$S_x = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.014$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$				
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px;">$T_{MAX} = 30.0$</td> <td style="padding: 2px;">30.0</td> </tr> </table> ft	Minor Storm	Major Storm	$T_{MAX} = 30.0$	30.0
Minor Storm	Major Storm				
$T_{MAX} = 30.0$	30.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px;">$d_{MAX} = 6.0$</td> <td style="padding: 2px;">7.0</td> </tr> </table> inches	Minor Storm	Major Storm	$d_{MAX} = 6.0$	7.0
Minor Storm	Major Storm				
$d_{MAX} = 6.0$	7.0				
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> </tr> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input type="checkbox"/>
Minor Storm	Major Storm				
<input type="checkbox"/>	<input type="checkbox"/>				
MINOR STORM Allowable Capacity is based on Depth Criterion					
MAJOR STORM Allowable Capacity is based on Depth Criterion					
Minor storm max. allowable capacity GOOD - greater than the design peak flow of 9.20 cfs on sheet 'Inlet Management'					
Major storm max. allowable capacity GOOD - greater than the design peak flow of 17.30 cfs on sheet 'Inlet Management'					
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px;">$Q_{allow} = 16.3$</td> <td style="padding: 2px;">27.4</td> </tr> </table> cfs	Minor Storm	Major Storm	$Q_{allow} = 16.3$	27.4
Minor Storm	Major Storm				
$Q_{allow} = 16.3$	27.4				

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)

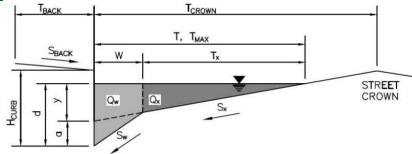


Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1		
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: OK - Q < Allowable Street Capacity				
Total Inlet Interception Capacity	8.6	12.7	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.6	4.6	cfs	
Capture Percentage = Q_i/Q_o	94	74	%	

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

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

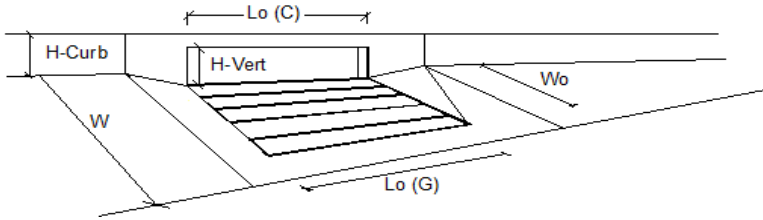
Project: Sterling Ranch Filing 4
 Inlet ID: Ex Inlet DPe11



Gutter Geometry:							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = $ <input style="width: 50px;" type="text" value="10.0"/> ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = $ <input style="width: 50px;" type="text" value="0.020"/> ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = $ <input style="width: 50px;" type="text" value="0.016"/>						
Height of Curb at Gutter Flow Line	$H_{CURB} = $ <input style="width: 50px;" type="text" value="6.00"/> inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = $ <input style="width: 50px;" type="text" value="30.0"/> ft						
Gutter Width	$W = $ <input style="width: 50px;" type="text" value="2.00"/> ft						
Street Transverse Slope	$S_x = $ <input style="width: 50px;" type="text" value="0.020"/> ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_y = $ <input style="width: 50px;" type="text" value="0.083"/> ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = $ <input style="width: 50px;" type="text" value="0.014"/> ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = $ <input style="width: 50px;" type="text" value="0.016"/>						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">ft</th> </tr> <tr> <td style="padding: 2px;">$T_{MAX} =$ <input style="width: 50px;" type="text" value="30.0"/></td> <td style="padding: 2px;"><input style="width: 50px;" type="text" value="30.0"/></td> <td style="padding: 2px;"></td> </tr> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = $ <input style="width: 50px;" type="text" value="30.0"/>	<input style="width: 50px;" type="text" value="30.0"/>	
Minor Storm	Major Storm	ft					
$T_{MAX} = $ <input style="width: 50px;" type="text" value="30.0"/>	<input style="width: 50px;" type="text" value="30.0"/>						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">inches</th> </tr> <tr> <td style="padding: 2px;">$d_{MAX} =$ <input style="width: 50px;" type="text" value="6.0"/></td> <td style="padding: 2px;"><input style="width: 50px;" type="text" value="6.0"/></td> <td style="padding: 2px;"></td> </tr> </table>	Minor Storm	Major Storm	inches	$d_{MAX} = $ <input style="width: 50px;" type="text" value="6.0"/>	<input style="width: 50px;" type="text" value="6.0"/>	
Minor Storm	Major Storm	inches					
$d_{MAX} = $ <input style="width: 50px;" type="text" value="6.0"/>	<input style="width: 50px;" type="text" value="6.0"/>						
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> </tr> <tr> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> <td style="padding: 2px; text-align: center;"><input type="checkbox"/></td> </tr> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input type="checkbox"/>		
Minor Storm	Major Storm						
<input type="checkbox"/>	<input type="checkbox"/>						
MINOR STORM Allowable Capacity is based on Depth Criterion							
MAJOR STORM Allowable Capacity is based on Depth Criterion							
Minor storm max. allowable capacity GOOD - greater than the design peak flow of 9.50 cfs on sheet 'Inlet Management'							
WARNING: MAJOR STORM max. allowable capacity is less than the design peak flow of 19.90 cfs on sheet 'Inlet Management'							
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">cfs</th> </tr> <tr> <td style="padding: 2px;">$Q_{allow} =$ <input style="width: 50px;" type="text" value="16.3"/></td> <td style="padding: 2px;"><input style="width: 50px;" type="text" value="16.3"/></td> <td style="padding: 2px;"></td> </tr> </table>	Minor Storm	Major Storm	cfs	$Q_{allow} = $ <input style="width: 50px;" type="text" value="16.3"/>	<input style="width: 50px;" type="text" value="16.3"/>	
Minor Storm	Major Storm	cfs					
$Q_{allow} = $ <input style="width: 50px;" type="text" value="16.3"/>	<input style="width: 50px;" type="text" value="16.3"/>						

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



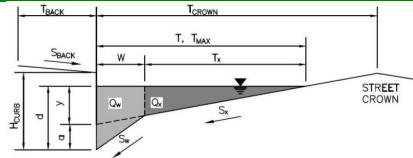
Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches	
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1		
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft	
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A		
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10		
Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MAJOR STORM				
Total Inlet Interception Capacity	8.8	13.7	cfs	
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.7	6.2	cfs	
Capture Percentage = Q_i/Q_o	93	69	%	

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

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

Project: Sterling Ranch Filing 4

Inlet ID: Inlet DP1e



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

T_{BACK} =	10.0	ft
S_{BACK} =	0.020	ft/ft
n_{BACK} =	0.016	

Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

H_{CURB} =	6.00	inches
T_{CROWN} =	30.0	ft
W =	2.00	ft
S_x =	0.020	ft/ft
S_w =	0.083	ft/ft
S_o =	0.029	ft/ft
n_{STREET} =	0.016	

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
T_{MAX} =	30.0	30.0	ft
d_{MAX} =	6.0	6.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

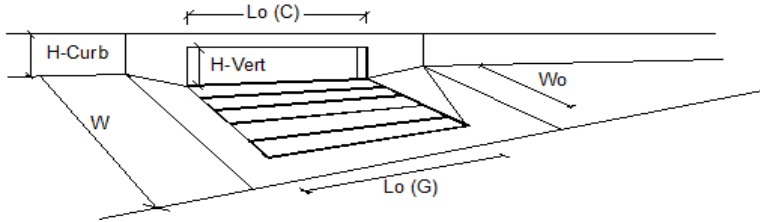
MINOR STORM Allowable Capacity is based on Depth Criterion
 MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	17.9	17.9	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.10 cfs on sheet 'Inlet Management'
 Major storm max. allowable capacity GOOD - greater than the design peak flow of 12.50 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)

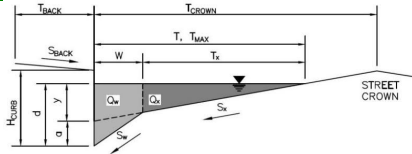


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity			
Total Inlet Interception Capacity	4.1	10.6	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	1.9	cfs
Capture Percentage = Q_i/Q_o	100	85	%

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

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

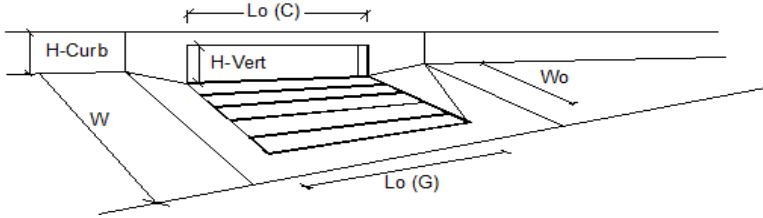
Project: Sterling Ranch Filing 4
 Inlet ID: Inlet DP2e



Gutter Geometry:																	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = $ <input style="width: 50px;" type="text" value="10.0"/> ft																
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = $ <input style="width: 50px;" type="text" value="0.020"/> ft/ft																
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = $ <input style="width: 50px;" type="text" value="0.016"/>																
Height of Curb at Gutter Flow Line	$H_{CURB} = $ <input style="width: 50px;" type="text" value="6.00"/> inches																
Distance from Curb Face to Street Crown	$T_{CROWN} = $ <input style="width: 50px;" type="text" value="30.0"/> ft																
Gutter Width	$W = $ <input style="width: 50px;" type="text" value="2.00"/> ft																
Street Transverse Slope	$S_X = $ <input style="width: 50px;" type="text" value="0.020"/> ft/ft																
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_Y = $ <input style="width: 50px;" type="text" value="0.083"/> ft/ft																
Street Longitudinal Slope - Enter 0 for sump condition	$S_Z = $ <input style="width: 50px;" type="text" value="0.029"/> ft/ft																
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = $ <input style="width: 50px;" type="text" value="0.016"/>																
Max. Allowable Spread for Minor & Major Storm	<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;"></th> <th style="width: 25%; text-align: center;">Minor Storm</th> <th style="width: 25%; text-align: center;">Major Storm</th> <th style="width: 10%;"></th> </tr> <tr> <td style="padding: 5px;">$T_{MAX} =$</td> <td style="text-align: center;"><input style="width: 50px;" type="text" value="30.0"/></td> <td style="text-align: center;"><input style="width: 50px;" type="text" value="30.0"/></td> <td style="text-align: right;">ft</td> </tr> <tr> <td style="padding: 5px;">$d_{MAX} =$</td> <td style="text-align: center;"><input style="width: 50px;" type="text" value="6.0"/></td> <td style="text-align: center;"><input style="width: 50px;" type="text" value="6.0"/></td> <td style="text-align: right;">inches</td> </tr> <tr> <td style="padding: 5px;">Allow Flow Depth at Street Crown (check box for yes, leave blank for no)</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> </tr> </table>		Minor Storm	Major Storm		$T_{MAX} = $	<input style="width: 50px;" type="text" value="30.0"/>	<input style="width: 50px;" type="text" value="30.0"/>	ft	$d_{MAX} = $	<input style="width: 50px;" type="text" value="6.0"/>	<input style="width: 50px;" type="text" value="6.0"/>	inches	Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<input type="checkbox"/>	<input type="checkbox"/>	
	Minor Storm	Major Storm															
$T_{MAX} = $	<input style="width: 50px;" type="text" value="30.0"/>	<input style="width: 50px;" type="text" value="30.0"/>	ft														
$d_{MAX} = $	<input style="width: 50px;" type="text" value="6.0"/>	<input style="width: 50px;" type="text" value="6.0"/>	inches														
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<input type="checkbox"/>	<input type="checkbox"/>															
MINOR STORM Allowable Capacity is based on Depth Criterion																	
MAJOR STORM Allowable Capacity is based on Depth Criterion																	
Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.00 cfs on sheet 'Inlet Management'																	
Major storm max. allowable capacity GOOD - greater than the design peak flow of 11.00 cfs on sheet 'Inlet Management'																	
$Q_{allow} = $	<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%;"></th> <th style="width: 25%; text-align: center;">Minor Storm</th> <th style="width: 25%; text-align: center;">Major Storm</th> <th style="width: 10%;"></th> </tr> <tr> <td style="padding: 5px;">$Q_{allow} =$</td> <td style="text-align: center;"><input style="width: 50px;" type="text" value="17.9"/></td> <td style="text-align: center;"><input style="width: 50px;" type="text" value="17.9"/></td> <td style="text-align: right;">cfs</td> </tr> </table>		Minor Storm	Major Storm		$Q_{allow} = $	<input style="width: 50px;" type="text" value="17.9"/>	<input style="width: 50px;" type="text" value="17.9"/>	cfs								
	Minor Storm	Major Storm															
$Q_{allow} = $	<input style="width: 50px;" type="text" value="17.9"/>	<input style="width: 50px;" type="text" value="17.9"/>	cfs														

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity			
Total Inlet Interception Capacity	4.0	9.8	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	1.2	cfs
Capture Percentage = Q_i/Q_s	100	89	%

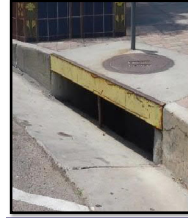
INLET PICTURES



CDOT Type R Curb Opening



Denver No. 14 Curb Opening



Colorado Springs D-10-R



CDOT/Denver 13 Valley Grate



CDOT/Denver Y3 Combination



Denver No. 16 Combination



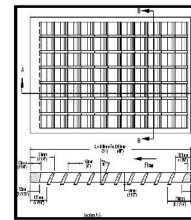
Wheat Ridge Combination Inlet



Denver No. 16 Valley Grate



Bidirectional Cast Vane Grate



Directional 30-Degree Bar Grate (courtesy HEC-22)



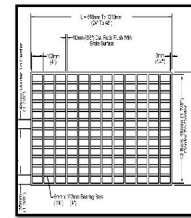
Directional 45-Degree Bar Grate



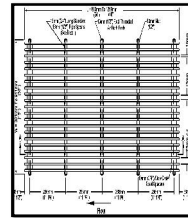
Reinforcing Riveted Grate



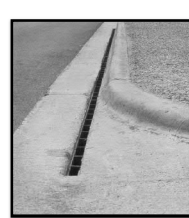
1-7/8" Bar Grate, Crossbars @ 6"



1-7/8" Bar Grate, Crossbars @ 4" (courtesy HEC-22)



1-1/8" Bar Grate, Crossbars @ 6 in. (courtesy HEC-22)



Slotted Inlet Parallel to Flow



CDOT Type C Grate (Close Mesh)



CDOT Type C Grate



CDOT Type C Inlet



CDOT Type C Inlet in Depression



CDOT Type D Inlet in Series (Flat & Depressed)



CDOT Type D Inlet in Series (10° Incline & Depressed)



CDOT Type D Inlet in Series (20° Incline & Depressed)



CDOT Type D Inlet in Series (30° Incline & Depressed)



CDOT Type D Inlet Parallel (Flat & Depressed)



CDOT Type D Inlet Parallel (10° Incline & Depressed)



CDOT Type D Inlet Parallel (20° Incline & Depressed)



CDOT Type D Inlet Parallel (30° Incline & Depressed)

Channel Report

Barbarick FSD Overflow Channel Section A-A

Trapezoidal

Bottom Width (ft) = 3.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 7018.00
Slope (%) = 0.50
N-Value = 0.013

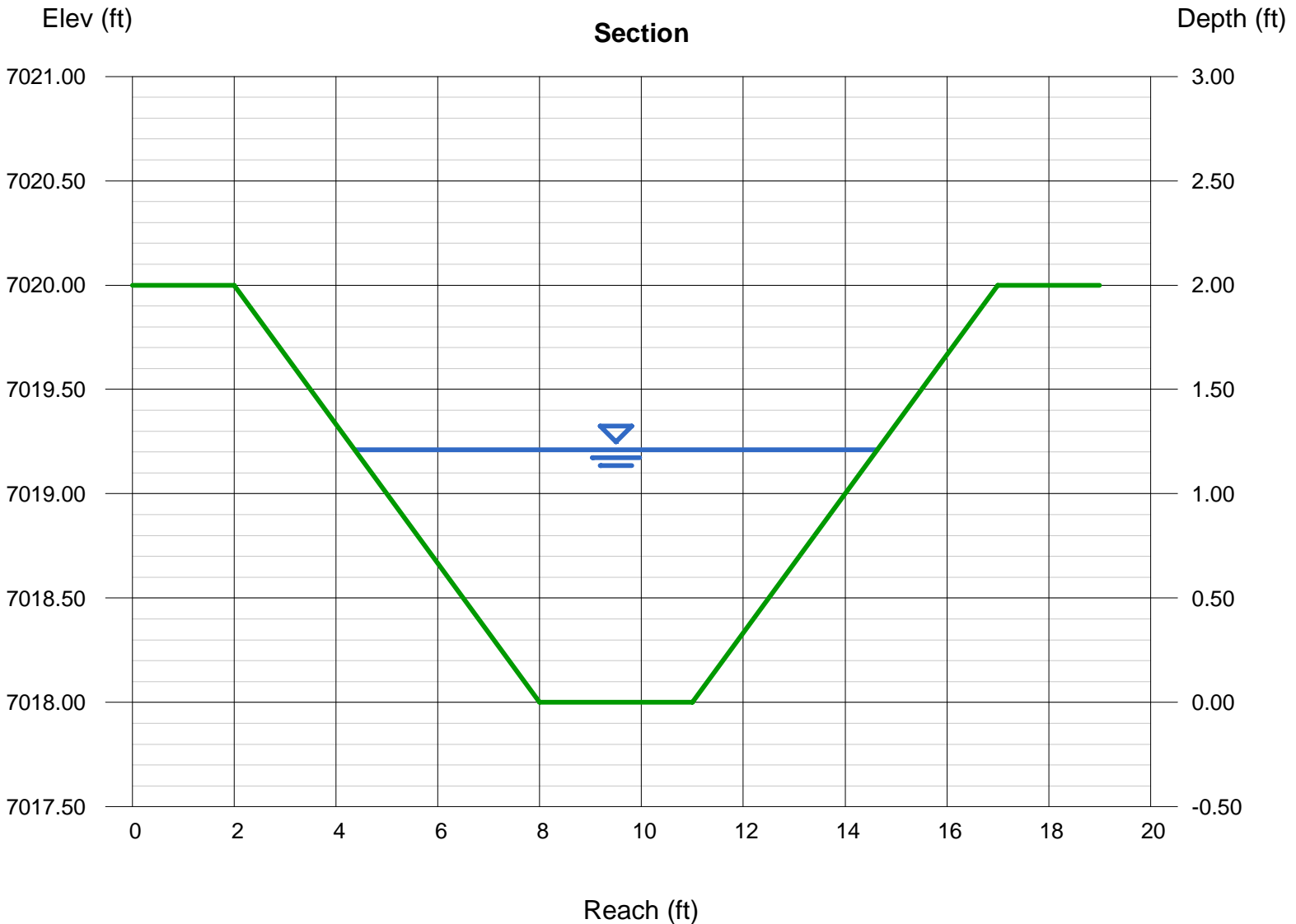
Highlighted

Depth (ft) = 1.21
Q (cfs) = 52.80
Area (sqft) = 8.02
Velocity (ft/s) = 6.58
Wetted Perim (ft) = 10.65
Crit Depth, Yc (ft) = 1.39
Top Width (ft) = 10.26
EGL (ft) = 1.88

Calculations

Compute by: Known Q
Known Q (cfs) = 52.80

← verify sizing is for overflow Q100




PIPE OUTFALL RIPRAP SIZING CALCULATIONS

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

Project Name: Sterling Ranch Filing No. 4
 Project No.: 25188.11
 Calculated By: ARJ
 Checked By: _____
 Date: 11/2/22

undetained? 

	STORM DRAIN SYSTEM			Notes
	Barbarick Overflow	DESIGN POINT	DESIGN POINT	
Q ₁₀₀ (cfs):	52.8			Flows are the greater of proposed vs. future 
Conduit	Box Culvert			
D _c , Pipe Diameter (in):	N/A	N/A		
W, Box Width (ft):	3			
H, Box Height (ft):	3	N/A		
Y _t , Tailwater Depth (ft):	1.20			If unknown, use Y _t /D _c (or H)=0.4
Y _t /D _c or Y _t /H	0.40			
Q/D ^{2.5} or Q/(WH ^{3/2})	3.39			
Supercritical?	Yes			
Y _n , Normal Depth (ft) [Supercritical]:	1.00			
D _a , H _a (in) [Supercritical]:	2.00			D _a =(D _c +Y _n)/2
Riprap d ₅₀ (in) [Supercritical]:	3.48			
Riprap d ₅₀ (in) [Subcritical]:	N/A			
Required Riprap Size:	L			Fig. 9-38 or Fig. 9-36
d ₅₀ (in):	9			
Expansion Factor, 1/(2 tanθ):	6.00			Read from Fig. 9-35 or 9-36
θ:	0.08			
Erosive Soils?	No			
Area of Flow, A _t (ft ²):	7.54			A _t =Q/V
Length of Protection, L _p (ft):	19.7			L=(1/(2 tan θ))(A _t /Y _t - D)
Min Length (ft)	9.0			Min L=3D or 3H
Max Length (ft)	30.0			Max L=10D or 10H
Min Bottom Width, T (ft):	6.3			T=2*(L _p *tanθ)+W
Design Length (ft)	20.0			
Design Width (ft)	6.3			
Riprap Depth (in)	18			Depth=2(d ₅₀)
Type II Bedding Depth (in)*	6			*Not used if Soil Riprap
Cutoff Wall	Yes			
Cutoff Wall Depth (ft)	24.0			Depth of Riprap and Base
Cutoff Wall Width (ft)	#N/A			

Note: No Type II Base to be used if Soil Riprap is specified within the plans
 * For use when the flow in the culvert is supercritical (and less than full).

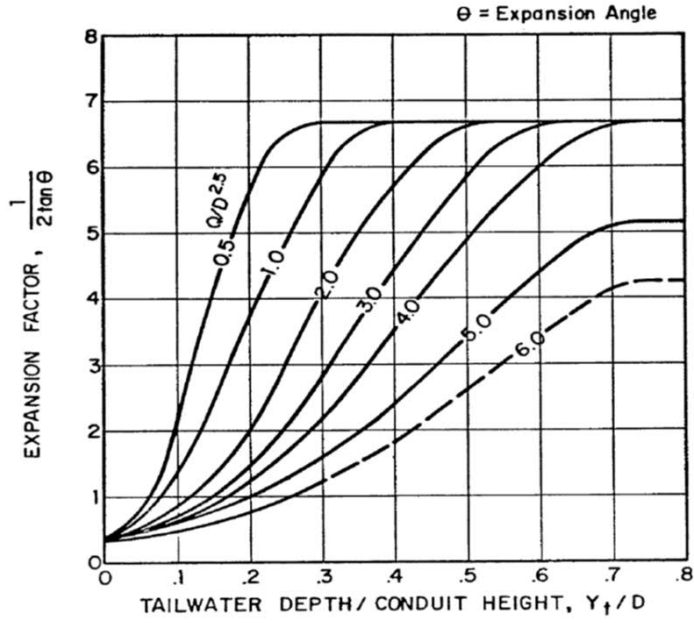


Figure 9-35. Expansion factor for circular conduits

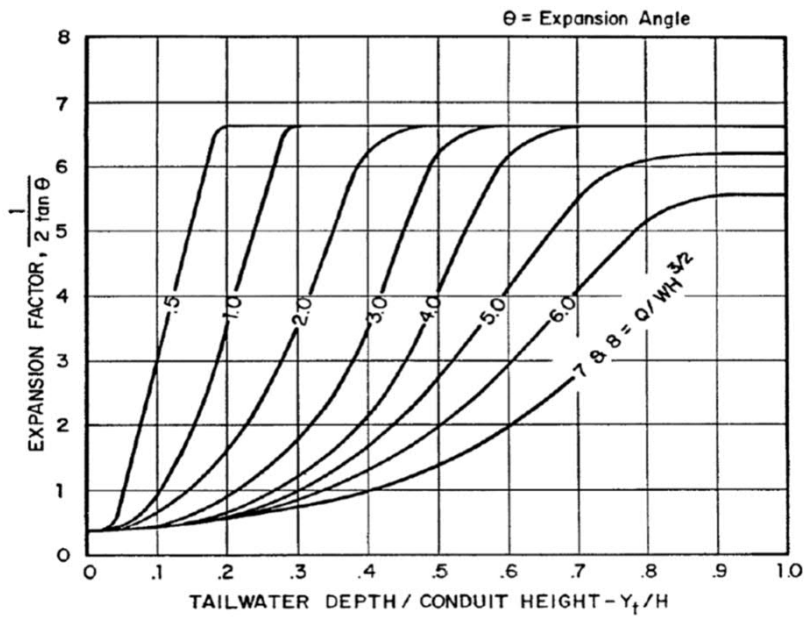


Figure 9-36. Expansion factor for rectangular conduits

Channel Report

Swale Section Point 2.i -Section BB

Trapezoidal

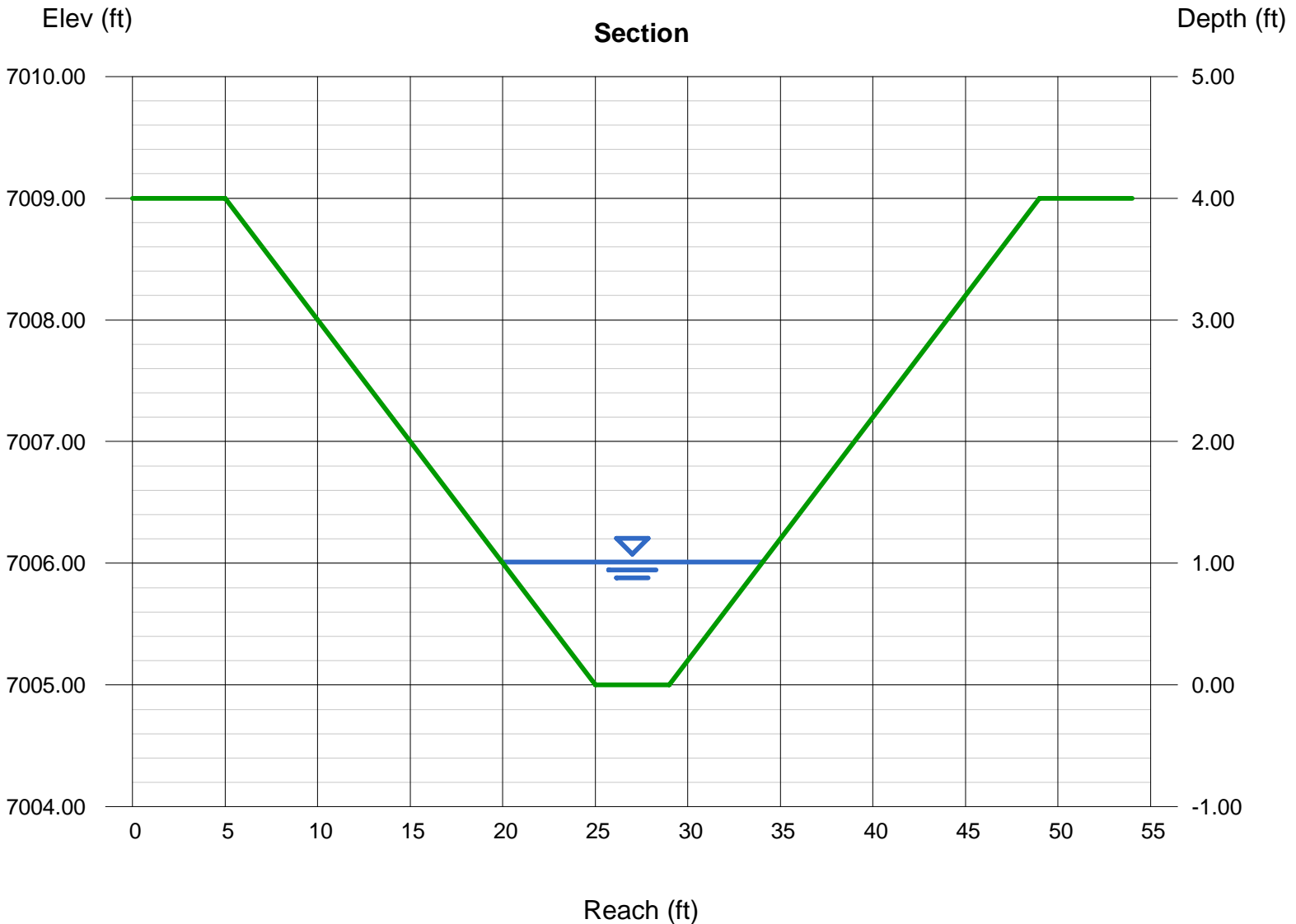
Bottom Width (ft) = 4.00
Side Slopes (z:1) = 5.00, 5.00
Total Depth (ft) = 4.00
Invert Elev (ft) = 7005.00
Slope (%) = 2.00
N-Value = 0.035

Highlighted

Depth (ft) = 1.01
Q (cfs) = 40.30
Area (sqft) = 9.14
Velocity (ft/s) = 4.41
Wetted Perim (ft) = 14.30
Crit Depth, Yc (ft) = 1.00
Top Width (ft) = 14.10
EGL (ft) = 1.31

Calculations

Compute by: Known Q
Known Q (cfs) = 40.30



Channel Report

Swale Section Point 7 -Section CC

Triangular

Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.00

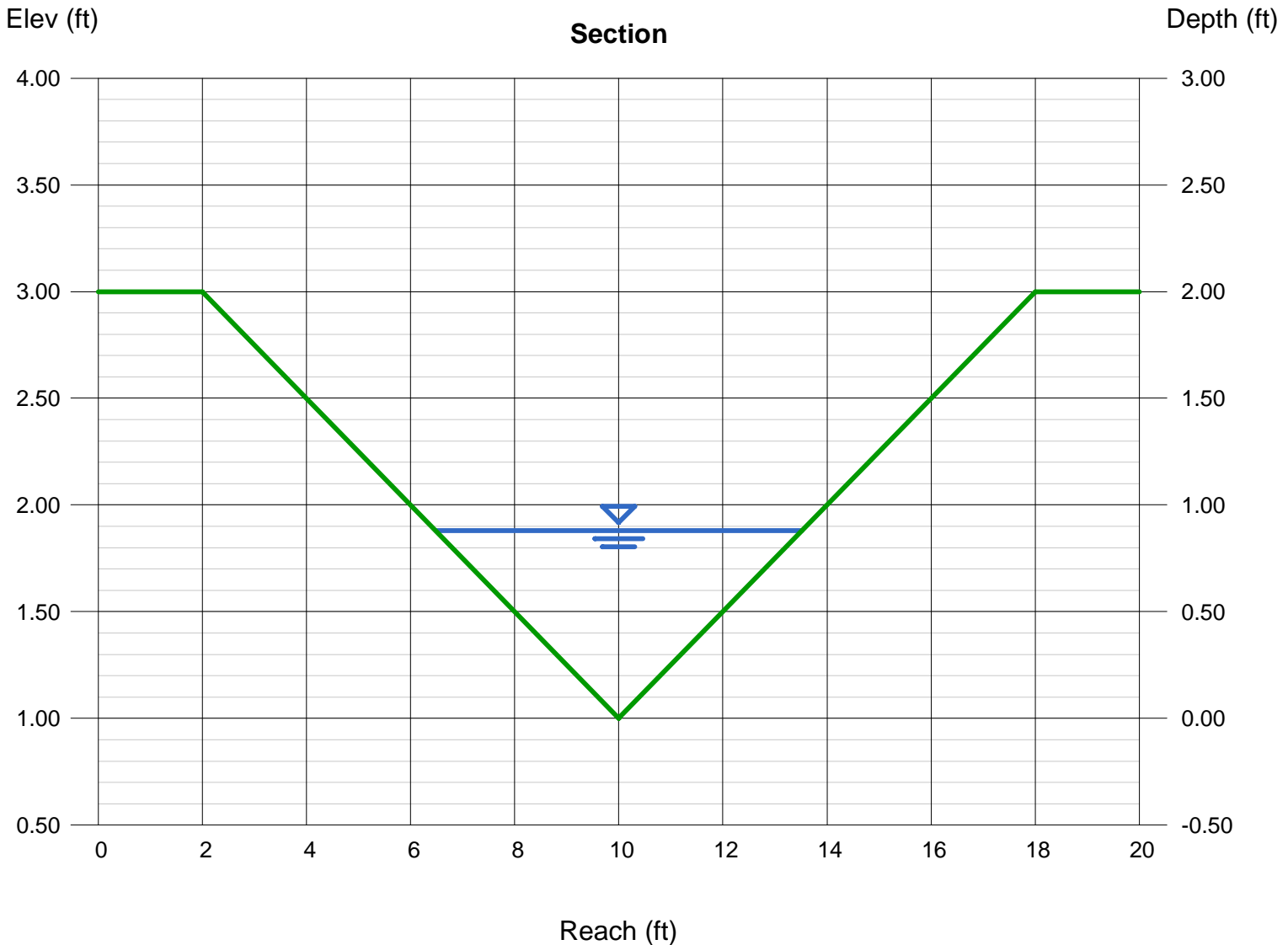
Invert Elev (ft) = 1.00
Slope (%) = 3.00
N-Value = 0.035

Calculations

Compute by: Known Q
Known Q (cfs) = 12.80

Highlighted

Depth (ft) = 0.88
Q (cfs) = 12.80
Area (sqft) = 3.10
Velocity (ft/s) = 4.13
Wetted Perim (ft) = 7.26
Crit Depth, Yc (ft) = 0.92
Top Width (ft) = 7.04
EGL (ft) = 1.15



Channel Report

Swale Section Point 24 -Section DD

Trapezoidal

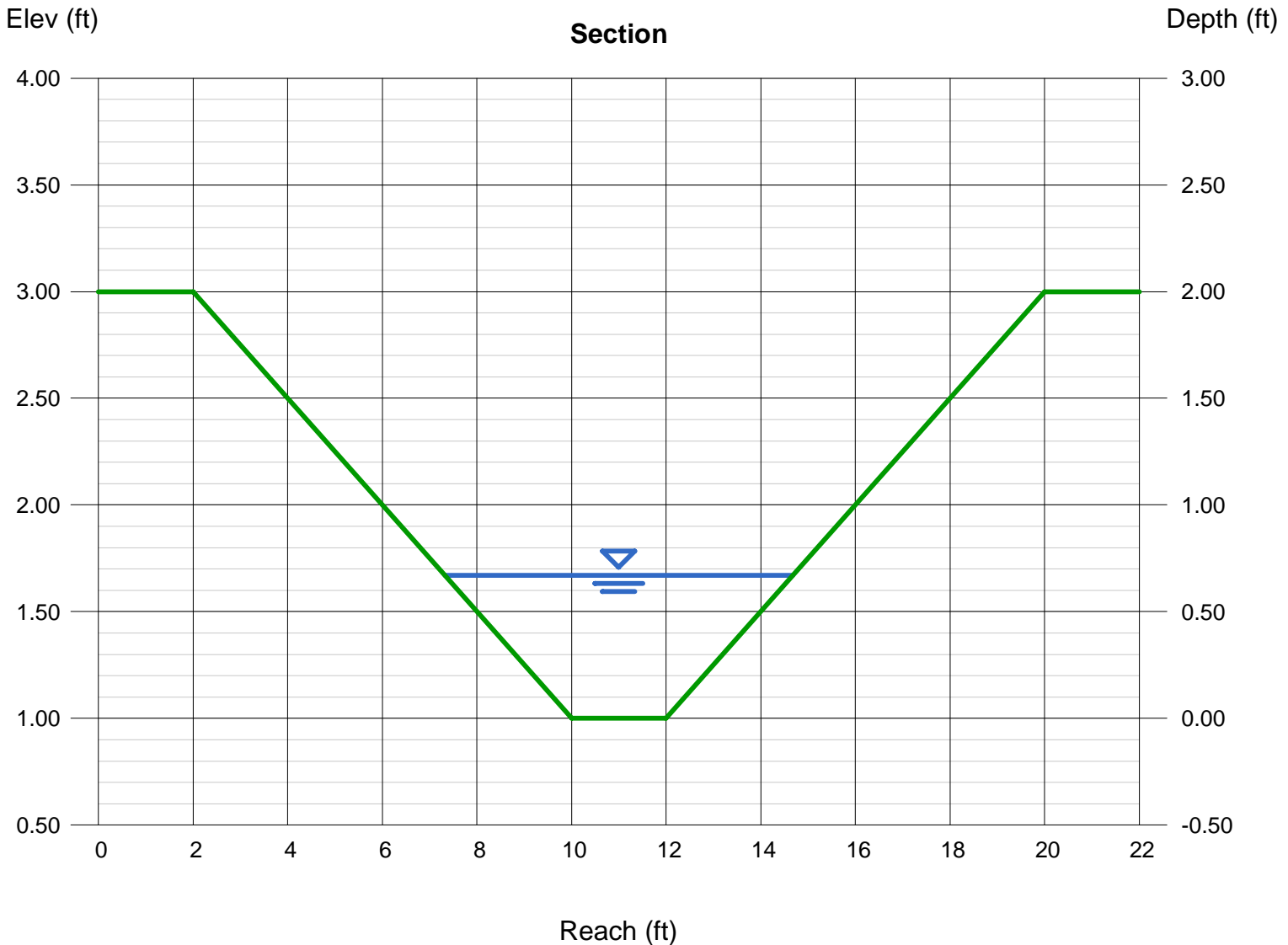
Bottom Width (ft) = 2.00
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 1.00
Slope (%) = 1.59
N-Value = 0.035

Highlighted

Depth (ft) = 0.67
Q (cfs) = 9.200
Area (sqft) = 3.14
Velocity (ft/s) = 2.93
Wetted Perim (ft) = 7.52
Crit Depth, Yc (ft) = 0.60
Top Width (ft) = 7.36
EGL (ft) = 0.80

Calculations

Compute by: Known Q
Known Q (cfs) = 9.20



Channel Report

Swale Section Point 3.i -Section EE

Trapezoidal

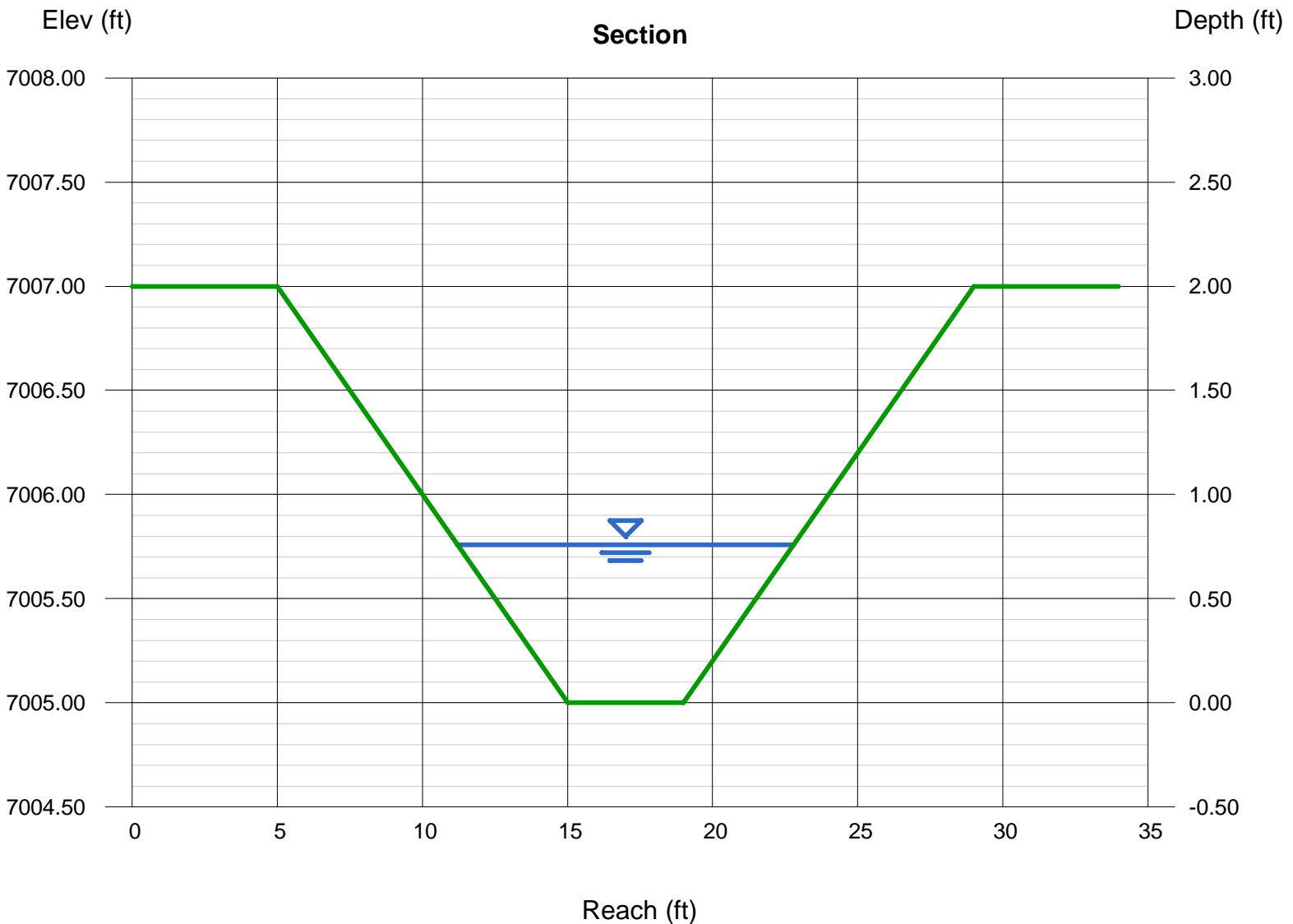
Bottom Width (ft) = 4.00
Side Slopes (z:1) = 5.00, 5.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 7005.00
Slope (%) = 1.50
N-Value = 0.035

Highlighted

Depth (ft) = 0.76
Q (cfs) = 19.40
Area (sqft) = 5.93
Velocity (ft/s) = 3.27
Wetted Perim (ft) = 11.75
Crit Depth, Yc (ft) = 0.68
Top Width (ft) = 11.60
EGL (ft) = 0.93

Calculations

Compute by: Known Q
Known Q (cfs) = 19.40



Froude Number Calculation's

Sterling Ranch Filing No.4

Froude Number Equation:

$$Fr = \frac{v}{(gh_m)^{1/2}}$$

Where:

v= velocity (ft/s)

g= acceleration of gravity (32.2ft/s²)

h_m=hydraulic mean depth (ft)

Hydraulic Mean Depth Equation:

$$h_m = \frac{A}{T}$$

Where:

A= cross sectional area of filled flow in channel (ft²)

T= width of channel open to surface (ft)

Inlet DP2.i Swale Section BB Calculations:

Parameters: A= 9.14 ft² , T= 14.10 ft, v= 4.41 ft/s

There for:

$$h_m = \frac{9.14}{14.10} = 0.64 \text{ ft}$$

$$Fr = \frac{4.41}{(32.2*0.64)^{1/2}} = 0.97$$

For cohesive soils maximum Froude Number is 0.80.

Type L Soil Riprap used for this swale.

Inlet DP7 Swale Section CC Calculations:

Parameters: A= 3.048 ft² , T= 7.04 ft, v= 4.13 ft/s

There for:

$$h_m = \frac{3.08}{7.04} = 0.44 \text{ ft}$$

$$Fr = \frac{4.13}{(32.2*0.44)^{1/2}} = 1.09$$

For cohesive soils maximum Froude Number is 0.80.

Type VL Soil Riprap used for this swale

Inlet DP 24 Swale Section DD Calculations:

Parameters: $A = 3.14 \text{ ft}^2$, $T = 7.36 \text{ ft}$, $v = 2.93 \text{ ft/s}$

There for:
$$h_m = \frac{3.14}{7.36} = 0.42 \text{ ft}$$

$$Fr = \frac{2.93}{(32.2 * 0.42)^{1/2}} = 0.79$$

For cohesive soils maximum Froude Number is 0.80.

Inlet DP 3.i Swale Section EE Calculations:

Parameters: $A = 5.92 \text{ ft}^2$, $T = 11.60 \text{ ft}$, $v = 3.27 \text{ ft/s}$

There for:
$$h_m = \frac{5.92}{11.60} = 0.51 \text{ ft}$$

$$Fr = \frac{3.27}{(32.2 * 0.51)^{1/2}} = 0.80$$

For cohesive soils maximum Froude Number is 0.80.

Used to Calculate riprap for swale sections: BB, CC

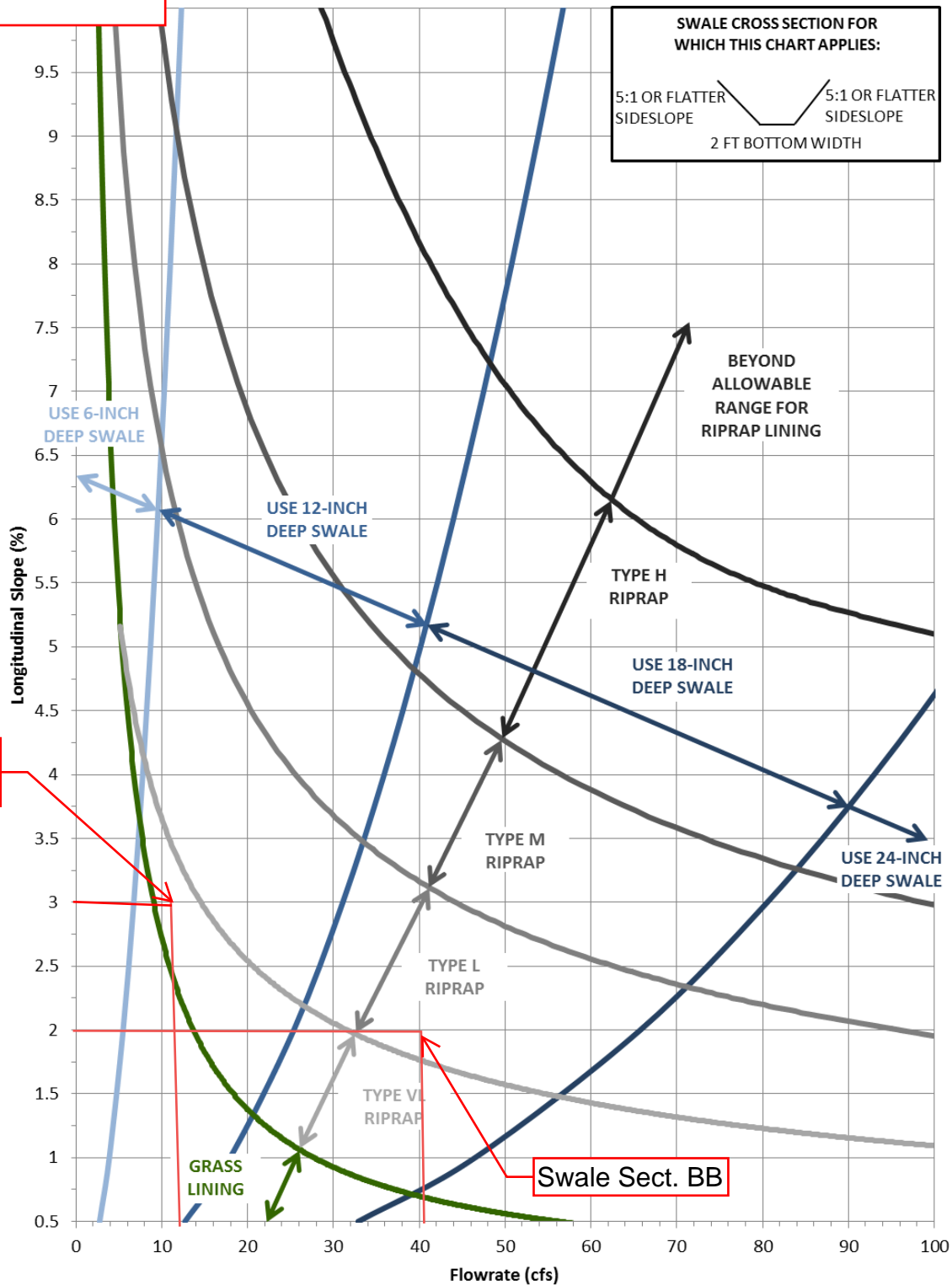
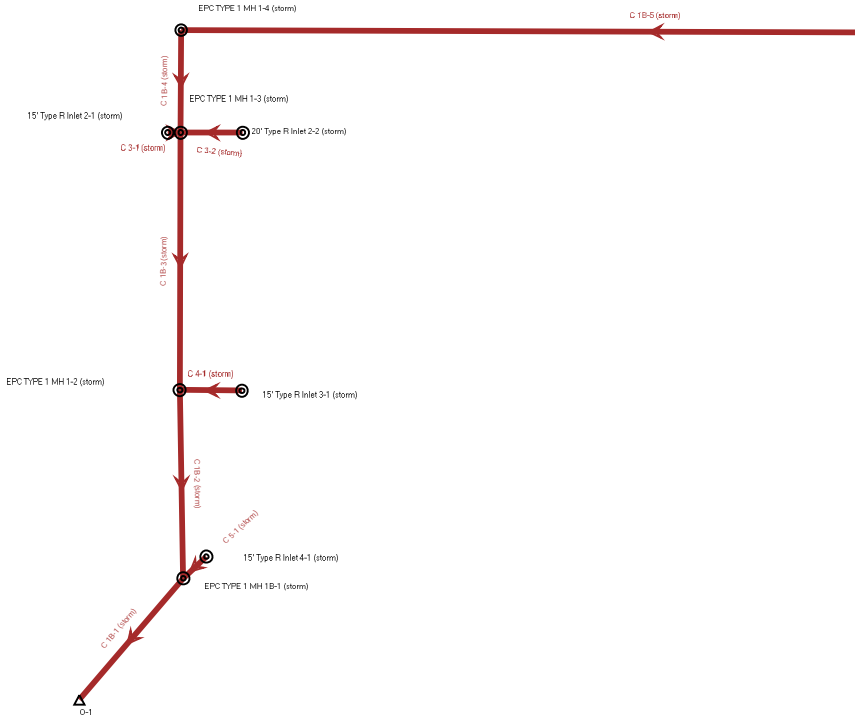
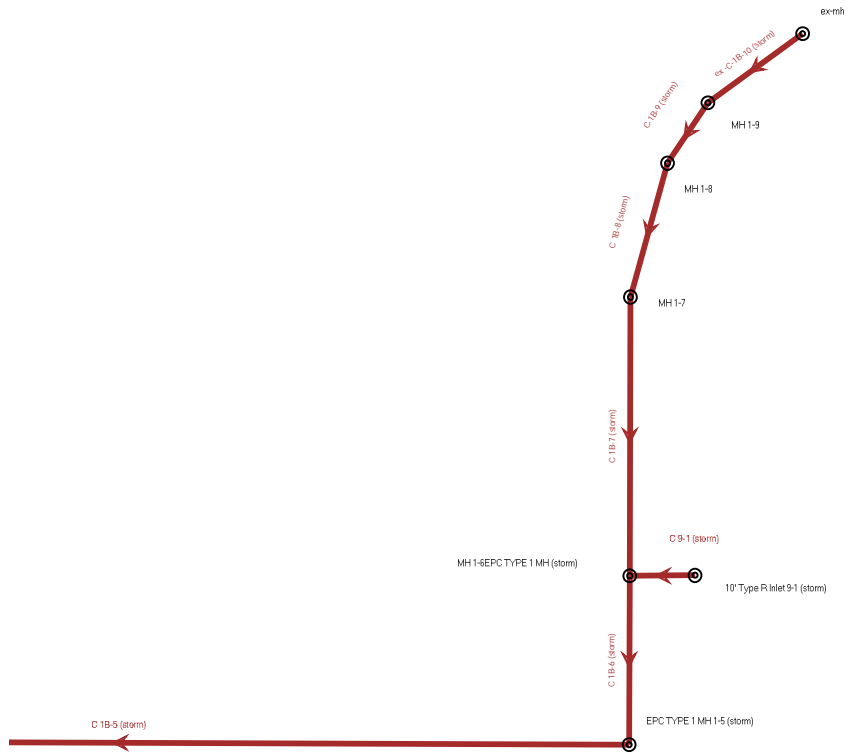


Figure 8-22. Swale stability chart; 2- to 4-foot bottom width and side slopes between 5:1 and 10:1
 (Note: Riprap classifications refer to gradation for riprap used in soil riprap or void-filled riprap. See Figure 8-34 for gradations.) (Source: Muller Engineering Company)

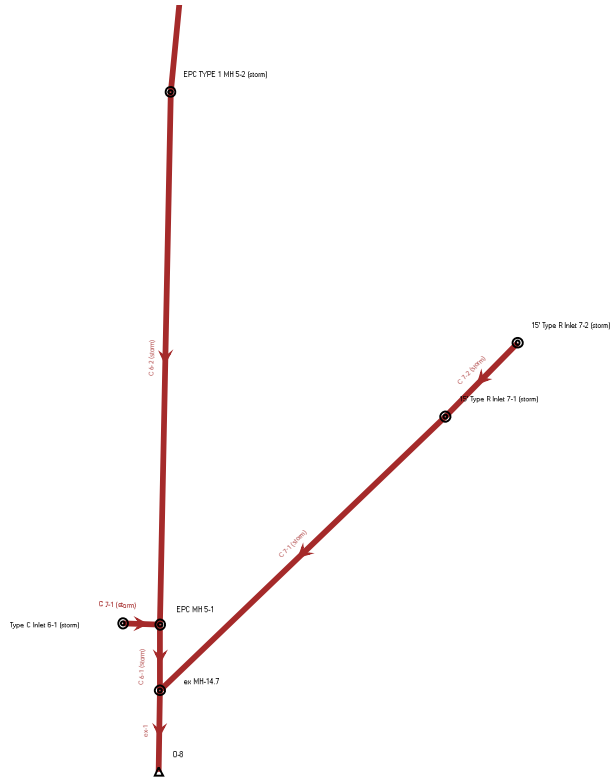
Scenario: 100 Year



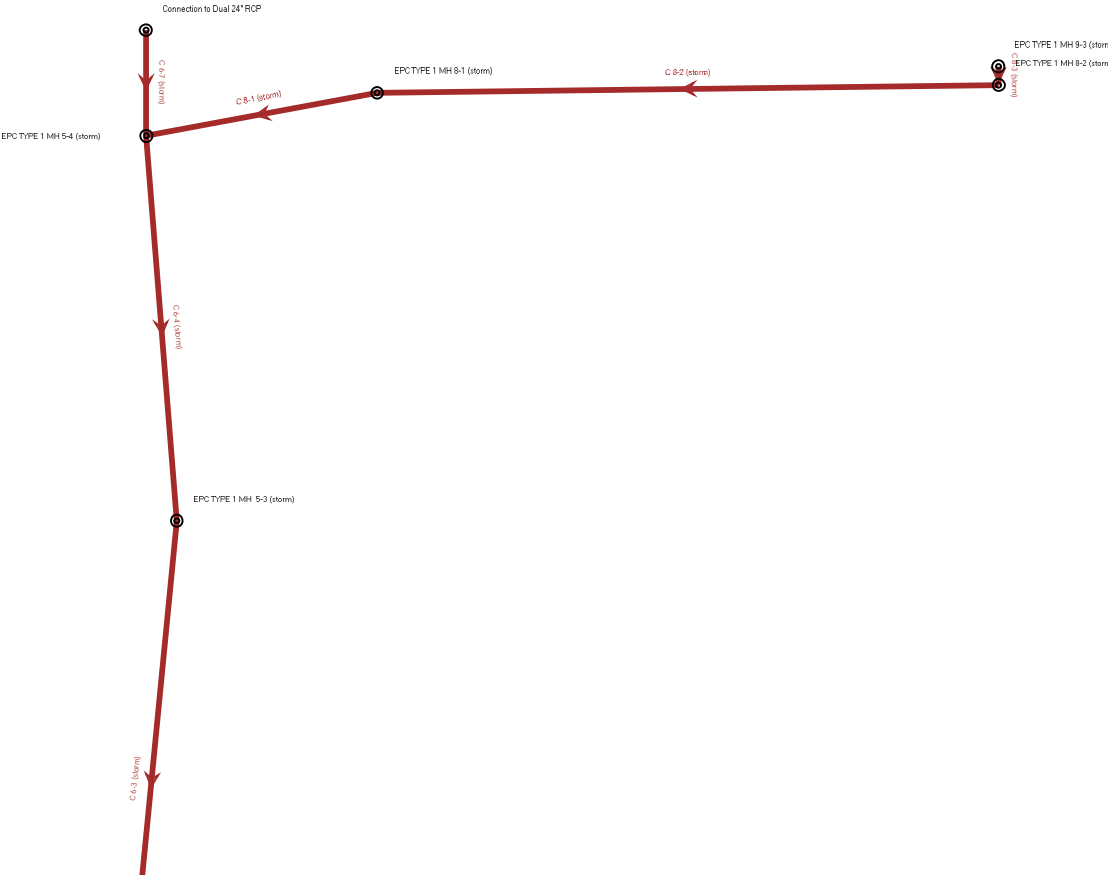
Scenario: Sterling Ranch Fil. No. 4 -5 Year



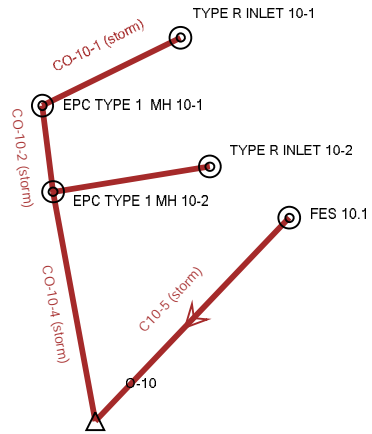
Scenario: Sterling Ranch Fil. No. 4 -100 Year



Scenario: 100 Year



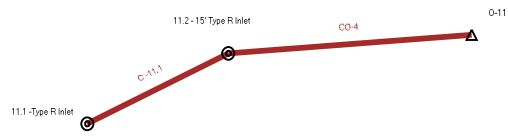
Scenario: Sterling Ranch Fil. No. 4 -100 Year



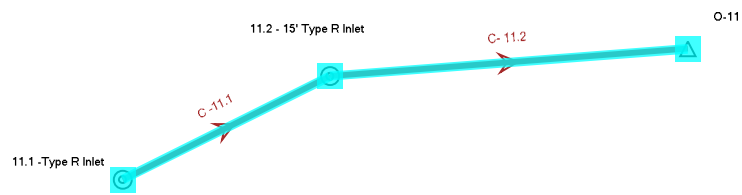
Scenario: Sterling Ranch Fil. No. 4 -100 Year



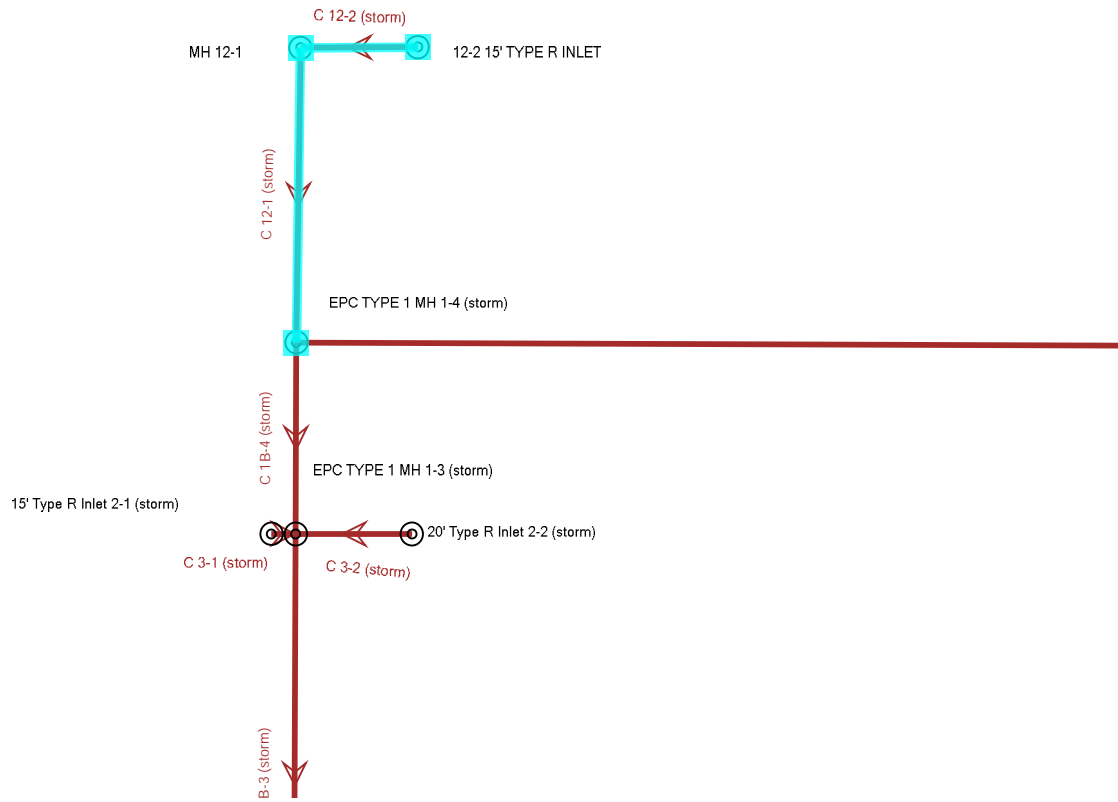
Scenario: Sterling Ranch Fil. No. 4 -100 Year



Scenario: Sterling Ranch Fil. No. 4 -100 Year



Scenario: Sterling Ranch Fil. No. 4 -100 Year



Scenario: Sterling Ranch Fil. No. 4 -100 Year
Current Time Step: 0.000 h
FlexTable: Manhole Table

Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Method
10' Type R Inlet 9-1 (storm)	7.70	6,990.17	6,986.21	7.70	6,987.31	6,987.29	6,987.81	6,987.79	Standard
11.1 -Type R Inlet	10.30	6,972.50	6,969.53	10.30	6,971.04	6,971.01	6,971.57	6,971.54	Standard
11.2 - 15' Type R Inlet	21.00	6,972.50	6,967.33	21.00	6,970.08	6,970.07	6,970.70	6,970.22	Standard
12-2 15' TYPE R INLET	13.90	6,982.28	6,978.00	13.90	6,980.96	6,980.65	6,981.26	6,980.95	Standard
15' Type R Inlet 2-1 (storm)	11.70	6,980.90	6,976.89	11.70	6,979.53	6,979.50	6,980.21	6,980.18	Standard
15' Type R Inlet 3-1 (storm)	12.60	6,979.81	6,975.99	12.60	6,978.63	6,978.59	6,979.42	6,979.38	Standard
15' Type R Inlet 4-1 (storm)	18.70	6,979.58	6,972.75	18.70	6,977.25	6,977.17	6,978.99	6,978.91	Standard
15' Type R Inlet 7-1 (storm)	36.30	7,003.30	6,993.10	36.30	6,995.10	6,995.06	6,996.91	6,995.92	Standard
15' Type R Inlet 7-2 (storm)	25.90	7,001.62	6,995.31	25.90	6,997.16	6,997.10	6,998.35	6,998.29	Standard
20' Type R Inlet 2-2 (storm)	12.90	6,980.82	6,977.18	12.90	6,979.57	6,979.55	6,979.83	6,979.82	Standard
Connection to Dual 24" RCP	72.20	7,021.50	7,019.12	72.20	7,022.10	7,021.05	7,024.20	7,023.15	Standard
EPC MH 5-1	110.40	6,996.65	6,988.34	110.40	6,992.87	6,992.12	6,997.98	6,993.37	Standard
EPC TYPE 1 MH 10-1	0.00	7,011.29	7,004.12	22.30	7,006.77	7,005.81	7,007.56	7,006.77	Standard
EPC TYPE 1 MH 5-3 (storm)	104.30	7,015.59	7,006.01	104.30	7,009.88	7,009.11	7,013.46	7,010.66	Standard
EPC TYPE 1 MH 1-2 (storm)	91.60	6,979.46	6,971.03	91.60	6,978.20	6,977.64	6,979.32	6,979.05	Standard
EPC TYPE 1 MH 1-3 (storm)	81.60	6,980.54	6,971.95	81.60	6,979.47	6,979.02	6,980.12	6,980.14	Standard
EPC TYPE 1 MH 1-4 (storm)	62.20	6,981.10	6,972.48	62.20	6,979.97	6,979.65	6,980.82	6,980.30	Standard
EPC TYPE 1 MH 1-5 (storm)	52.40	6,988.70	6,981.88	52.40	6,985.83	6,984.24	6,985.93	6,985.44	Standard
EPC TYPE 1 MH 10-2	0.00	7,010.40	7,002.24	32.90	7,005.15	7,004.10	7,005.96	7,004.89	Standard
EPC TYPE 1 MH 14-1	10.60	7,008.00	7,008.00	10.60	7,009.25	7,009.25	7,009.96	7,009.96	Absolute
EPC TYPE 1 MH 1B-1 (storm)	106.60	6,979.57	6,970.28	106.60	6,976.87	6,976.11	6,978.61	6,978.02	Standard
EPC TYPE 1 MH 5-2 (storm)	104.30	7,008.21	6,998.76	104.30	7,002.63	7,001.85	7,006.98	7,003.41	Standard
EPC TYPE 1 MH 5-4 (storm)	104.30	7,020.02	7,011.28	104.30	7,015.47	7,014.38	7,016.60	7,015.93	Standard
EPC TYPE 1 MH 8-1 (storm)	60.40	7,021.12	7,013.38	60.40	7,016.93	7,016.36	7,018.07	7,017.50	Standard
EPC TYPE 1 MH 8-2 (storm)	60.40	7,021.99	7,016.65	60.40	7,021.04	7,019.16	7,022.58	7,020.58	Standard
EPC TYPE 1 MH 9-3 (storm)	48.90	7,020.00	7,017.29	48.90	7,020.77	7,020.00	7,022.31	7,021.54	Standard
MH 1-6EPC TYPE 1 MH (storm)	18.10	6,989.81	6,983.60	18.10	6,985.99	6,985.83	6,987.52	6,985.99	Standard
MH 1-7	44.90	6,991.32	6,984.98	44.90	6,987.58	6,987.16	6,988.51	6,988.20	Standard
MH 1-8	44.90	6,992.17	6,986.00	44.90	6,988.60	6,988.18	6,989.53	6,989.22	Standard
MH 1-9	44.90	6,992.82	6,987.54	44.90	6,990.14	6,989.72	6,991.07	6,990.75	Standard
MH 12-1	13.60	6,981.92	6,977.50	13.60	6,980.53	6,980.24	6,980.84	6,980.53	Standard
TYPE R INLET 10-1	22.30	7,007.72	7,007.72	22.30	7,007.41	7,007.41	7,008.37	7,008.37	Absolute
Type C Inlet 6-1 (storm)	11.70	6,993.40	6,990.65	11.70	6,993.44	6,993.10	6,994.13	6,993.79	Standard
Type C-13-2	9.10	6,976.64	6,972.05	9.10	6,976.65	6,976.64	6,976.78	6,976.77	Standard
ex MH-14.7	132.60	6,997.00	6,987.47	132.60	6,991.94	6,990.91	6,992.35	6,992.98	Standard
ex-mh	44.90	6,994.20	6,988.02	44.90	6,990.86	6,990.55	6,991.64	6,991.33	Standard

X:\2510000.all\2518811\StormCAD\2518811 Filing No 4 StormCAD model.stsw

Scenario: Sterling Ranch Fil. No. 4 -5 Year
Current Time Step: 0.000 h
FlexTable: Conduit Table

Label	Flow (cfs)	Diameter (in)	Rise (ft)	Span (ft)	Manning's n	Slope (Calculated) (ft/ft)	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)	Velocity (ft/s)	Length (User Defined) (ft)
C -11.1	3.90	-	1.2	1.9	0.013	0.005	6,969.53	6,969.16	6,972.50	6,972.50	6,970.16	6,969.77	6,970.41	6,970.04	4.19	73.6
C 1B-1 (storm)	47.50	42.0	-	-	0.013	0.004	6,970.28	6,969.97	6,979.57	6,973.84	6,972.50	6,972.12	6,973.35	6,973.03	7.36	74.8
C 1B-2 (storm)	42.60	42.0	-	-	0.013	0.005	6,971.03	6,970.57	6,979.46	6,979.57	6,973.06	6,972.84	6,973.90	6,973.49	7.72	92.3
C 1B-3 (storm)	39.60	42.0	-	-	0.013	0.005	6,971.95	6,971.33	6,980.54	6,979.46	6,973.91	6,973.40	6,974.70	6,974.09	7.59	124.3
C 1B-4 (storm)	21.40	42.0	-	-	0.013	0.005	6,972.48	6,972.25	6,981.10	6,980.54	6,974.20	6,974.23	6,974.52	6,974.45	6.42	46.8
C 1B-5 (storm)	22.70	36.0	-	-	0.013	0.016	6,981.88	6,974.26	6,988.70	6,981.10	6,983.42	6,975.32	6,984.02	6,976.92	10.15	472.8
C 1B-6 (storm)	22.70	36.0	-	-	0.013	0.020	6,983.60	6,982.08	6,989.81	6,988.70	6,985.13	6,984.22	6,985.74	6,984.50	10.95	76.1
C 1B-7 (storm)	21.50	36.0	-	-	0.013	0.010	6,984.98	6,983.89	6,991.32	6,989.81	6,986.47	6,985.75	6,987.06	6,986.09	8.37	110.1
C 1B-8 (storm)	21.50	36.0	-	-	0.013	0.010	6,986.00	6,985.28	6,992.17	6,991.32	6,987.49	6,986.48	6,988.08	6,987.51	8.41	72.1
C 3-1 (storm)	7.00	18.0	-	-	0.013	0.112	6,976.89	6,976.61	6,980.90	6,980.54	6,977.91	6,977.36	6,978.37	6,978.34	15.50	2.5
C 3-2 (storm)	6.50	24.0	-	-	0.013	0.026	6,977.18	6,976.46	6,980.82	6,980.54	6,978.08	6,977.08	6,978.43	6,978.05	8.83	27.0
C 4-1 (storm)	3.80	18.0	-	-	0.013	0.030	6,975.99	6,975.18	6,979.81	6,979.46	6,976.74	6,975.67	6,977.03	6,976.55	8.14	26.9
C 5-1 (storm)	6.30	18.0	-	-	0.013	0.020	6,972.75	6,972.57	6,979.58	6,979.57	6,973.72	6,973.36	6,974.14	6,974.05	7.99	9.2
C 6-1 (storm)	43.20	48.0	-	-	0.013	0.022	6,988.34	6,987.47	6,996.65	6,997.00	6,990.31	6,990.11	6,991.08	6,990.48	13.28	39.7
C 6-2 (storm)	42.50	48.0	-	-	0.013	0.027	6,998.76	6,990.09	7,008.21	6,996.65	7,000.71	6,991.24	7,001.47	6,994.38	14.23	321.4
C 6-3 (storm)	42.50	48.0	-	-	0.013	0.023	7,006.01	7,000.16	7,015.59	7,008.21	7,007.96	7,001.36	7,008.72	7,004.16	13.43	254.8
C 6-4 (storm)	42.50	48.0	-	-	0.013	0.019	7,011.28	7,007.73	7,020.02	7,015.59	7,013.23	7,009.00	7,013.99	7,011.39	12.50	189.2
C 6-7 (storm)	35.40	24.0	-	-	0.013	0.025	7,019.12	7,017.85	7,021.50	7,020.02	7,020.64	7,018.91	7,021.38	7,020.61	11.42	50.0
C 7-1 (storm)	17.00	36.0	-	-	0.013	0.023	6,993.10	6,987.47	7,003.30	6,997.00	6,994.42	6,990.11	6,994.92	6,990.21	10.66	243.1
C 7-1-1 (storm)	3.40	18.0	-	-	0.013	0.034	6,990.65	6,990.01	6,993.40	6,996.65	6,991.35	6,990.77	6,991.62	6,991.00	8.23	18.9
C 7-2 (storm)	12.00	24.0	-	-	0.013	0.020	6,995.31	6,994.10	7,001.62	7,003.30	6,996.56	6,994.98	6,997.09	6,996.25	9.46	60.8
C 8-1 (storm)	20.60	36.0	-	-	0.013	0.010	7,013.38	7,012.27	7,021.12	7,020.02	7,014.84	7,013.76	7,015.41	7,014.30	8.34	109.9
C 8-2 (storm)	20.60	36.0	-	-	0.013	0.010	7,016.65	7,013.63	7,021.99	7,021.12	7,018.11	7,015.12	7,018.68	7,015.66	8.32	301.7
C 8-3 (storm)	20.60	30.0	-	-	0.013	0.010	7,017.29	7,017.19	7,020.00	7,021.99	7,018.83	7,018.86	7,019.48	7,019.40	8.48	9.6
C 9-1 (storm)	1.60	18.0	-	-	0.013	0.029	6,986.21	6,985.45	6,990.17	6,989.81	6,986.69	6,985.76	6,986.86	6,986.34	6.26	26.3
C 12-1 (storm)	9.00	24.0	-	-	0.013	0.010	6,977.50	6,976.76	6,981.92	6,981.10	6,978.57	6,977.64	6,979.00	6,978.35	6.79	73.9
C 12-2 (storm)	9.00	24.0	-	-	0.013	0.014	6,978.00	6,977.60	6,982.28	6,981.92	6,979.07	6,979.01	6,979.50	6,979.23	7.58	29.6
C 13-1 (Storm)	2.20	24.0	-	-	0.013	0.002	6,972.05	6,971.93	6,976.64	6,973.50	6,972.68	6,972.45	6,972.78	6,972.63	2.53	63.0
C- 11.2	8.00	36.0	-	-	0.013	0.015	6,967.33	6,965.36	6,972.50	6,969.00	6,968.22	6,968.27	6,968.54	6,968.29	7.28	134.7
C-1B-9 (storm)	21.50	36.0	-	-	0.013	0.027	6,987.54	6,986.30	6,992.82	6,992.17	6,989.03	6,987.29	6,989.61	6,989.02	12.08	45.5
CO-10-1 (storm)	8.90	24.0	-	-	0.013	-0.020	7,004.42	7,005.72	7,011.29	7,007.72	7,006.78	7,005.61	7,007.21	7,005.93	8.72	64.9
CO-10-2 (storm)	8.90	24.0	-	-	0.013	0.020	7,004.12	7,003.24	7,011.29	7,010.40	7,005.18	7,003.99	7,005.61	7,005.04	8.73	43.8
CO-10-3 (storm)	4.30	18.0	-	-	0.013	0.052	7,008.00	7,003.74	7,008.00	7,010.40	7,008.79	7,004.17	7,009.11	7,005.81	10.26	82.0
CO-10-4 (storm)	13.20	36.0	-	-	0.013	0.020	7,002.24	6,999.81	7,010.40	7,010.00	7,003.40	7,000.57	7,003.83	7,001.94	9.40	121.8
ex -C-1B-10 (storm)	21.50	36.0	-	-	0.013	0.003	6,988.02	6,987.85	6,994.20	6,992.82	6,989.63	6,989.34	6,990.11	6,989.93	5.50	54.3
ex-1	53.40	48.0	-	-	0.013	0.020	6,987.47	6,986.46	6,997.00	6,990.00	6,989.67	6,988.05	6,990.55	6,990.09	13.69	49.8

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Scenario: Sterling Ranch Fil. No. 4 -5 Year
Current Time Step: 0.000 h
FlexTable: Manhole Table

Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Method
10' Type R Inlet 9-1 (storm)	1.60	6,990.17	6,986.21	1.60	6,986.70	6,986.69	6,986.87	6,986.86	Standard
11.1 -Type R Inlet	3.90	6,972.50	6,969.53	3.90	6,970.17	6,970.16	6,970.42	6,970.41	Standard
11.2 - 15' Type R Inlet	8.00	6,972.50	6,967.33	8.00	6,968.24	6,968.22	6,968.51	6,968.54	Standard
12-2 15' TYPE R INLET	9.00	6,982.28	6,978.00	9.00	6,979.51	6,979.07	6,979.94	6,979.50	Standard
15' Type R Inlet 2-1 (storm)	7.00	6,980.90	6,976.89	7.00	6,977.94	6,977.91	6,978.40	6,978.37	Standard
15' Type R Inlet 3-1 (storm)	3.80	6,979.81	6,975.99	3.80	6,976.75	6,976.74	6,977.04	6,977.03	Standard
15' Type R Inlet 4-1 (storm)	6.30	6,979.58	6,972.75	6.30	6,973.74	6,973.72	6,974.16	6,974.14	Standard
15' Type R Inlet 7-1 (storm)	17.00	7,003.30	6,993.10	17.00	6,994.44	6,994.42	6,995.71	6,994.92	Standard
15' Type R Inlet 7-2 (storm)	12.00	7,001.62	6,995.31	12.00	6,996.58	6,996.56	6,997.11	6,997.09	Standard
20' Type R Inlet 2-2 (storm)	6.50	6,980.82	6,977.18	6.50	6,978.10	6,978.08	6,978.44	6,978.43	Standard
Connection to Dual 24" RCP	35.40	7,021.50	7,019.12	35.40	7,021.01	7,020.64	7,021.75	7,021.38	Standard
EPC MH 5-1	43.20	6,996.65	6,988.34	43.20	6,990.77	6,990.31	6,991.00	6,991.08	Standard
EPC TYPE 1 MH 10-1	0.00	7,011.29	7,004.12	8.90	7,005.61	7,005.18	7,005.93	7,005.61	Standard
EPC TYPE 1 MH 5-3 (storm)	42.50	7,015.59	7,006.01	42.50	7,008.34	7,007.96	7,010.74	7,008.72	Standard
EPC TYPE 1 MH 1-2 (storm)	42.60	6,979.46	6,971.03	42.60	6,973.40	6,973.06	6,974.09	6,973.90	Standard
EPC TYPE 1 MH 1-3 (storm)	39.60	6,980.54	6,971.95	39.60	6,974.23	6,973.91	6,974.45	6,974.70	Standard
EPC TYPE 1 MH 1-4 (storm)	21.40	6,981.10	6,972.48	21.40	6,974.36	6,974.20	6,975.97	6,974.52	Standard
EPC TYPE 1 MH 1-5 (storm)	22.70	6,988.70	6,981.88	22.70	6,984.22	6,983.42	6,984.50	6,984.02	Standard
EPC TYPE 1 MH 10-2	0.00	7,010.40	7,002.24	13.20	7,003.96	7,003.40	7,005.01	7,003.83	Standard
EPC TYPE 1 MH 14-1	4.30	7,008.00	7,008.00	4.30	7,008.79	7,008.79	7,009.11	7,009.11	Absolute
EPC TYPE 1 MH 1B-1 (storm)	47.50	6,979.57	6,970.28	47.50	6,972.84	6,972.50	6,973.49	6,973.35	Standard
EPC TYPE 1 MH 5-2 (storm)	42.50	7,008.21	6,998.76	42.50	7,001.09	7,000.71	7,003.89	7,001.47	Standard
EPC TYPE 1 MH 5-4 (storm)	42.50	7,020.02	7,011.28	42.50	7,013.76	7,013.23	7,014.30	7,013.99	Standard
EPC TYPE 1 MH 8-1 (storm)	20.60	7,021.12	7,013.38	20.60	7,015.12	7,014.84	7,015.66	7,015.41	Standard
EPC TYPE 1 MH 8-2 (storm)	20.60	7,021.99	7,016.65	20.60	7,018.86	7,018.11	7,019.40	7,018.68	Standard
EPC TYPE 1 MH 9-3 (storm)	20.60	7,020.00	7,017.29	20.60	7,019.16	7,018.83	7,019.81	7,019.49	Standard
MH 1-6EPC TYPE 1 MH (storm)	22.70	6,989.81	6,983.60	22.70	6,985.75	6,985.13	6,986.09	6,985.74	Standard
MH 1-7	21.50	6,991.32	6,984.98	21.50	6,986.70	6,986.47	6,987.74	6,987.06	Standard
MH 1-8	21.50	6,992.17	6,986.00	21.50	6,987.72	6,987.49	6,989.45	6,988.08	Standard
MH 1-9	21.50	6,992.82	6,987.54	21.50	6,989.26	6,989.03	6,989.85	6,989.62	Standard
MH 12-1	9.00	6,981.92	6,977.50	9.00	6,979.01	6,978.57	6,979.23	6,979.00	Standard
TYPE R INLET 10-1	8.90	7,007.72	7,007.72	8.90	7,006.78	7,006.78	7,007.21	7,007.21	Absolute
Type C Inlet 6-1 (storm)	3.40	6,993.40	6,990.65	3.40	6,991.49	6,991.35	6,991.76	6,991.62	Standard
Type C-13-2	2.20	6,976.64	6,972.05	2.20	6,972.68	6,972.68	6,972.79	6,972.78	Standard
ex MH-14.7	53.40	6,997.00	6,987.47	53.40	6,990.11	6,989.67	6,990.21	6,990.55	Standard
ex-mh	21.50	6,994.20	6,988.02	21.50	6,989.83	6,989.63	6,990.31	6,990.11	Standard

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Channel Report

Trickle Channel

Rectangular

Bottom Width (ft) = 2.00
Total Depth (ft) = 0.50

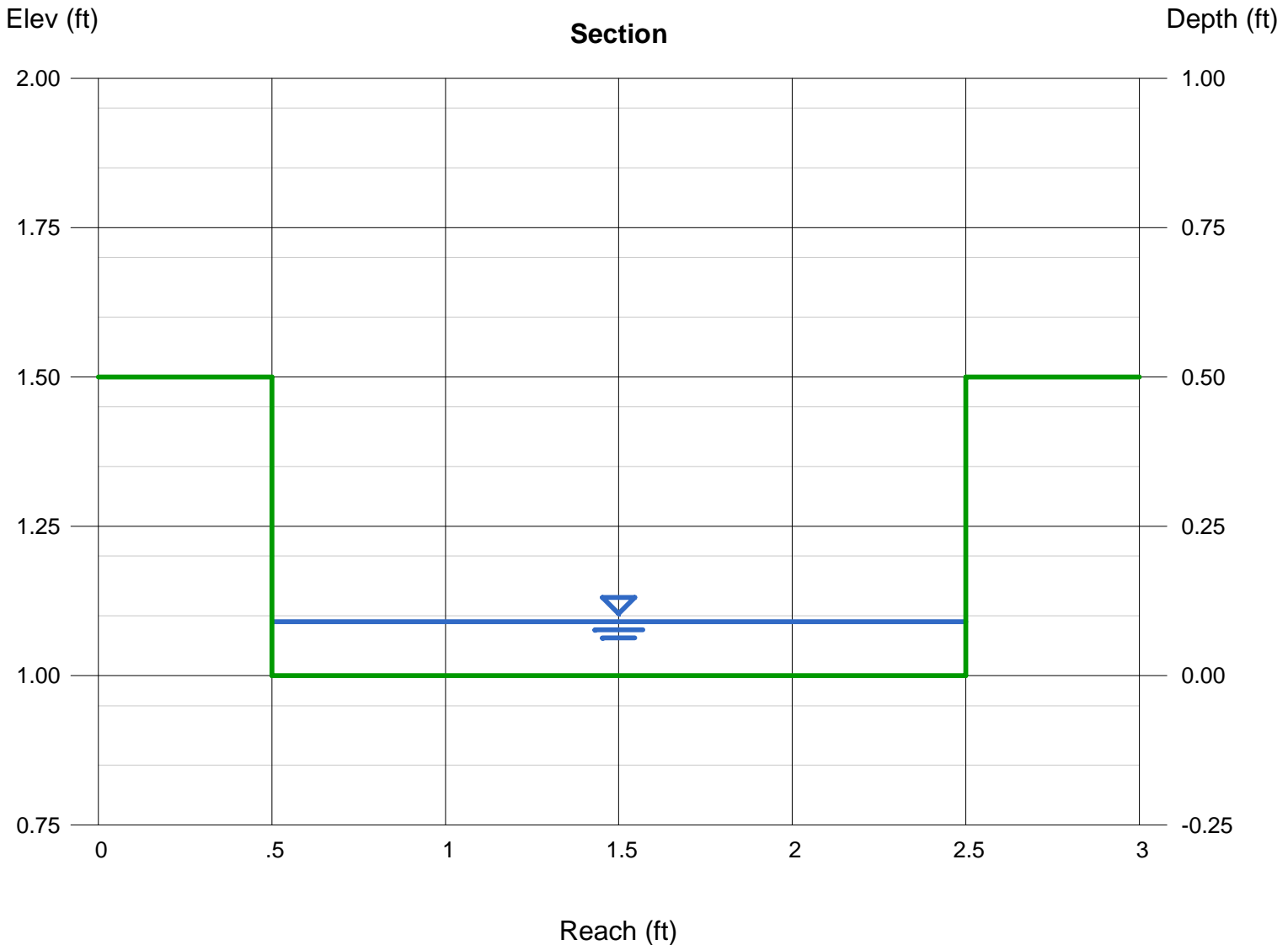
Invert Elev (ft) = 1.00
Slope (%) = 0.50
N-Value = 0.013

Calculations

Compute by: Known Q
Known Q (cfs) = 0.25

Highlighted

Depth (ft) = 0.09
Q (cfs) = 0.250
Area (sqft) = 0.18
Velocity (ft/s) = 1.39
Wetted Perim (ft) = 2.18
Crit Depth, Y_c (ft) = 0.08
Top Width (ft) = 2.00
EGL (ft) = 0.12



Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: RAB
Company: JR ENGINEERING
Date: November 9, 2022
Project: Sterling Ranch Filing No.4 - 36" Forebay
Location: EL PASO COUNTY

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} * 0.43))$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) NRCS Hydrologic Soil Groups of Tributary Watershed i) Percentage of Watershed consisting of Type A Soils ii) Percentage of Watershed consisting of Type B Soils iii) Percentage of Watershed consisting of Type C/D Soils</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$</p> <p>K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)</p>	<p>$I_a =$ <input type="text" value="84.5"/> %</p> <p>$i =$ <input type="text" value="0.845"/></p> <p>Area = <input type="text" value="1.790"/> ac</p> <p>$d_6 =$ <input type="text" value="0.43"/> in</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input checked="" type="radio"/> Water Quality Capture Volume (WQCV)</p> <p><input type="radio"/> Excess Urban Runoff Volume (EURV)</p> </div> <p>$V_{DESIGN} =$ <input type="text"/> ac-ft</p> <p>$V_{DESIGN\ OTHER} =$ <input type="text" value="0.053"/> ac-ft</p> <p>$V_{DESIGN\ USER} =$ <input type="text"/> ac-ft</p> <p>HSG _A = <input type="text"/> %</p> <p>HSG _B = <input type="text"/> %</p> <p>HSG _{C/D} = <input type="text"/> %</p> <p>$EURV_{DESIGN} =$ <input type="text"/> ac-ft</p> <p>$EURV_{DESIGN\ USER} =$ <input type="text"/> ac-ft</p>
<p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p>	<p>L : W = <input type="text" value="2.0"/> : 1</p>
<p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>Z = <input type="text" value="4.00"/> ft / ft</p>
<p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p>	<p>_____</p> <p>_____</p> <p>_____</p>
<p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMN} =$ <input type="text" value="1"/> % of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F =$ <input type="text" value="12"/> inch maximum)</p> <p>D) Forebay Discharge</p> <p>i) Undetained 100-year Peak Discharge</p> <p>ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p>	<p>$V_{FMN} =$ <input type="text" value="0.001"/> ac-ft</p> <p>$V_F =$ <input type="text" value="0.003"/> ac-ft</p> <p>$D_F =$ <input type="text" value="12.0"/> in</p> <p>$Q_{100} =$ <input type="text" value="12.70"/> cfs</p> <p>$Q_F =$ <input type="text" value="0.25"/> cfs</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> </div> <p>Flow too small for berm w/ pipe</p> <p>Calculated $D_P =$ <input type="text"/> in</p> <p>Calculated $W_N =$ <input type="text" value="3.3"/> in</p>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: RAB
Company: JR ENGINEERING
Date: November 9, 2022
Project: Sterling Ranch Filing No.4 - 36" Forebay
Location: EL PASO COUNTY

<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Choose One <input checked="" type="radio"/> Concrete <input type="radio"/> Soft Bottom </div> <p>S = <input style="width: 50px;" type="text" value="0.0050"/> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-foot minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>D_M = <input style="width: 50px;" type="text"/> ft</p> <p>A_M = <input style="width: 50px;" type="text"/> sq ft</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> Choose One <input checked="" type="radio"/> Orifice Plate <input type="radio"/> Other (Describe): </div> <hr/> <hr/> <hr/> <p>D_{orifice} = <input style="width: 50px;" type="text"/> inches</p> <p>A_{or} = <input style="width: 50px;" type="text"/> square inches</p>
<p>8. Initial Surcharge Volume</p> <p>A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)</p> <p>B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)</p> <p>C) Initial Surcharge Provided Above Micropool</p>	<p>D_{IS} = <input style="width: 50px;" type="text"/> in</p> <p>V_{IS} = <input style="width: 50px;" type="text"/> cu ft</p> <p>V_s = <input style="width: 50px;" type="text"/> cu ft</p>
<p>9. Trash Rack</p> <p>A) Water Quality Screen Open Area: $A_t = A_{or} * 38.5 * (e^{-0.095D})$</p> <p>B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)</p> <p style="margin-left: 40px;">Other (Y/N): <input style="width: 50px;" type="text" value="N"/></p> <p>C) Ratio of Total Open Area to Total Area (only for type 'Other')</p> <p>D) Total Water Quality Screen Area (based on screen type)</p> <p>E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)</p> <p>F) Height of Water Quality Screen (H_{TR})</p> <p>G) Width of Water Quality Screen Opening (W_{opening}) (Minimum of 12 inches is recommended)</p>	<p>A_t = <input style="width: 50px;" type="text"/> square inches</p> <hr/> <hr/> <hr/> <p>User Ratio = <input style="width: 50px;" type="text"/></p> <p>A_{total} = <input style="width: 50px;" type="text"/> sq. in.</p> <p>H = <input style="width: 50px;" type="text"/> feet</p> <p>H_{TR} = <input style="width: 50px;" type="text"/> inches</p> <p>W_{opening} = <input style="width: 50px;" type="text"/> inches</p>

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 3

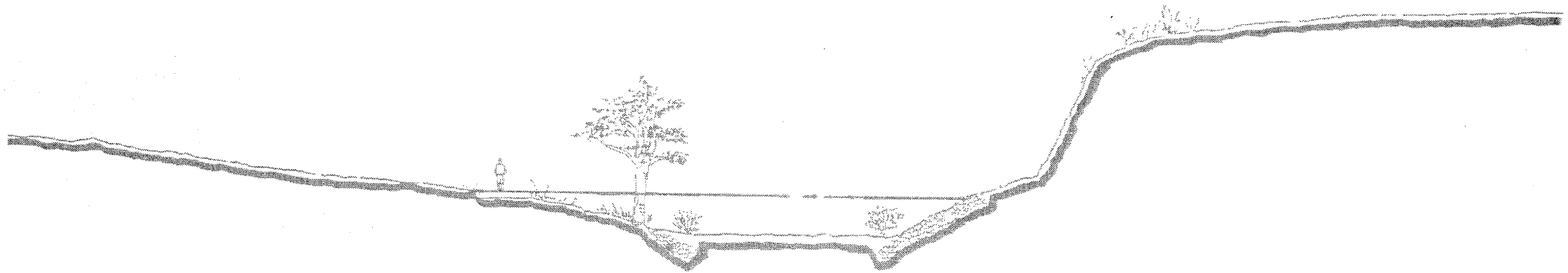
Designer: RAB
Company: JR ENGINEERING
Date: November 9, 2022
Project: Sterling Ranch Filing No.4 - 36" Forebay
Location: EL PASO COUNTY

<p>10. Overflow Embankment</p> <p>A) Describe embankment protection for 100-year and greater overtopping:</p> <p>B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>Ze = <input type="text" value=""/> ft / ft</p>
<p>11. Vegetation</p>	<p>Choose One</p> <p><input type="radio"/> Irrigated</p> <p><input type="radio"/> Not Irrigated</p>
<p>12. Access</p> <p>A) Describe Sediment Removal Procedures</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Notes: _____</p> <p>_____</p> <p>_____</p> <p>_____</p>	

Appendix D

Reference Material

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN REPORT
CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO



PREPARED FOR:

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

PREPARED BY:

Kiowa Engineering Corporation
1011 North Weber
Colorado Springs, CO 80903

II. STUDY AREA DESCRIPTION

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

Basin Description

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

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

Climate

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

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

Soils and Geology

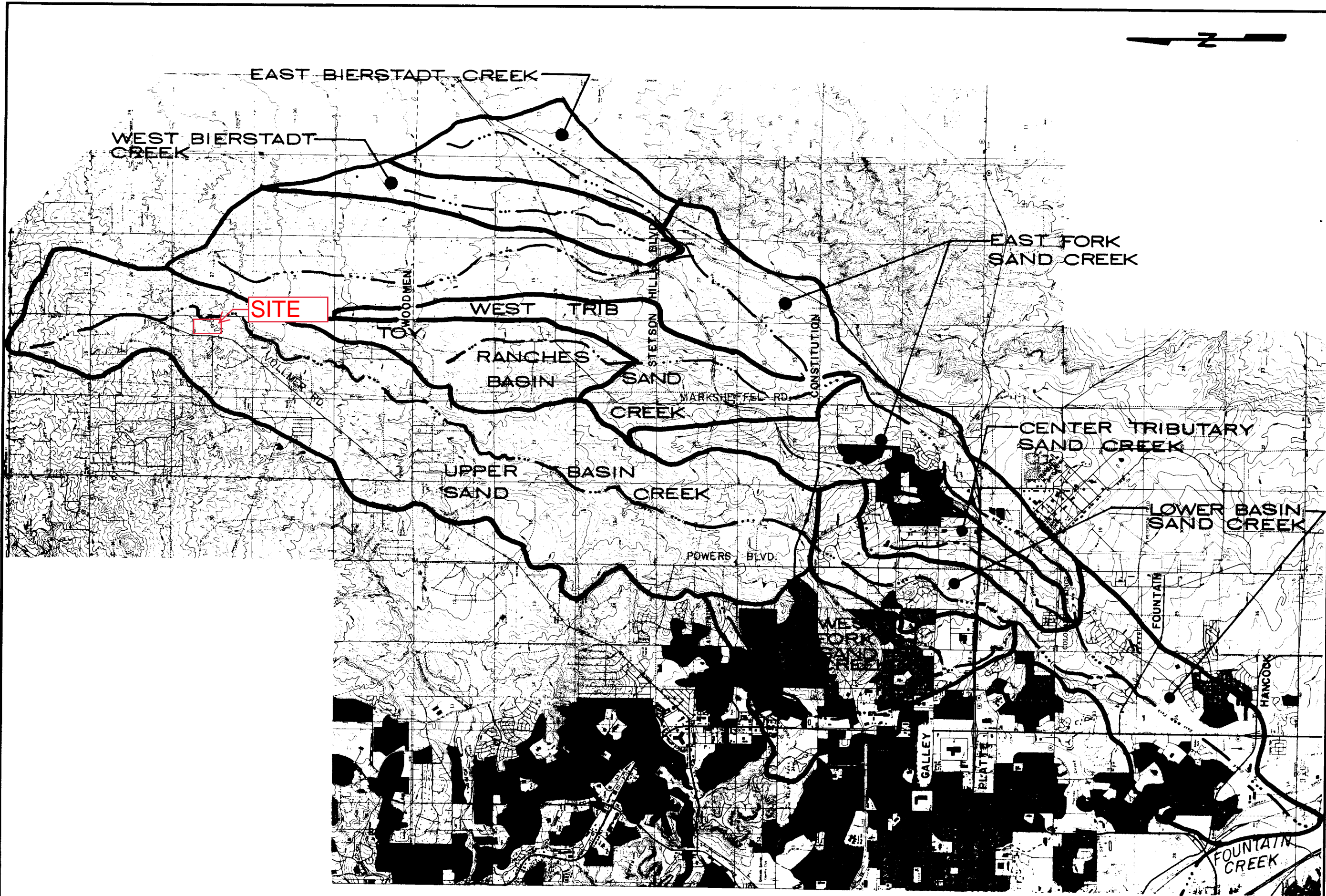
Soils within the Sand Creek basin vary between soil types A through D, as identified by the U. S. Department of Agriculture, Soil Conservation Service. The predominant soil groupings are in the Truckton and Bresser soil associations. The soils consist of deep, well drained soils that formed in alluvium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

Property Ownership and Impervious Land Densities

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

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

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



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

SAND CREEK DRAINAGE
 BASIN PLANNING STUDY
 REGIONAL SUB-BASINS

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

Worksheet for FSD Outlet Orifice Plate

Project Description

Solve For Diameter

Input Data

Discharge	45.90	ft ³ /s	(16.5 H ₁₅ + 29.4 P _{acc})
Headwater Elevation	4.70	ft	
Centroid Elevation	0.00	ft	
Tailwater Elevation	0.00	ft	
Discharge Coefficient	0.60		

Results

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

Worksheet for FSD Overflow - Pass

Project Description

Solve For Discharge

Input Data

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

Results

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

$(55 \text{ DU}) + 29.4 \text{ pcc} = 84.4 \text{ (ft)}$

Pond FDS Barbarack Subdivision Overflow Weir

Worksheet for FSD Overflow - Pass

Project Description

Solve For Discharge

Input Data

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

Results

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

$(55 \text{ DU}) + 29.4 \text{ p.u.c.} = 84.4 \text{ (ft)}$

Worksheet for SFB Overflow Developed

Project Description

Solve For

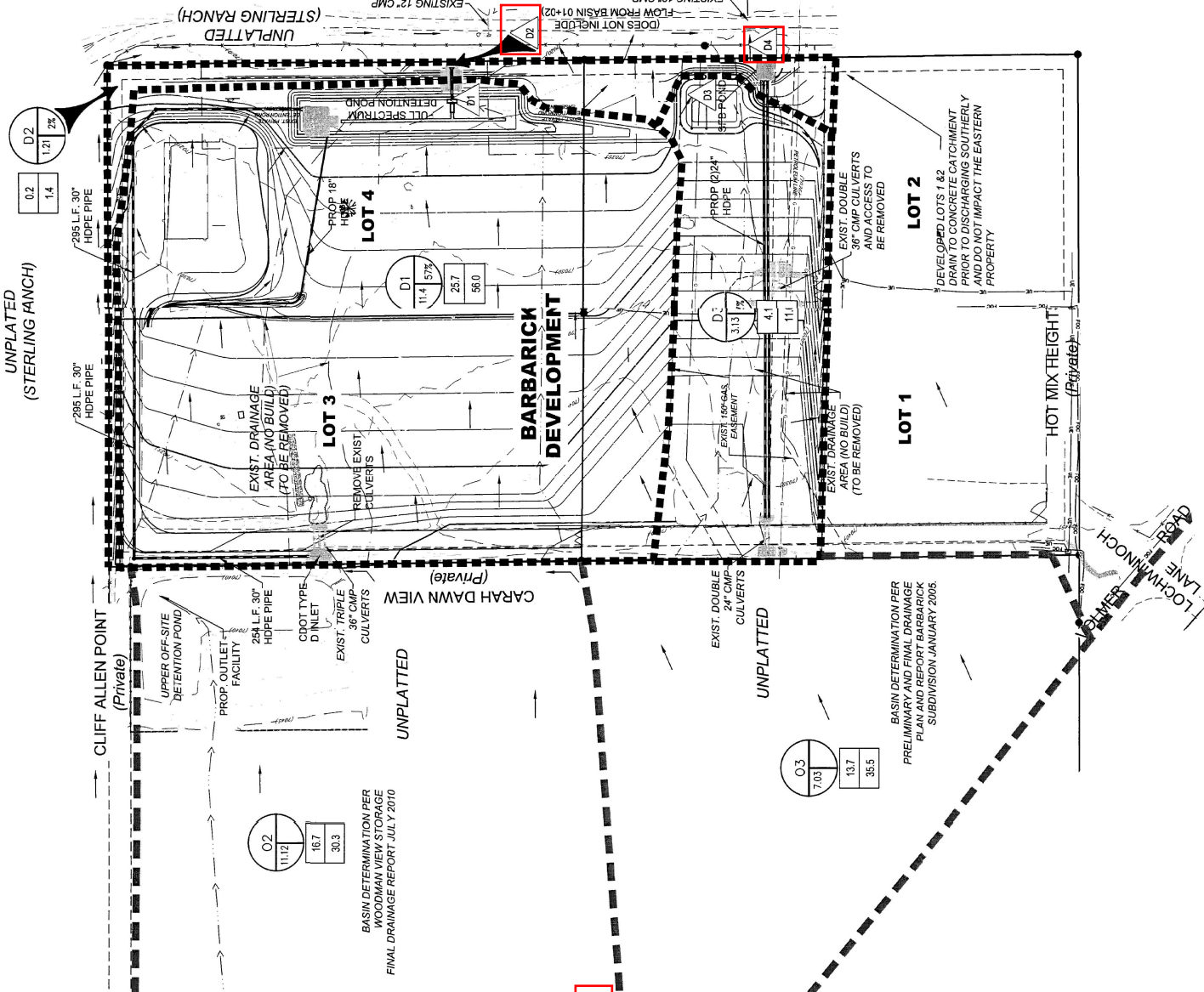
Discharge

Input Data

Headwater Elevation		0.45	ft
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Gravel		
Crest Breadth		6.00	ft
Crest Length		10.00	ft

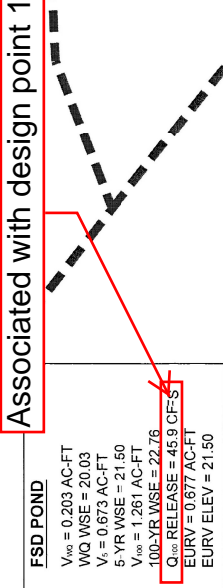
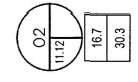
Results

Discharge		8.08	ft ³ /s
Headwater Height Above Crest		0.45	ft
Tailwater Height Above Crest		0.00	ft
Weir Coefficient		2.68	US
Submergence Factor		1.00	
Adjusted Weir Coefficient		2.68	US
Flow Area		4.50	ft ²
Velocity		1.80	ft/s
Wetted Perimeter		10.90	ft
Top Width		10.00	ft



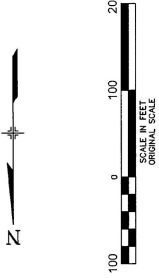
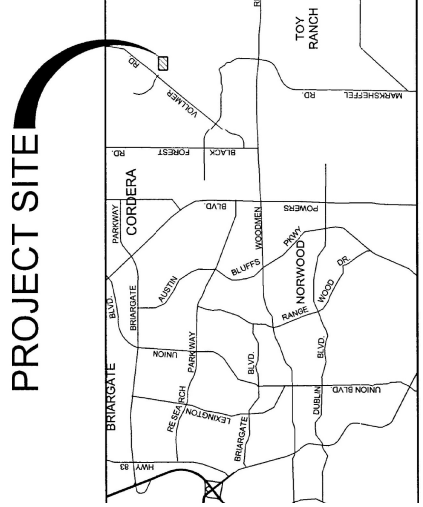
BASIN DETERMINATION PER WOODMAN VIEW STORAGE FINAL DRAINAGE REPORT JULY 2010

BASIN DETERMINATION PER PRELIMINARY AND FINAL DRAINAGE PLAN FOR BARBARICK SUBDIVISION JANUARY 2006.



BARBARICK DRAINAGE SUMMARY TABLE

BASIN	AREA (AC.)	Q15 (CFS)	Q100 (CFS)	% IMP.	COMMENT
D1	11.40	25.7	56.0	57%	D1 BASIN TO FSD +022 PASS THROUGH
D2	1.21	0.8	3.0	2%	POND RELEASE + D2
D3	3.13	4.1	11.6	57%	D3 BASIN TO SFB
O2	11.12	16.7	30.3		REF: WOODMAN STORAGE FDR 2010
O3	7.03	13.7	35.5		REF: BARBARICK FDR 2005
DESIGN POINT					
	AREA (AC.)	Q15 (CFS)	Q100 (CFS)	COMMENT	
D1	11.40	85.4		D1 BASIN TO FSD +022 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	



VERTICAL BENCHMARK

THE VERTICAL BENCHMARK DATA IS BASED ON THE NATIONAL RESURVEYED VERTICAL DATUM OF 1989 AND THE 1980 SUPPLEMENTARY ADJUSTMENT BEING A ROUND 3.25' ALUMINUM CAP IN A ROAD BOX DESIGNATED AS FACILITIES INFORMATION MANAGEMENT SYSTEM (FIMS) MONUMENT 1.69' AND HAVING PUBLISHED ELEVATION OF 6975.62 FEET WAS USED TO BACK SIGHT THE BENCHMARK FROM A POINT ON THE WEST LINE 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 GUARDRAIL POST IS 25.7 FEET TO THE NORTH.

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

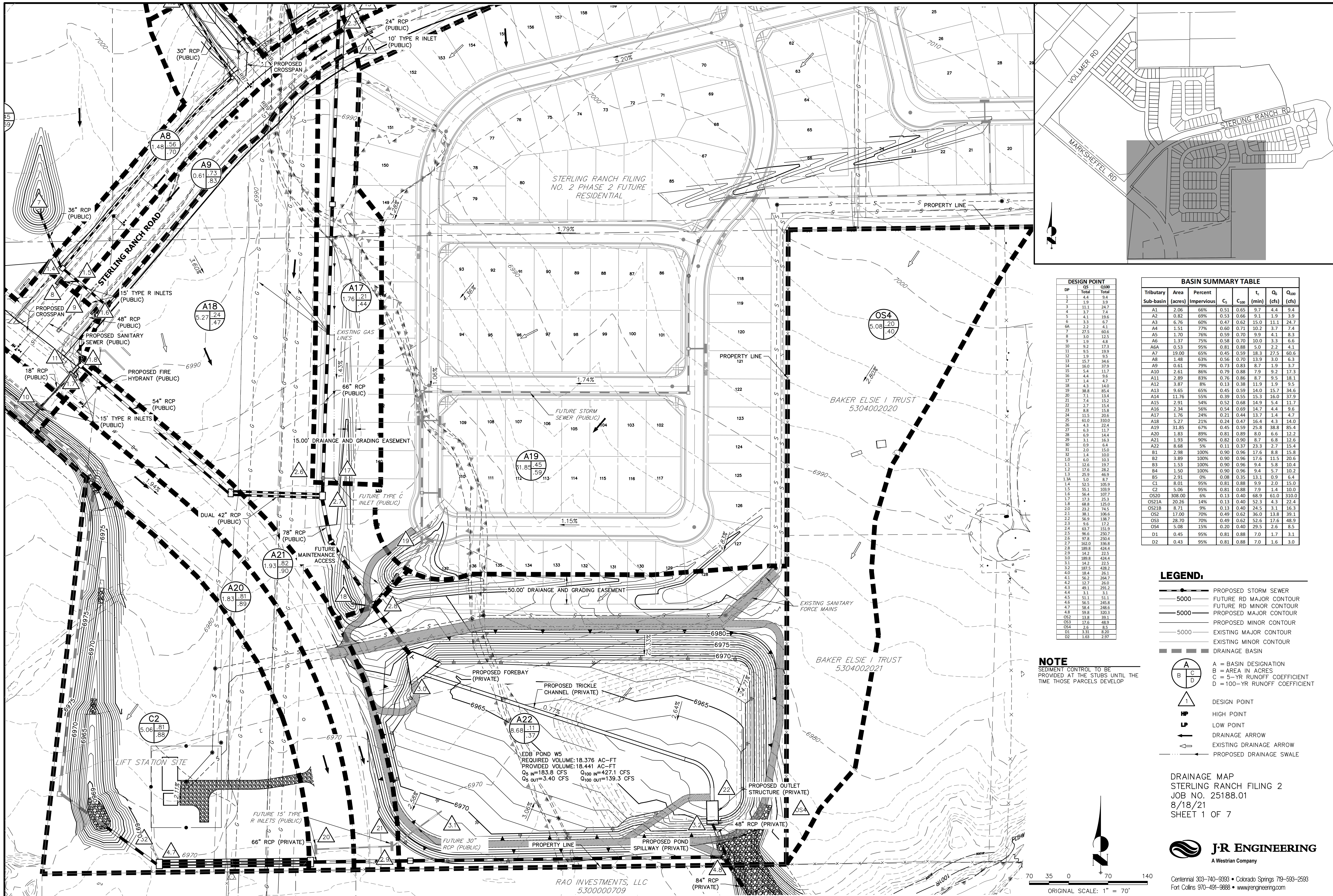
EXISTING FLOW DIRECTION

NO.	DATE	DESCRIPTION	BY
REVISIONS			
BENCHMARK DATA(ELEV.) (DATUM)			
BENCHMARK DATA(LOCATION) (DESCRIPTION/LOCATION)			

BARBARICK SUBDIVISION LOTS 1-4

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

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



DESIGN POINT	Q5	Q100
1	4.4	9.4
2	1.9	3.9
3	15.1	24.7
4	3.7	7.4
5	4.1	19.6
6	3.3	6.7
7	2.2	4.1
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	36.8	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	63.0	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
1.4	5.0	8.7
1.5	52.5	105.9
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	23.5
3.0	189.8	424.4
3.2	187.5	426.2
4.0	15.4	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
052	13.8	39.1
053	17.6	48.9
054	2.8	8.5
01	3.31	8.20
02	1.63	2.97

BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C ₁	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
AB6A	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	20.5
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

- LEGEND:**
- PROPOSED STORM SEWER
 - - - - FUTURE RD MAJOR CONTOUR
 - - - - FUTURE RD MINOR CONTOUR
 - - - - PROPOSED MAJOR CONTOUR
 - - - - PROPOSED MINOR CONTOUR
 - - - - EXISTING MAJOR CONTOUR
 - - - - EXISTING MINOR CONTOUR
 - DRAINAGE BASIN
 - (A/B/C/D) A = BASIN DESIGNATION
B = AREA IN ACRES
C = 5-YR RUNOFF COEFFICIENT
D = 100-YR RUNOFF COEFFICIENT
 - ▲ DESIGN POINT
 - HP HIGH POINT
 - LP LOW POINT
 - DRAINAGE ARROW
 - EXISTING DRAINAGE ARROW
 - PROPOSED DRAINAGE SWALE

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

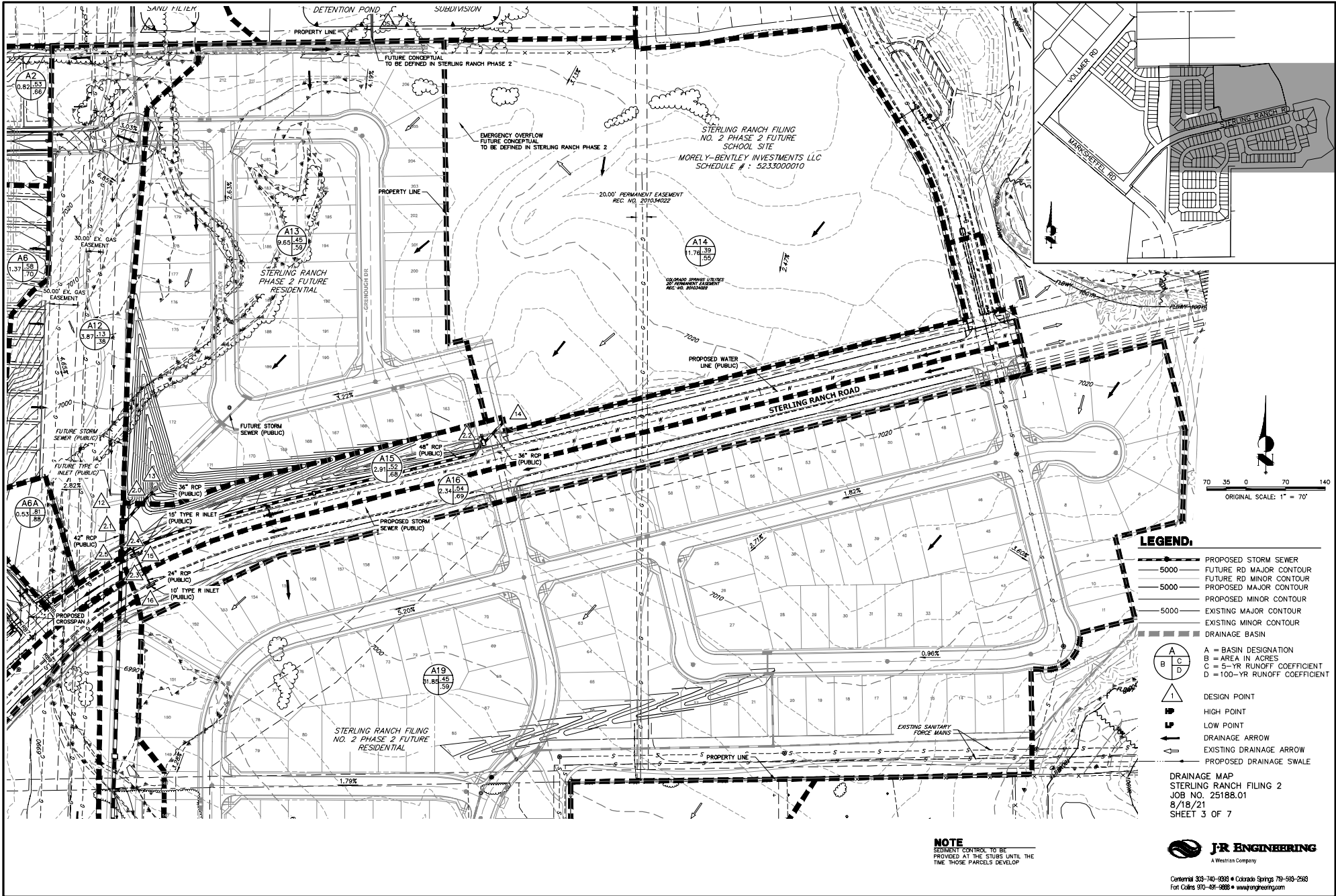
RAO INVESTMENTS, LLC
5300000709

ORIGINAL SCALE: 1" = 70'

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



Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com



DRAINAGE MAP
 STERLING RANCH FILING 2
 JOB NO. 25188.01
 8/18/21
 SHEET 3 OF 7

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



Central 303-740-0935 • Colorado Springs 719-589-2593
 Fort Collins 970-491-9888 • www.jrengineering.com

X:\25188\25188.dwg (18/08/2021 10:00:00 AM) PLOT: 8/18/21 10:00:00 AM



Know what's below.
Call before you dig.

ASPEN MEADOWS

COLORADO SPRINGS, CO

PROPOSED CONDITIONS MAP

Design Point	Upstream			Subbasins Included	Inlet			Outlet Pipe Size/Type	Downstream Design Point
	Area (Acres)	Q5 (cfs)	Q100 (cfs)		Name	Type	Size (in)		
DP1	4.22	4.6	13.2	A2	A2	D 10 R	8	24" RCP/HP	D2
DP2	8.17	10.0	28.7	A1,A2	A1	D 10 R	8	30" RCP/HP	D5
DP3	0.93	1.5	4.2	A3	A3	D 10 R	6	18" RCP/HP	D4
DP4	1.31	2.0	5.7	A3,A4	A4	D 10 R	6	18" RCP/HP	D5
DP5	9.48	12.0	34.4	A1,A2,A3,A4	D5	MH	6	30" RCP/HP	D9
DP6	3.92	3.3	11.0	A6	A6	D 10 R	8	24" RCP/HP	D7
DP7	5.08	5.0	15.9	A6,A7	A5	D 10 R	6	24" RCP/HP	D8
DP8	0.43	0.7	1.9	A8	A7	D 10 R	6	18" RCP/HP	D8
DP9	16.10	19.3	56.8	A1,A2,A3,A4,A6,A7,A8,A9	A8	D 10 R	8	36" RCP/HP	D10
DP10	2.00	2.8	8.0	A5	A5	D 10 R	0	0	0
DP Pond	21.45	24.4	75.1	A1,A2,A3,A4,A5,A6,A7,A8,A9,A10	A9	Detention Outlet Structure	Orifice Plate: 1.02 Sq. In. (Stage 0, 9' & 1.06') Overflow Weir/Grate: L=2', W=2' w/ slope: 0 Structure Outlet Pipe: 18" RCP/HP (10.5" Orifice Plate)		Sand Creek
DP11	1.88	5.4	12.1	A12	A12	D 10 R	16	18" RCP/HP	D12
DP12	3.82	10.7	24.0	A12,A13	A13	D 10 R	16	24" RCP/HP	D14
DP13	0.71	2.7	6.0	A14	A14	D 10 R	16	18" RCP/HP	D14
DP14	5.24	16.0	36.0	A12,A13,A14,A15	A15	D 10 R	16	30" RCP/HP	D16
DP15	1.90	4.8	11.6	A16	A16	D 10 R	20	18" RCP/HP	D16
DP16	8.09	24.3	55.4	A12,A13,A14,A15,A16,A17	A17	D 10 R	16	30" RCP/HP	Sand Creek

Basin Summary Table				
Aspen Meadows				
Area ID	Area (Acres)	Q5 (cfs)	Q100 (cfs)	
RP-7C	1.28	2.8	6.4	
RP-7D	1.21	2.9	6.5	
A1	4.22	5.4	15.5	
A2	3.95	4.6	13.2	
A3	0.93	1.5	4.2	
A4	0.38	0.5	1.5	
A5	2.00	2.8	8.0	
A6	3.92	3.3	11.0	
A7	1.17	1.7	4.8	
A8	0.43	0.7	1.9	
A9	1.11	1.6	4.6	
A10	3.34	2.3	10.3	
A11	0.88	0.3	2.8	
A12	0.67	2.5	5.6	
A13	0.66	2.5	5.6	
A14	0.71	2.7	6.0	
A15	0.71	2.6	5.9	
A16	1.90	4.8	11.6	
A17	0.94	3.5	7.9	

CONSULTANT:
CIVIL ENGINEER:
Matrix
DESIGN GROUP
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
Phone 719-575-0100
Fax 719-575-0208
LANDSCAPE ARCHITECT:
Thomas & Thomas Planning-Urban
614 N. Tejon Street
Colorado Springs, CO 80903
Phone (719)578-8777

PROJECT:
ASPEN MEADOWS
FILING NO. 1
DEVELOPMENT PLAN
CITY OF COLORADO SPRINGS
JANUARY 2019

OWNER:
COLA, LLC
555 MIDDLE PARKWAY
COLORADO SPRINGS, CO 80921
(719)459-0807

DEVELOPER:
COLA, LLC
555 MIDDLE PARKWAY
COLORADO SPRINGS, CO 80921
(719)459-0807

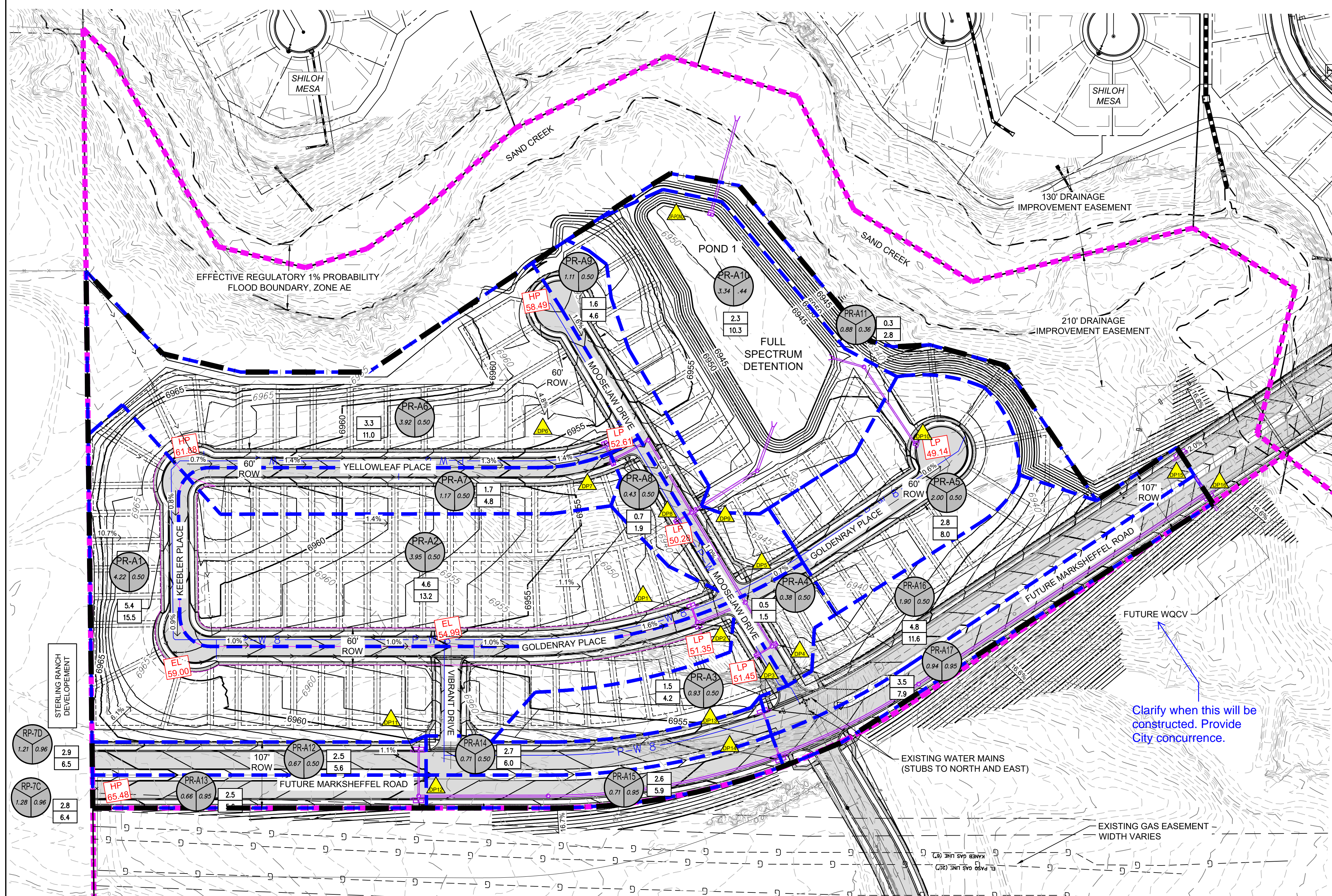
CITY PLANNING FILE NO.: AR DP XXXXXXXXX
ISSUE: JANUARY, 2019

DRAWING INFORMATION:
PROJECT NO.: 17.886.004.000
DRAWN BY: CRAIG DOLD
CHECKED BY: JEFF ODOR
APPROVED BY: JEFF ODOR
SHEET TITLE:

DRAINAGE REPORT MAP

DR02

SHEET 2 OF 3

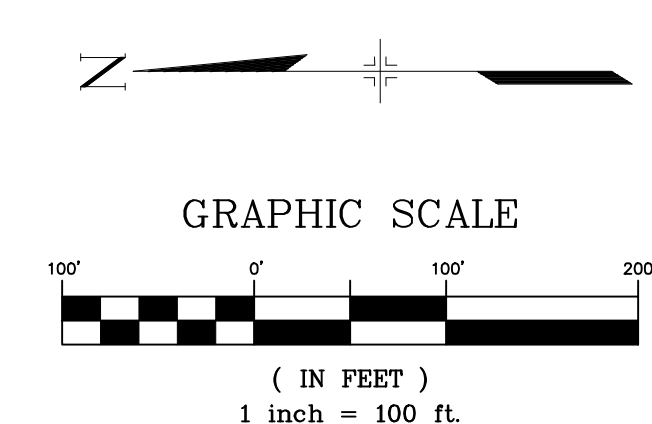


NOTES:
1. Spot elevations subject to change with final grading design and construction.

LEGEND

- SUB-BASIN BOUNDARY
- 4900 EXISTING CONTOUR
- 6970 PROPOSED CONTOUR
- FLOW DIRECTION
- LOW POINT AND ELEVATION
- HIGH POINT AND ELEVATION
- 95.71 SPOT ELEVATION
- SWALE
- DESIGN POINT
- SUB BASIN DESIGNATION
- SUB BASIN RUNOFF COEFFICIENT
- SUB BASIN AREA (AC.)
- 5-YEAR STORM EVENT PEAK FLOW (CFS)
- 100-YEAR STORM EVENT PEAK FLOW (CFS)
- PROPERTY LINE
- STORM PIPE

Clarify when this will be constructed. Provide City concurrence.



NOTES:
1. Spot elevations subject to change with final grading design and construction.

ASPEN MEADOWS

COLORADO SPRINGS, CO

PROPOSED STORM SEWER EXHIBIT MAP

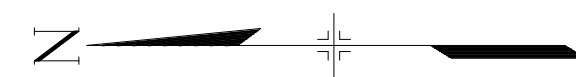


Know what's below.
Call before you dig.

ASPEN MEADOWS
FILING NO. 1
COLORADO SPRINGS, CO
DEVELOPMENT PLAN

LEGEND

- SUB-BASIN BOUNDARY
- 4900 EXISTING CONTOUR
- 6970 PROPOSED CONTOUR
- FLOW DIRECTION
- LOW POINT AND ELEVATION
- HIGH POINT AND ELEVATION
- SPOT ELEVATION
- SWALE
- DESIGN POINT
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- 5-YEAR STORM EVENT PEAK FLOW (CFS)
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- PROPERTY LINE
- STORM PIPE

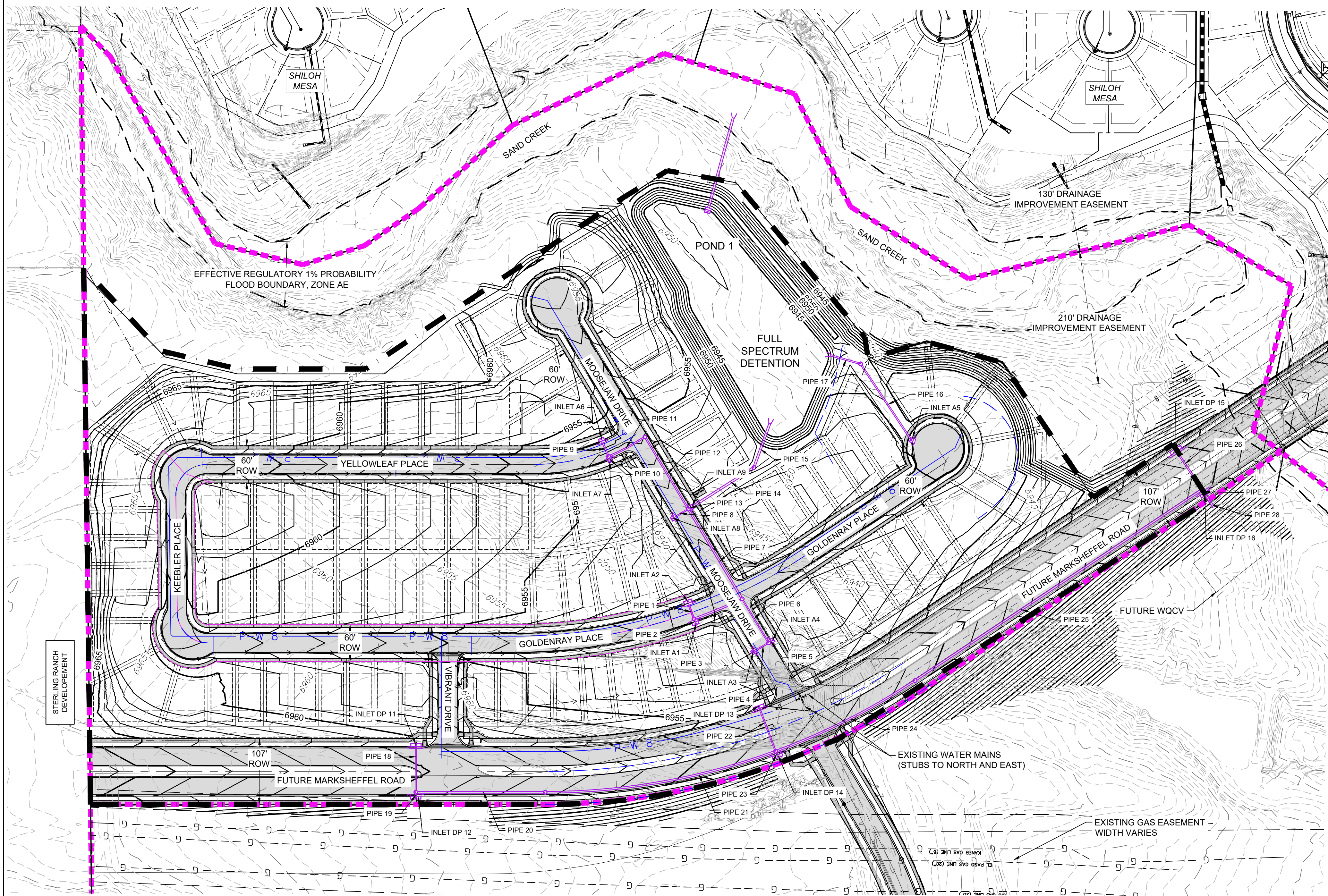


GRAPHIC SCALE



(IN FEET)

1 inch = 100 ft.



STORM PIPE SUMMARY TABLE

PIPE LABEL	PIPE DIAMETER (IN)	PIPE LENGTH (FT)	PIPE FLOW (cfs)
PIPE 1	24"	28	13.2
PIPE 2	24"	6	15.5
PIPE 3	30"	88	28.7
PIPE 4	18"	28	4.2
PIPE 5	18"	6	1.5
PIPE 6	18"	83	5.7
PIPE 7	30"	170	34.4
PIPE 8	18"	28	1.9
PIPE 9	24"	28	11.6
PIPE 10	18"	6	4.8
PIPE 11	24"	68	16.4
PIPE 12	24"	137	16.4
PIPE 13	36"	6	52.7
PIPE 14	36"	117	57.3
PIPE 15	36"	77	57.3
PIPE 16	24"	148	7.9
PIPE 17	24"	52	7.9
PIPE 18	24"	75	10.5
PIPE 19	24"	7	10.4
PIPE 20	30"	210	20.9
PIPE 21	30"	382	20.9
PIPE 22	18"	75	7.5
PIPE 23	18"	7	7.3
PIPE 24	30"	255	35.7
PIPE 25	30"	560	35.7
PIPE 26	24"	75	11.4
PIPE 27	36"	7	47.1
PIPE 28	36"	24	54.9

STORM SUMMARY TABLE

INLET LABEL	INLET OPENING (FT)	FLOW TO INLET (CFS)	FLOW CAPTURED (CFS)
INLET A1 (D10R)	12'	15.5	15.5
INLET A2 (D10R)	10'	13.2	13.2
INLET A3 (D10R)	6'	4.2	4.2
INLET A4 (D10R)	6'	1.5	1.5
INLET A5 (D10R)	6'	8.0	8.0
INLET A6 (D10R)	8'	11.0	11.0
INLET A7 (D10R)	6'	4.8	4.8
INLET A8 (D10R)	6'	1.9	1.9
INLET A9 (D10R)	6'	4.6	4.6
INLET DP11 (D10R)	16'	12.1	10.5
INLET DP12 (D10R)	16'	12.0	10.4
INLET DP13 (D10R)	16'	7.6	7.5
INLET DP14 (D10R)	16'	7.4	7.3
INLET DP15 (D10R)	20'	11.7	11.4
INLET DP16 (D10R)	16'	8.0	7.8

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LANDSCAPE ARCHITECT:
Thomas & Thomas Planning-Urban
614 N. Tejon Street
Colorado Springs, CO 80903
Phone (719)578-8777

PROJECT:
ASPEN MEADOWS
FILING NO. 1
DEVELOPMENT PLAN
CITY OF COLORADO SPRINGS
JANUARY 2019
OWNER:
COLA, LLC
555 MIDDLE PARKWAY
COLORADO SPRINGS, CO 80921
(719)459-0807

DEVELOPER:
COLA, LLC
555 MIDDLE PARKWAY
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(719)459-0807
CITY PLANNING FILE NO.: AR DP XXXXXXXXX
ISSUE: JANUARY, 2019

DRAWING INFORMATION:
PROJECT NO.: 17.886.004.000
DRAWN BY: CRAIG DOLD
CHECKED BY: JEFF ODOR
APPROVED BY: JEFF ODOR

DRAINAGE REPORT EXHIBIT

DR03
SHEET 3 OF 3

**FINAL DRAINAGE REPORT
FOR
STERLING RANCH FILING 3**

Prepared For:

**SR Land, LLC
20 Boulder Crescent, Suite 200
Colorado Springs, CO 80903
(719) 491-3024**

**April 2022
Project No. 25188.02
SF-2132**

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

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

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)	(in/hr)	Q (cfs)	t _c (min)	C*A (ac)	(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	0.55	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 Rear lot and area inlets
	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	Piped to DP 11.1 Area Inlet Piped to DP 14.1	
	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	
	11	I1	24.50	0.09	31.8	2.17	2.40	5.2															FES
	11.1								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	
	12	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)

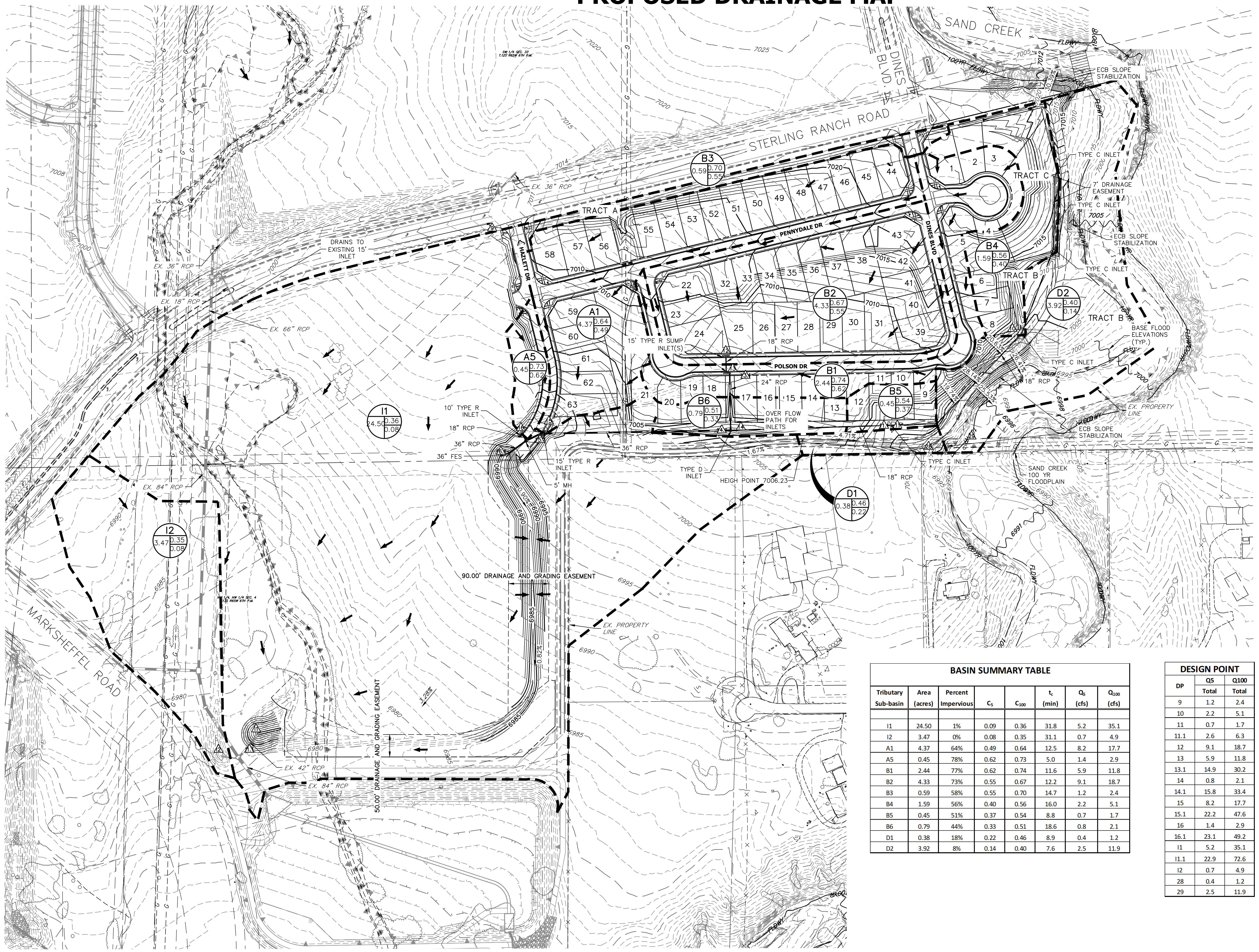
Subdivision: Sterling Ranch Subdivision
 Location: El Paso County
 Design Storm: 100-Year

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.

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

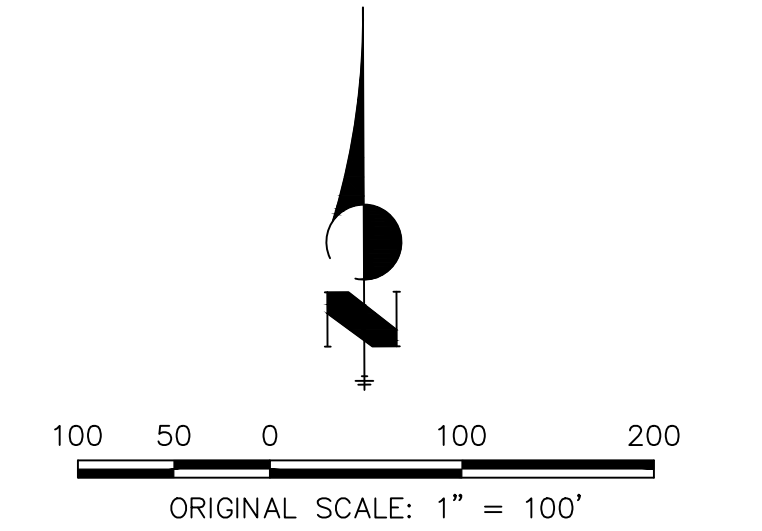
PROPOSED

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C _s	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	Q5	Q100
	Total	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



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

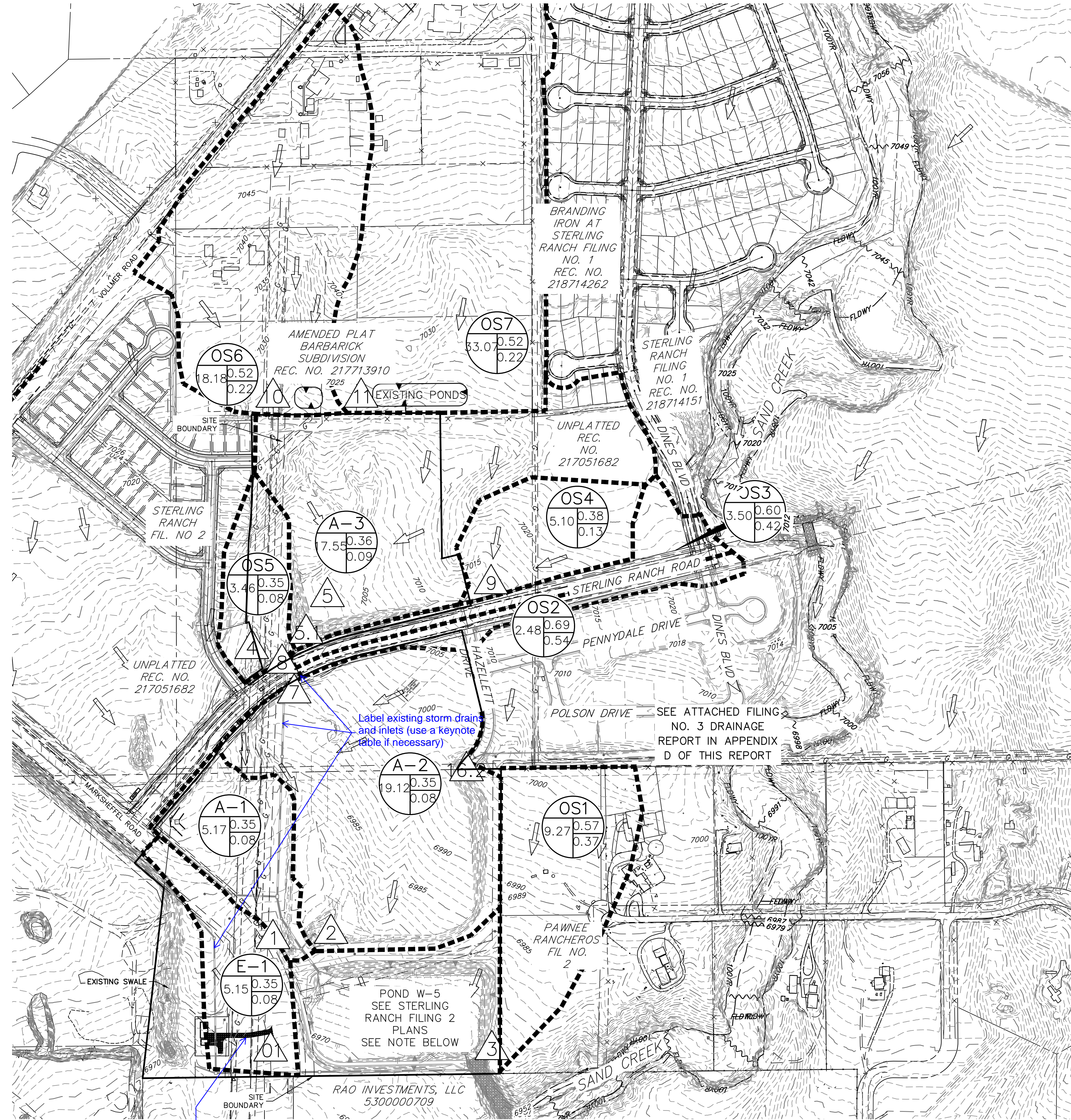


Appendix E

Drainage Maps

STERLING RANCH FILING NO. 4

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

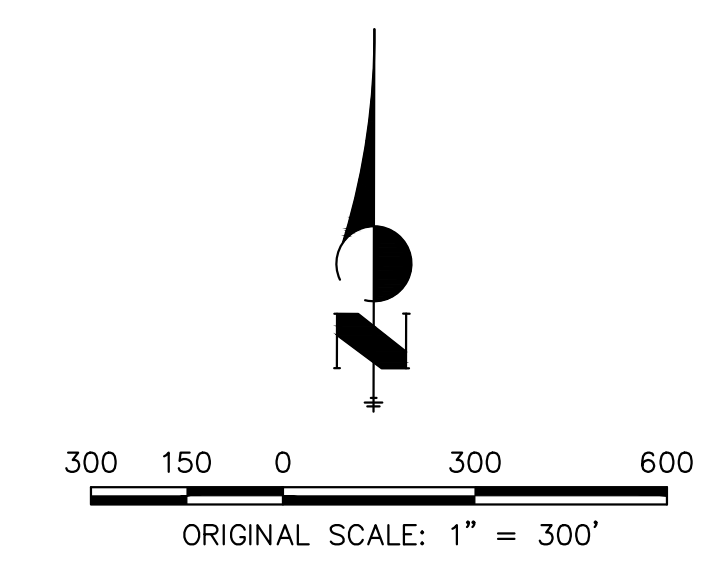
DESIGN POINT

DP	Q5		Q100	
	Total	Total	Total	Total
1	1.1	8.0		
16.2	23.1	49.2		
2	22.7	68.5		
3	9.5	24.6		
4	0.7	5.0		
7	4.3	9.1		
8	5.0	12.1		
9	1.6	7.9		
10	25.4	76.8		
11	16.2	63.5		
5	5.1	33.1		
5.1	32.9	114.0		
01	1.3	9.5		

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C _s	C ₁₀₀	t _c (min)	Q _s (cfs)	Q ₁₀₀ (cfs)
A-1	5.17	0%	0.08	0.35	27.4	1.1	8.0
A-2	19.12	0%	0.08	0.35	28.7	3.9	28.6
A-3	17.55	2%	0.09	0.36	19.4	5.1	33.1
OS1	9.27	37%	0.37	0.57	24.4	9.5	24.6
OS2	2.48	56%	0.54	0.69	19.0	4.3	9.1
OS3	3.50	42%	0.42	0.60	16.2	5.0	12.1
OS4	5.10	8%	0.13	0.38	31.1	1.6	7.9
OS5	3.46	0%	0.08	0.35	30.4	0.7	5.0
OS6	18.18	46%	0.42	0.75	16.8	25.4	76.8
OS7	33.07	19%	0.22	0.52	35.9	16.2	63.5
E-1	5.15	0%	0.08	0.35	19.4	1.3	9.5

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



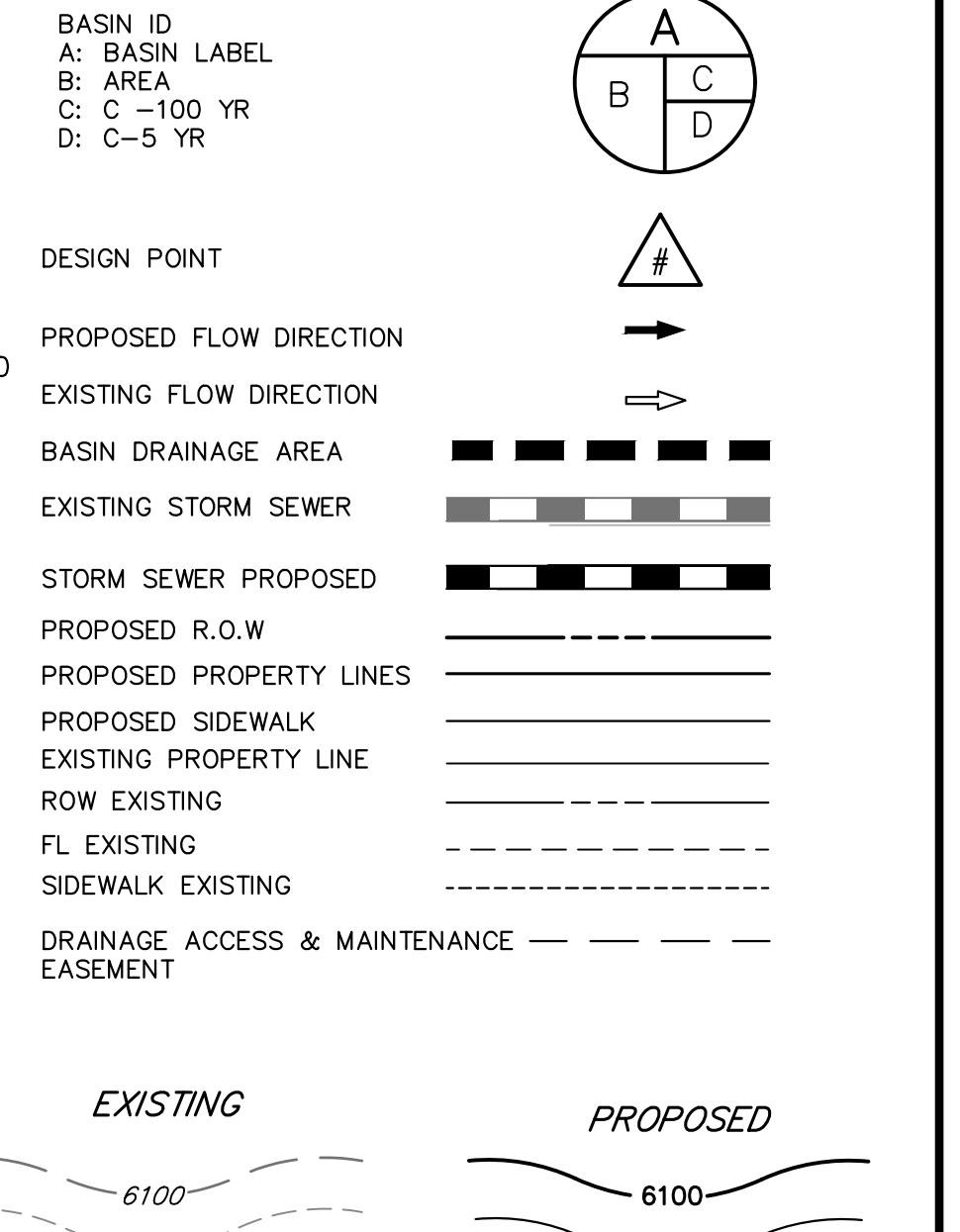
STERLING RANCH FILING NO. 4
 EXISTING DRAINAGE MAP
 JOB NO. 25188.11
 11/18/22
 SHEET 1 OF 1



Centennial 303-740-9393 • Colorado Springs 719-593-2593
 Fort Collins 970-491-9888 • www.jrengineering.com

STERLING RANCH FILING NO. 4 PROPOSED DRAINAGE MAP

LEGEND

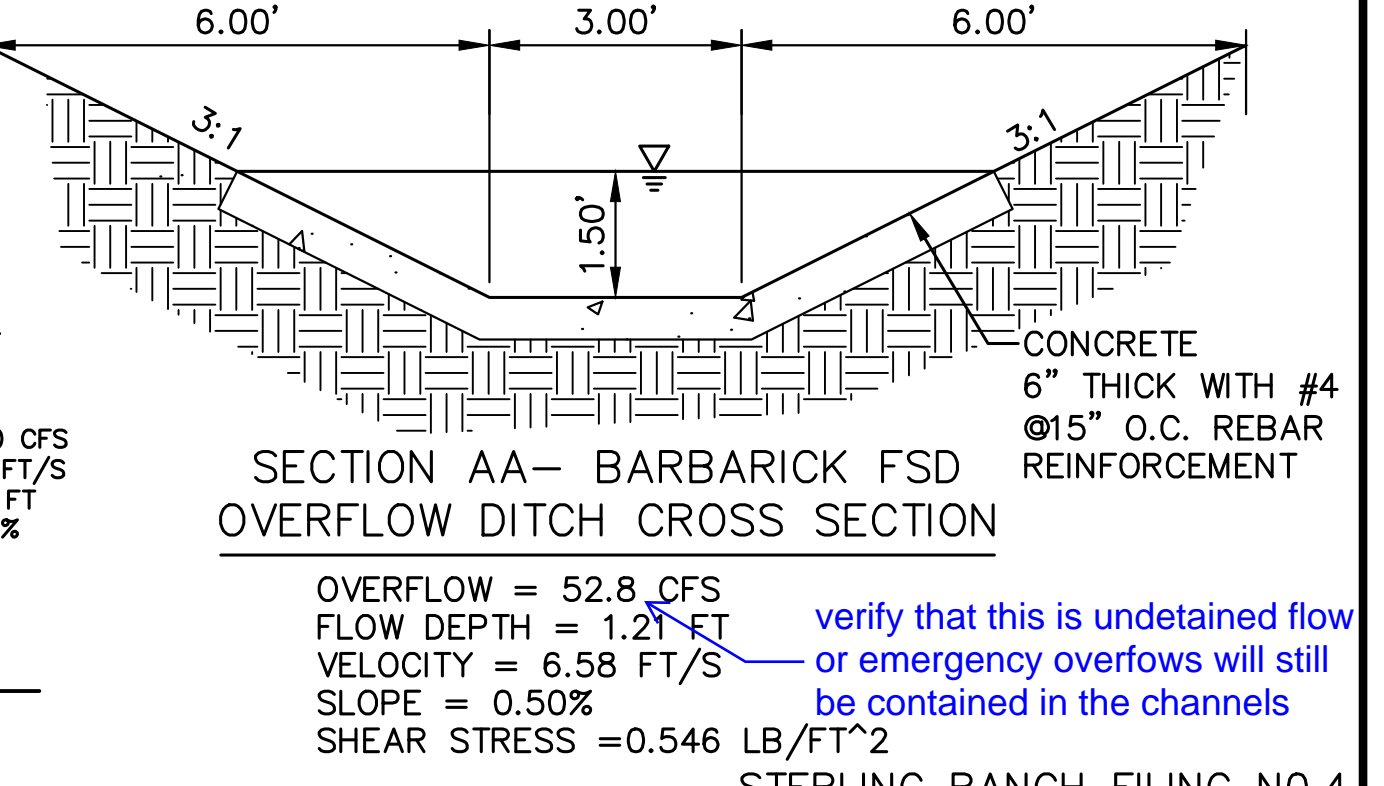
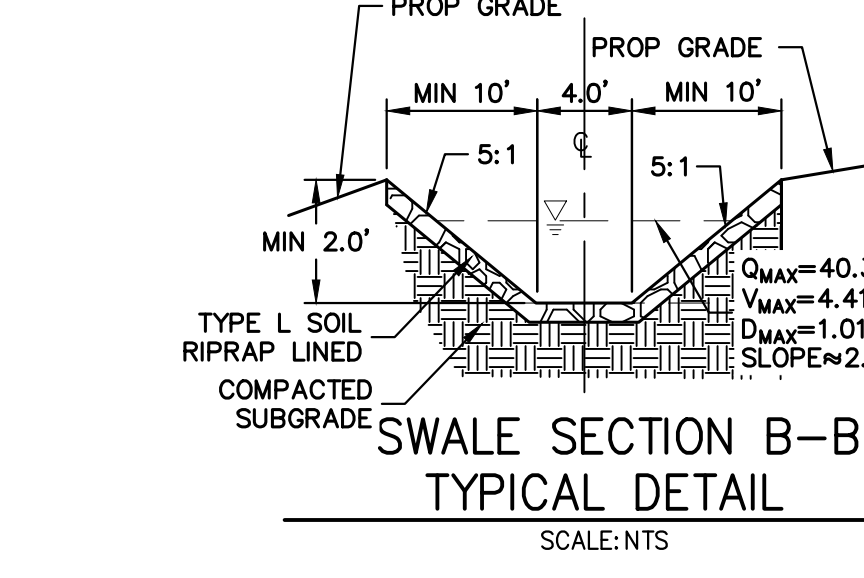
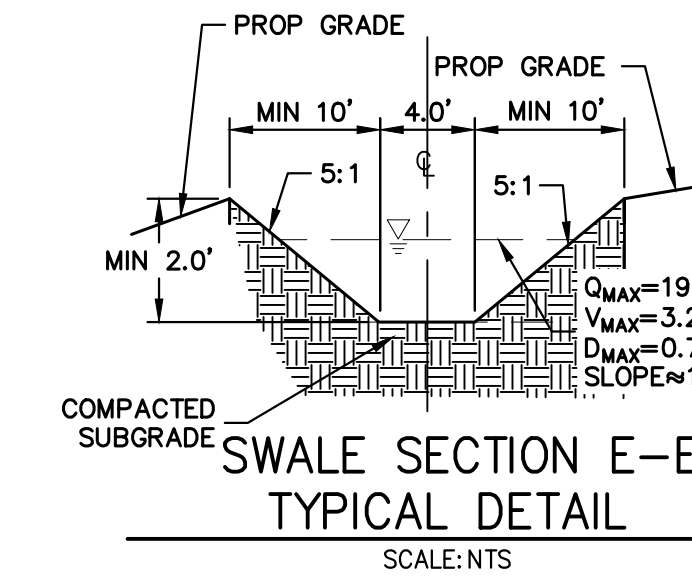
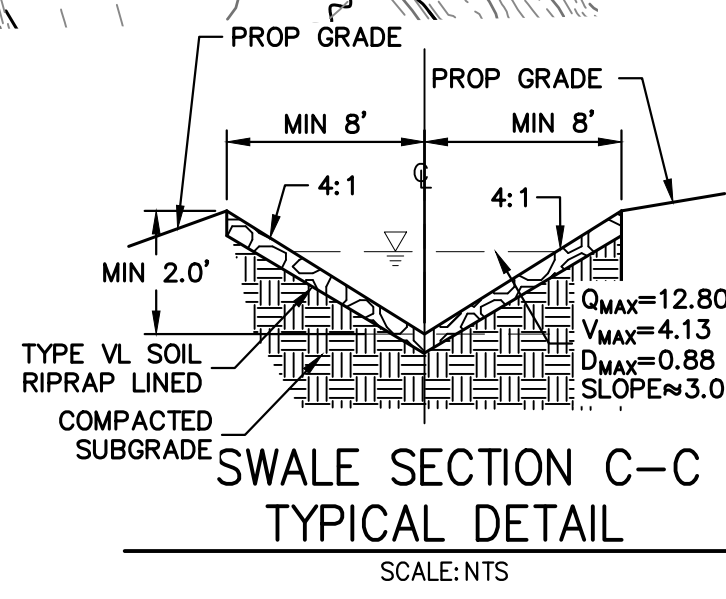
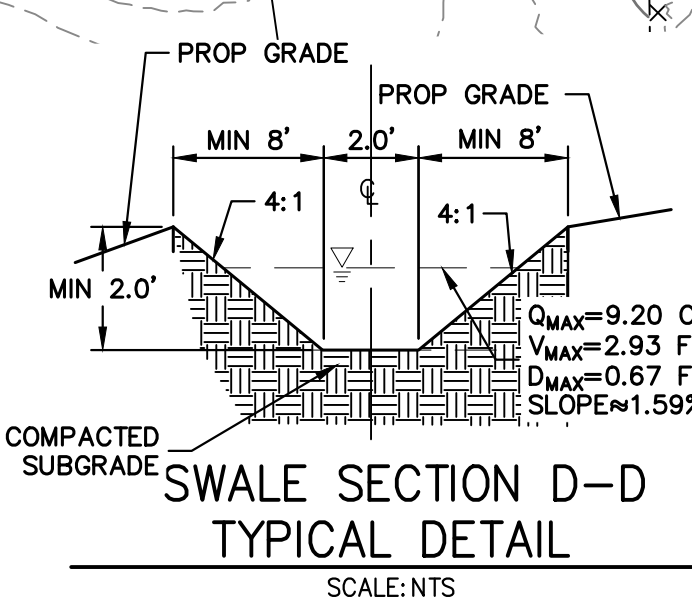
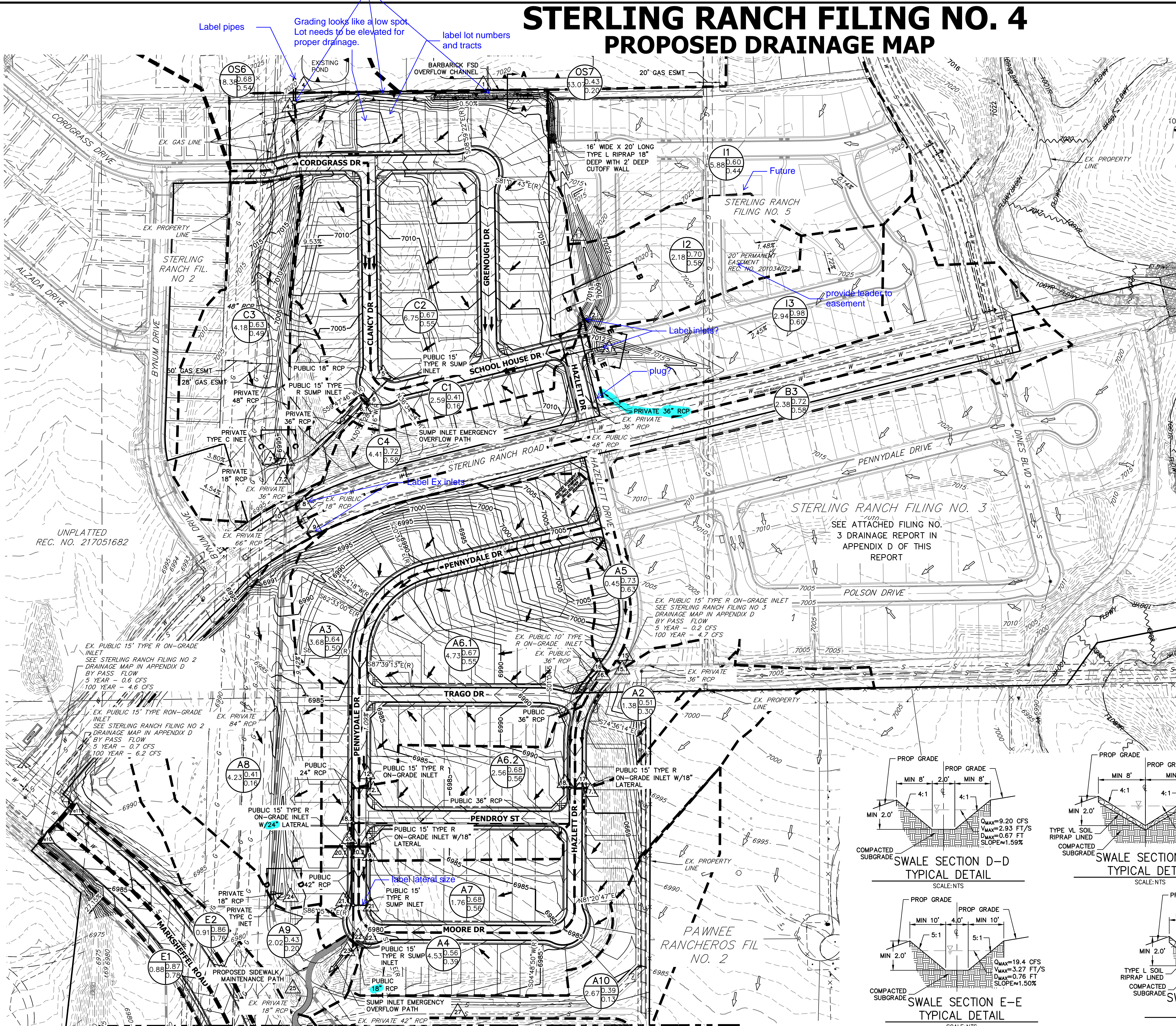


ORIGINAL SCALE: 1" = 100'

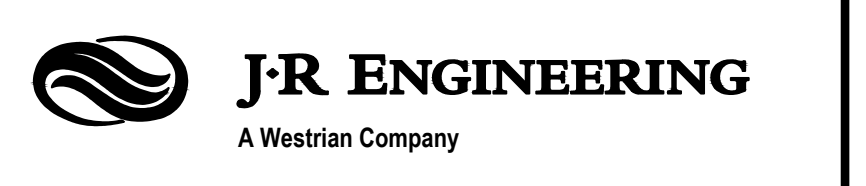
DP	Q5		Q100	
	Total	Total	Total	Total
1	14.6	52.8		
4	22.3	55.6		
4.1	29.0	87.9		
5	12.0	25.9		
6	6.1	12.7		
6.1	17.0	36.3		
7	3.5	12.8		
7.1	29.9	92.5		
7.2	39.8	113.6		
8	6.1	12.9		
9	3.8	7.9		
15	8.2	17.7		
15.1	21.0	43.2		
16	1.4	2.9		
16.1	21.5	44.9		
17	1.6	7.9		
17.1	1.6	7.7		
18.1	22.7	52.4		
12	10.0	20.5		
12.1	9.1	13.9		
18.2	29.2	62.2		
19	6.4	17.8		
19.1	6.4	12.9		
20	7.0	14.9		
20.1	7.0	11.7		
20.2	39.6	81.6		
21	3.8	12.6		
21.1	42.5	91.6		
22	6.3	18.3		
22.1	6.3	18.3		
23	47.4	106.6		
24	2.2	9.2		
25	1.0	4.8		
27	2.9	8.8		
1.1	7.8	17.9		
3.1	7.1	19.4		
2.1	17.0	40.3		
e11	0.7	6.2		
1e	4.1	12.5		
1.1e	4.1	10.6		
e10	0.6	4.6		
2e	4.0	11.0		
2.1e	8.1	20.4		
3e	1.4	4.4		
4e	1.3	4.3		

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C _s	C ₁₀₀	t _c (min)	Q _s (cfs)	Q ₁₀₀ (cfs)
A2							
A3	1.38	32%	0.30	0.51	10.3	1.7	4.8
A4	3.68	65%	0.50	0.64	12.5	7.0	14.9
A5	4.53	48%	0.39	0.56	15.0	6.3	15.1
A6.1	4.73	72%	0.55	0.67	12.1	10.0	20.5
A6.2	2.56	74%	0.56	0.68	12.1	5.6	11.3
A7	1.76	73%	0.56	0.68	9.4	4.2	8.5
A8	4.23	13%	0.16	0.41	18.9	2.2	9.2
C1	2.59	69%	0.55	0.67	8.7	6.1	12.7
C2	6.75	63%	0.49	0.63	14.2	12.0	25.9
C3	4.18	19%	0.20	0.43	9.3	3.5	12.8
A9	2.02	8%	0.13	0.39	13.6	1.0	4.8
A10	2.67	26%	0.27	0.49	10.7	2.9	8.8
B3	2.38	63%	0.58	0.72	25.5	3.8	7.9
C4	4.41	62%	0.54	0.68	28.3	6.1	12.9
OS6	18.38	45%	0.37	0.55	17.5	22.3	55.6
OS7	33.07	19%	0.20	0.43	36.4	14.6	52.8
I1	5.88	54%	0.44	0.60	20.8	7.8	17.9
I2	2.18	71%	0.58	0.70	11.9	4.9	9.9
I3	2.94	68%	0.60	0.98	10.8	7.1	19.4
E1	0.88	86%	0.78	0.87	6.1	3.4	6.3
E2	0.91	83%	0.76	0.86	6.0	3.4	6.4
E3	0.35	89%	0.81	0.89	5.0	1.4	2.7
E4	0.61	47%	0.46	0.64	6.6	1.3	3.1



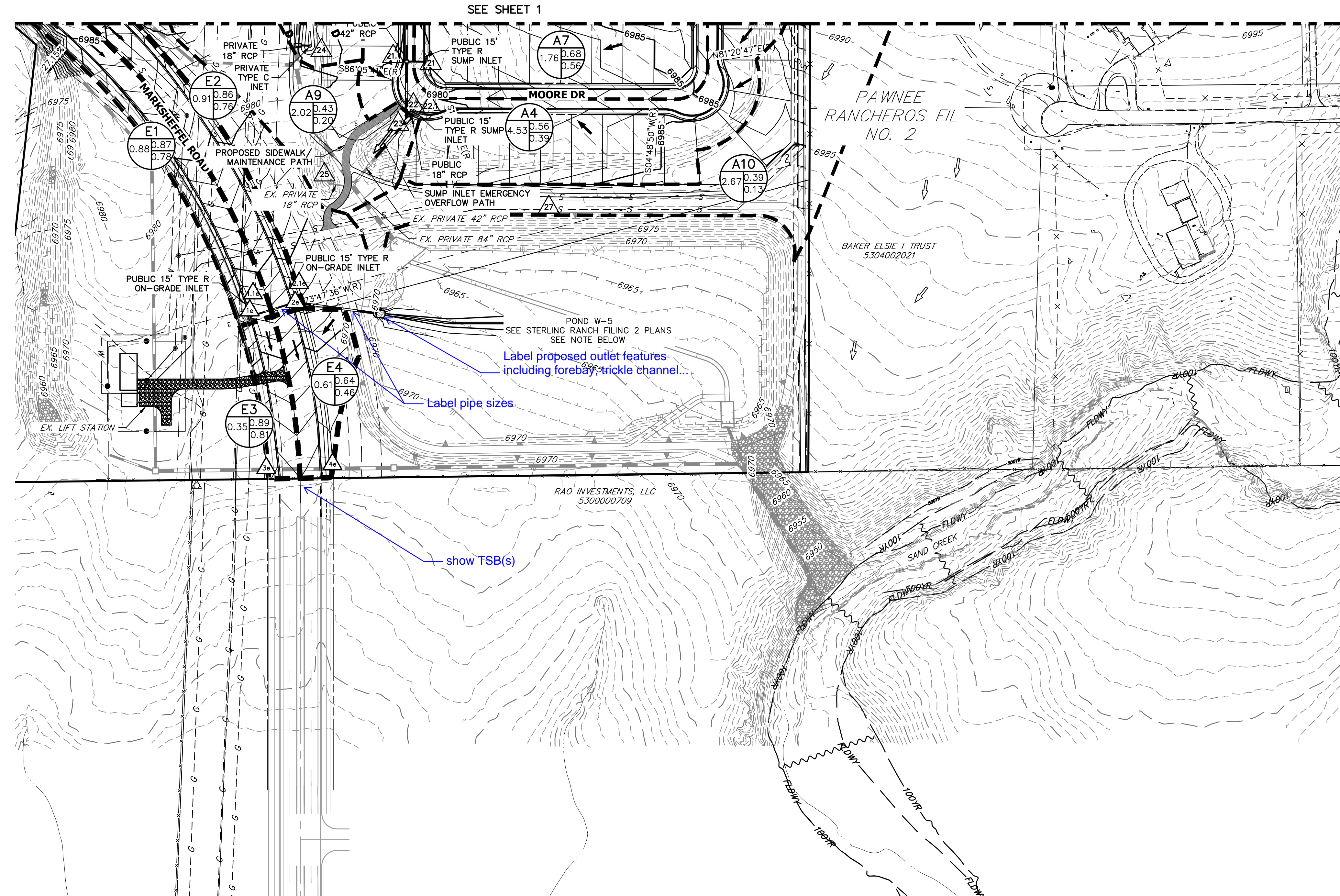
STERLING RANCH FILING NO. 4
PROPOSED DRAINAGE MAP
JOB NO. 25188.11
11/18/2022
SHEET 1 OF 2



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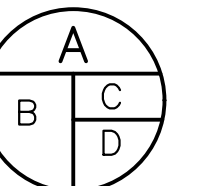
SEE SHEET 2

STERLING RANCH FILING NO. 4 PROPOSED DRAINAGE MAP



LEGEND

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



DESIGN POINT



PROPOSED FLOW DIRECTION



EXISTING FLOW DIRECTION



BASIN DRAINAGE AREA



EXISTING STORM SEWER



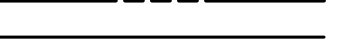
STORM SEWER PROPOSED



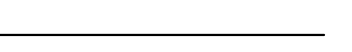
PROPOSED R.O.W



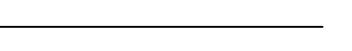
PROPOSED PROPERTY LINES



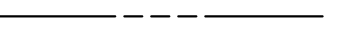
PROPOSED SIDEWALK



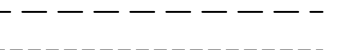
EXISTING PROPERTY LINE



ROW EXISTING



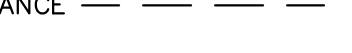
FL EXISTING



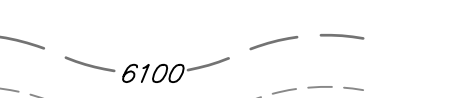
SIDEWALK EXISTING



DRAINAGE ACCESS & MAINTENANCE EASEMENT



EXISTING



PROPOSED

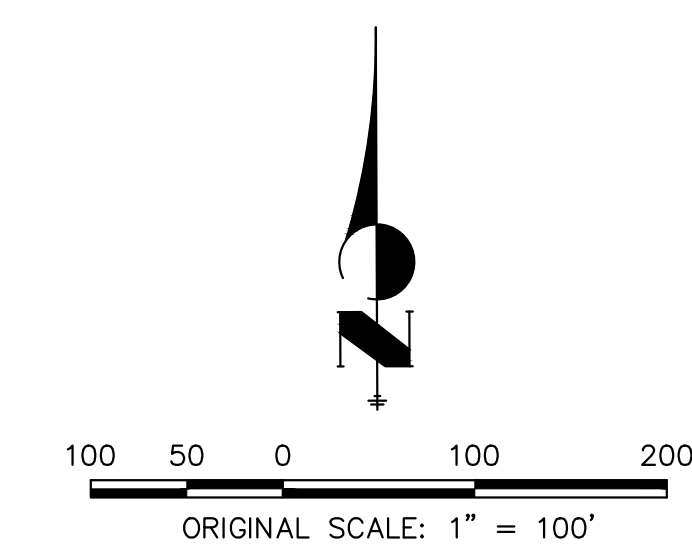


DESIGN POINT

DP	Q5		Q100				
	Total	Total	Total	Total			
1	14.6	52.8					
4	22.3	55.6					
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27	2.9	8.8					
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3.i	7.1	19.4					
2.i	17.0	40.3					
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e11	0.7	6.2					
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1.e	4.1	10.6					
e10	0.6	4.6					
2e	4.0	11.0					
2.1e	8.1	20.4					
3e	1.4	4.4					
4e	1.3	4.3					

BASIN SUMMARY TABLE

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A3	3.68	65%	0.50	0.64	12.5	7.0	14.9
A4	4.53	48%	0.39	0.56	15.0	6.3	15.1
A5	0.45	79%	0.63	0.73	5.0	1.4	2.9
A6.1	4.73	72%	0.55	0.67	12.1	10.0	20.5
A6.2	2.56	74%	0.56	0.68	12.1	5.6	11.3
A7	1.76	73%	0.56	0.68	9.4	4.2	8.5
A8	4.23	13%	0.16	0.41	18.9	2.2	9.2
C1	2.59	69%	0.55	0.67	8.7	6.1	12.7
C2	6.75	63%	0.49	0.63	14.2	12.0	25.9
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E3	0.35	89%	0.81	0.89	5.0	1.4	2.7
E4	0.61	47%	0.46	0.64	6.6	1.3	3.1



NOTE:
 FOR ADDITIONAL INFORMATION REGARDING DESIGN POINTS, ROUTING, AND RUNOFF VALUES ASSOCIATED WITH POND W-5. REFER TO THE FILING 2 DRAINAGE MAP, AS SHOWN IN APPENDIX D OF THIS REPORT.

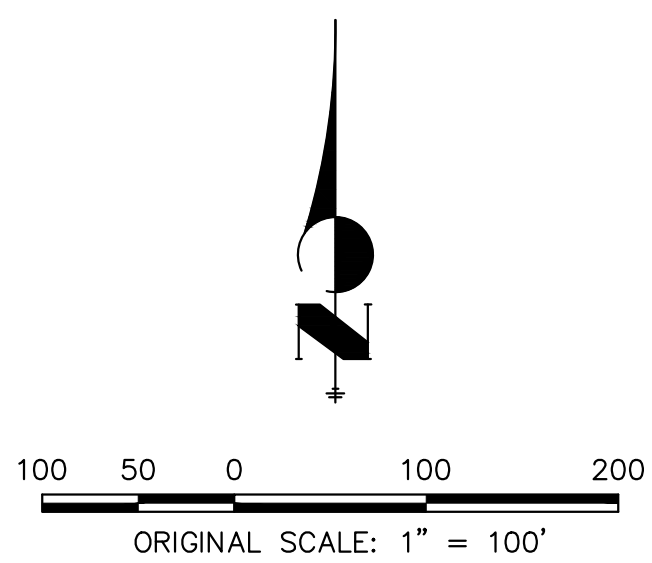
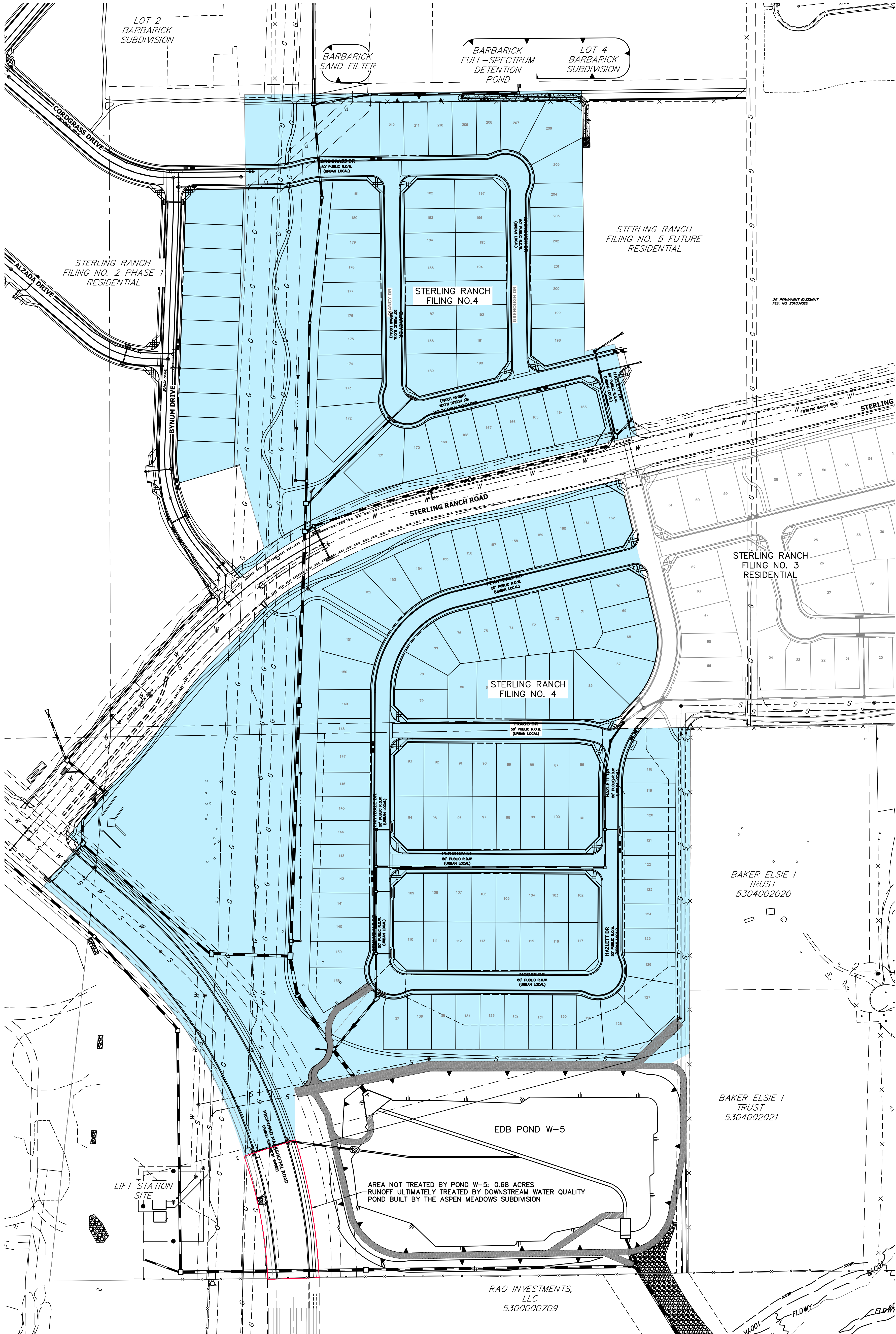
STERLING RANCH FILING NO. 4
 PROPOSED DRAINAGE MAP
 JOB NO. 25188.11
 11/18/2022
 SHEET 2 OF 2



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WATER QUALITY CAPTURE PLAN

STERLING RANCH FILING 4



**STERLING RANCH FILING 4
RUNOFF AREA TREATED BY POND W-5**

WATER QUALITY MAP
STERLING RANCH FILING 4
JOB NO. 25188.11
11-18-22
SHEET 1 OF 1

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