

**Engineering Review**

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*dsdrice*

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EPC Planning & Community  
Development Department

EPC STORMWATER REVIEW COMMENTS  
IN ORANGE BOXES WITH BLACK TEXT

PCD-ENGINEERING REVIEW COMMENTS  
IN BLUE BOXES WITH BLUE TEXT

See comment letter also.

**FINAL DRAINAGE REPORT  
FOR  
HOMESTEAD NORTH AT STERLING RANCH FILING NO. 1  
EL PASO COUNTY, COLORADO**

**Prepared For:**

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

**March, 2022  
Project No. 25188.00**

**Prepared By:**

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

**PCD Filing No.:**

**SF-22-XX**

**SF2213**



**JR ENGINEERING**

DRAINAGE REPORT FOR

HOMESTEAD NORTH AT STERLING RANCH FILING NO. 1

March, 2022

**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.

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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.

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

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Date

Conditions:



**JR ENGINEERING**

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- Appendix A – Vicinity Map, Soil Descriptions, FEMA Floodplain Map
- Appendix B – Hydrologic Calculations
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## PURPOSE

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This document is intended to serve as the Final Drainage Report of Homestead North at Sterling Ranch Filing No. 1. The purpose of this document is to identify on-site and off-site drainage patterns, storm sewer, culvert and inlet locations, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities that satisfies the requirements set forth by the El Paso County Drainage Criteria Manual and any conditions set forth by the approved master drainage development plans. The proposed use is permissible use within the residential zoning criteria.

## GENERAL SITE DESCRIPTION

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### GENERAL LOCATION

Homestead North at Sterling Ranch Filing 1, Vollmer Road and the undeveloped land to the north (hereby referred to as the “site”) is a proposed development with a total area of approximately 224.3 acres.

A portion of the SW 1/4 of the SW 1/4 of section 27, the SE 1/4 of section 28, section 33 and the W 1/2 of section 34, all in Township 12 South, Range 65 west of the 6th Principal Meridian County Of El Paso, State Of Colorado. The site is located immediately east of Vollmer Road. The site is bounded by Briargate Parkway to the south, an unplatted vacant future residential parcels to the north, and Sand Creek borders the site to the east. The parcels are planned to be platted after approval of the Preliminary Plan. Refer to the vicinity map in Appendix A for additional information.

### DESCRIPTION OF PROPERTY

The site is currently being designed to accommodate approximately 73 single-family residential lots. The site is comprised of variable sloping grasslands that generally slope(s) downward to the east at 3 to 7% towards the Sand Creek tributary basin.

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

Sand Creek is within the eastern portion of the site. Currently, JR Engineering, LLC. is performing studies and plans to address Sand Creek stabilization.

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





State that this plat is anticipated to be recorded prior to a LOMR for channel improvements, but the floodplain elevations will not be raised with channel improvements, if that is the case.

## FLOODPLAIN STATEMENT

Based on the FEMA Firm Maps Number 08041C0533G and 08041C0535G revised December 7, 2018, the vast majority of the development is located within Zone X, or areas area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The eastern property boundary will be platted to the center of Sand Creek, placing a portion of the site within Zone AE. The area of disturbance for site grading is located outside of the delineated floodway within Zone X. The FEMA map containing the site has been 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-basin is shown in Appendix E.

The Sand Creek DBPS assumed the Homestead North at Sterling Ranch property to have a "large lot residential" use for the majority of the site. However, the proposed Sterling Ranch master plan is a mix of; school, multi-family, single-family, and commercial land uses, resulting in higher runoff. The site generally drains from north to south consisting of rolling hills. Currently, the site is used as pasture land for cattle. Sand Creek is located in the east portion 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.

### EXISTING SUB-BASIN DRAINAGE

The existing/ predeveloped site consists of 3 onsite basins (H1, H2, and H3) and one offsite basin (2). This historic basins outfall to Sand Creek at 2 outfalls as shown in the Historic Drainage Map in Appendix D. A sub-division to the north of the site is being developed called "Retreat at Timberidge". Runoff from this sub-division will be detained and will not impact storm-water runoff on the Sterling Ranch Homestead site.

**Basin E-1** ( $Q_5 = 1.1$  cfs,  $Q_{100} = 5.2$  cfs) is 4.5 acres of undeveloped land adjacent to the northwest portion of Vollmer Road. Runoff from this basin drains to a 24" CMP pipe and outfalls on the eastern side of Vollmer Road and outfalls into Sand Creek.

, flows through Basin H1,



**Basin E-2** (Q5 = 28.1 cfs, Q100 = 192.9 cfs) is 180.3 acres of undeveloped land adjacent to the northwest portion of Vollmer Road. Runoff from this basin drains to a 24" CMP pipe and outfalls on the eastern side of Vollmer Road and outfalls into Sand Creek.

← flowing through Basin H3 to DP 3h

**Basin E-3** (Q5 = 2.1 cfs, Q100 = 13.6 cfs) is 12.39 acres of undeveloped land adjacent to the western portion of Vollmer Road. Runoff from this basin drains offsite into a road side swale adjacent to Vollmer Road ←

**Basin E-4** (Q5 = 9.9 cfs, Q100 = 72.3 cfs) is 70.5 acres of undeveloped land to the south of Retreat at Timber Ridge and on the eastern side of sand creek. Runoff from this basin drains to design point 4o.

**Basin E-5** (Q5 = 3.4 cfs, Q100 = 24.9 cfs) is 18.8 acres of undeveloped land adjacent to the eastern portion of Sand Creek. Runoff from this basin sheet flow to the south and ultimately drains to Sand Creek in confluence with flow from basin E-4.

← at DP...

**Basin E-6.1** (Q5 = 17.8 cfs, Q100 = 130.4 cfs) is 124.9 acres of undeveloped land that drains to the south directly into sand creek at design point 6.1o

← Show on plan

**Basin E-6.2** (Q5 = 7.5, Q100 = 55.4 cfs) is 49.61 acres of undeveloped land that drains to a low point directly adjacent to basin E-6.1 at design point 6.2o. Runoff from this basin then drains to Sand Creek directly south of design point 6.1o in confluence with runoff from E-6.1.

**Basin H1** (Q5 = 8.9 cfs, Q100 = 61.1 cfs) is 45.3 acres of undeveloped land covered in native prairie grass at DP 1h.

**Basin H2** (Q5 = 3.5 cfs, Q100 = 25.7 cfs) is 15.9 acres of undeveloped land covered in native prairie grass. This basin drains directly into Sand Creek. The basin is to the south east of Vollmer road. This basin drains directly into Sand Creek at DP 2h.

**Basin H3** (Q5 = 6.1 cfs, Q100 = 41.8 cfs) is 21.9 acres of undeveloped land covered in native prairie grass. This basin drains directly into Sand Creek at DP 3h. The basin is to the south east of Vollmer Road and North of Briargate Parkway.

↑  
highlighted values  
don't match  
drainage plan

## PROPOSED DRAINAGE CONDITIONS

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**Basin C1** 2.82 acres and 69% percent impervious is comprised of single-family lots, and the northwestern side of the local residential roads Texas Jack Drive and Harvey Logan Drive. Runoff ( $Q_5=5.4$  cfs,  $Q_{100}=11.4$  cfs) from basin C1 drains to design point 1C at Wheatland Drive.

southeastern?

**Basin C2.1** 0.20 acres and 91% percent impervious is comprised of single-family lots, and the northwestern side of the residential road Texas Jack Drive. Runoff ( $Q_5=0.8$  cfs,  $Q_{100}=1.6$  cfs) from basin C2.1 drains to design point 2.1C a 5' on grade type R inlet.

**Basin C2.2** 4.69 acres and 73% percent impervious is comprised of local roads, single-family lots, and the north western side of the residential road Wheatland Drive. Runoff ( $Q_5=9.9$  cfs,  $Q_{100}=20.3$  cfs) from basin C2.2 drains to design point 2.2C in confluence with bypass runoff from basin C2.3. The runoff ultimately drains to design point 4C a 20' type R sump inlet. The total runoff from basins C1, C2.1, C2.2, C2.3 and C4.1 is collected within the sump inlet.

**Basin C2.3** 0.83 acres and 67% percent impervious is comprised of local roads Tom Ketchum Drive Jack Helm Drive and Harvey Logan Drive, single-family lots, and the north western side of the residential road Wheatland Drive. Runoff ( $Q_5=1.9$  cfs,  $Q_{100}=3.9$  cfs) from basin C2.3 drains to design point 2.3C in confluence with runoff from basin C1 at an on grade 15' Type R inlet.

**Basin C3.1** 0.35 acres and 73% percent impervious is comprised of single-family lots, and the southeastern side of the residential road Wheatland Drive. Runoff ( $Q_5=1.2$  cfs,  $Q_{100}=2.4$  cfs) from basin C3.1 drains to design point 3.1C.

**Basin C3.2** 1.46 acres and 71% percent impervious is comprised of local roads, single-family lots, and the southeastern side of the residential road Wheatland Drive and Tom Ketchum Drive. Runoff ( $Q_5=3.6$  cfs,  $Q_{100}=7.4$  cfs) from basin C3.2 drains to design point 3.2C.

in 4.2?

**Basin C4.1** 6.35 acres and 65% percent impervious is comprised of single-family lots, and the northwestern side of the local residential road Texas Jack Drive, a right in lane and Nat Love Drive. Runoff ( $Q_5=12.1$  cfs,  $Q_{100}=25.9$  cfs) from basin C4.1 drains to design point 4C a 20' type R sump inlet. The total runoff from basins C1, C2.1, C2.2, C2.3 and C4.1 is collected within the sump inlet.

**Basin C4.2** 3.44 acres and 59% percent impervious is comprised of a local road Texas Jack Drive and single-family lots. Runoff ( $Q_5=6$  cfs,  $Q_{100}=13.3$  cfs) from basin C4.2 drains to design point 4.2C a 15' type R on grade inlet.

**Basin C5** 0.16 acres and 81% percent impervious is comprised of the northwestern side of a residential road Wheatland Drive. Runoff ( $Q_5=0.6$  cfs,  $Q_{100}=1.0$  cfs) from basin C5 drains to design



point 5C, a 15' type R sump inlet. Basin C5 collects runoff from basin C3.2 and C5. The runoff from basin C ultimately outfalls into pond C. In the event the inlet clogs at Basin C5 the runoff will overflow to pond C. A berm has been graded to ensure that the overflow path will go into pond C.

**Basin C6** 2.48 acres and 21% percent impervious is comprised of pond C and some single-family residential area. Runoff ( $Q_5=2.5$  cfs,  $Q_{100}=8.8$  cfs) generated in Basin B11 sheet flows into Pond C where it is treated for water-quality and is detained up until the 100 year-event. The MHFD Detention sheet for pond C is shown in Appendix C of this report.

**Pond C** has a tributary area of 224.34 acres and is 10.3 % impervious. Pond C has been conceptually graded in to fit the design volume, as shown in Appendix C of this report. This pond will be built in phase 1 of Homestead North at Sterling Ranch. The Pond C overflow emergency spillway will overflow into Sand Creek. The WQCV, 5 year and 100 year volumes, releases rates and stages for pond C are shown in Table 2.3 below. These results correspond to the Routed Hydrograph results, as shown in Appendix C of this report.

TABLE 2.3 Pond C			
	Stage –ft	Volume (Acres)	Release Rate (cfs)
<b>WQCV</b>	3.32	1.288	0.7
<b>5 Year</b>	6.22	4.310	43.8
<b>100 Year</b>	9.96	9.278	170.1

The following basins are tributary to the adjacent portion of Vollmer Road being designed by JR Engineering. Runoff will be detained within pond C and the runoff will then be released into Sand Creek adjacent to the crossing of Briargate road and Sand Creek.

**Basin D1** has a tributary area of 1.83 acres and is 39% impervious. Basin D1 consists of the northwest portion of Vollmer road (Rural Cross Section). Runoff from basin D1 ( $Q_5=2.4$  cfs,  $Q_{100}=6.0$  cfs) drains to an adjacent roadside swale and drains into a type C inlet at design point 1D. From here on the runoff is piped with upstream runoff from basin OS1 into the Vollmer storm sewer system.

1o then 1D?

**Basin D2** has a tributary area of 1.77 acres and is 43% impervious. Basin D2 consists of the northeast portion of Vollmer road (Rural Cross Section). Runoff from basin D2 ( $Q_5=2.5$  cfs,  $Q_{100}=6.1$  cfs) drains to an adjacent roadside swale and drains into a type C inlet at design point 2D. From here on the runoff is piped with upstream runoff from basin OS1 and basin D1 into the Vollmer storm sewer system.



**Basin D3** has a tributary area of 0.18 acres and is 68% impervious. Basin D3 ( $Q_5=0.6$  cfs,  $Q_{100}=1.2$  cfs) consists of the northeast portion of Vollmer road. Runoff on from this basin drains to an on grade 5' type R inlet at DP 3D.

**Basin D4** has a tributary area of 0.19 acres and is 57% impervious. Basin D4 ( $Q_5=0.5$  cfs,  $Q_{100}=1.1$  cfs) consists of the northwest portion of Vollmer road. Runoff on from this basin drains to an on grade 5' type R inlet at D P4D. 0.3 cfs is by-passed down to DP 6D. Runoff is piped from basin(s) D3 and D4 to the Vollmer storm within the street's R.O.W.

**Basin D5** has a tributary area of 0.91 Acres and is 77% impervious. Basin D5 ( $Q_5=3.1$  cfs,  $Q_{100}=6.1$  cfs) consists of the northeast portion of Vollmer road. Runoff from this basin drains to an on grade type R 10' inlet at the intersection of Vollmer and a right in right out at DP 5D, 0.7 cfs is by-passed downstream to design point D7 in the 100 year event.

7D? (with curb and gutter)

**Basin D6** has a tributary area of 0.83 Acres and is 69% impervious. Basin D6 ( $Q_5=2.5$  cfs,  $Q_{100}=5.2$  cfs) consists of the northwestern portion of Vollmer road and the runoff drains into a 10' on grade type R inlet at DP 6D. 0.4 cfs is by-passed to the downstream design point D8 in the 100 yr event.

**Basin D7** has a tributary area of 0.52 Acres and is 81.4 % impervious. Basin D7 ( $Q_5=2.0$  cfs,  $Q_{100}=3.8$  cfs) consists of the northeast portion of Vollmer road. Runoff from this basin drains to an on grade type R 10' inlet at the intersection of Vollmer and Briargate at DP 7D. All of the runoff received by this inlet is captured within the 100 year event.

**Basin D8** has a tributary area of 0.66 Acres and is 75% impervious. Basin D8 ( $Q_5=2.4$  cfs,  $Q_{100}=4.6$  cfs) consists of the northwestern portion of Vollmer road and the runoff drains into a 20' on grade type R inlet at DP 8D. 0.7 cfs is by-passed downstream and will drain into a roadside swale in continuity will the current condition.

**Basin OS1** has a tributary area of 2.85 Acres and is 2.0% impervious. The runoff from basin OS1 ( $Q_5=0.8$  cfs,  $Q_{100}=6.0$  cfs) drains into a depression adjacent to on the northwest portion of Vollmer road. The runoff from basin OS1 is captured in a type C inlet at DP 1o, from there on runoff is piped within Vollmer road and outfalls into sand Creek.

**Basin OS2** has a tributary area of 179.61 Acres and is 2.0 % impervious. The runoff from the basin ( $Q_5=27.1$  cfs,  $Q_{100}=190.9$ cfs) drains into a local depression at DP 2o near the northwest portion of Vollmer road. The runoff from the basin is piped within Vollmer Road and outfalls directly into Sand Creek.

into Pond C



**Basin OS3** has a tributary area of 11.99 Acres is 2.0 % impervious. The runoff from this basin ( $Q_5=2.2$  cfs,  $Q_{100}=12.6$  cfs) sheet flows onto Vollmer road and is captured within a 20' type R inlet that is on grade and corresponds to design point 8D.

## DRAINAGE DESIGN CRITERIA

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### DEVELOPMENT CRITERIA REFERENCE

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

### HYDROLOGIC CRITERIA

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

**Table 3 - 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, and the UDFCD MHFD-Detention v4.03 spreadsheet was utilized for evaluating proposed detention and water quality pond. Sump and on-grade inlets were sized using UDFCD UD-Inlet v2.07. Manning's equation was used to size the proposed pipes in this report and StormCAD will be used to model the proposed storm sewer system and to analyze the proposed HGL calculations for Construction Drawings. Manhole and pipe losses for the model were obtained from the *Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of*












*Computation Methods*, by AMEC Earth & Environmental, Inc. The manhole loss coefficients used in the model can be seen in Table 2 and apply for storm pipe 42" or smaller. StormCAD results along with street and inlet capacities are presented in Appendix C. The standard head loss stormCAD head loss coefficients were entered in for storm greater than 42" as shown in table 3 below.

Table 2 - StormCAD Standard Method Conversions

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

Table 3

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



Provide design point, routing,  
inlet, pipe... discussion.

## DRAINAGE FACILITY DESIGN

### GENERAL CONCEPT

The proposed stormwater conveyance system was designed to convey the developed Sterling Ranch Homestead North Filing No. 1 runoff to the proposed full spectrum water quality and detention pond C via storm sewer. Pond C will also be utilized to detain and treat large portions of offsite area tributary to Vollmer road. The proposed ponds were designed to release at less than the predeveloped rate to minimize adverse impacts downstream. Treated water will outfall directly into the Sand Creek Drainageway, where it will eventually outfall into Fountain Creek. The Pond will be owned and maintained by Sterling Ranch Metro District. A proposed drainage map is presented in Appendix D showing locations of the pond and channel outfall locations.

### 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 Homestead North at Sterling Ranch development project consists 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 Soils and Geology study on the site showed a potentially unstable region directly adjacent to the western bank of Sand Creek on the northeast corner of the site. At the time of final design, specifications from a Geotechnical Engineer will be implemented to ensure that the developed site is safe. Homestead North lots will discharge into Full Spectrum Detention Ponds, and outflows will be less than or equal to historic flows. Existing flows from the northwest of Vollmer road and runoff from the Vollmer Road improvements will be piped under Vollmer Road and then along the north side of Briargate Parkway and will be detained and treated for water quality directly on-site. The subdivision improvement agreement (SIA) for Sterling Ranch Filing 1 states that “bank stabilization of the Sand Creek channel shall be required prior to any replats of other final plats adjacent to the channel. The design and installation of said improvements shall be accomplished and guaranteed through the normal subdivision review and collateralization process.” Additionally, “Other drainage improvements in Tract D and future tracts containing the Sand Creek Channel, such





as drop structures, check structures and similar stabilization or protection improvements, will be designed and constructed by the District with the final construction drawings to be approved by the County no later than the final platting of the 700<sup>th</sup> single family lot within the boundaries of the approved Sterling Ranch Sketch Plan and the completion of all said improvements no later than the 800<sup>th</sup> single family lot with the boundaries of the approved Sterling Ranch Sketch Plan.”

Step 3 – Treat the WQCV: Water Quality treatment for this site is provided full spectrum water quality detention ponds: Pond C. 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 – Consider Need for Industrial and Commercial BMPs: There are no commercial or industrial components to this development; therefore no BMPs of this nature are required. BMPs will be utilized to minimize off-site contaminants and to protect the downstream receiving waters. The site is a residential subdivision (ie: not a high-risk site per Figure I-1 in ECM Appendix I), therefore specialized BMPs do not need to be considered. Site specific temporary source control BMPs that will be implemented include, but are not limited to, silt fencing placed around downstream areas of disturbance, construction vehicle tracking pads at the entrances, designated concrete truck washout basin, designated vehicle fueling areas, covered storage areas, spill containment and control, etc. The permanent erosion control BMPs include asphalt drives and parking, storm inlets and storm pipe, three full spectrum water quality and detention ponds, and permanent vegetation.

## WATER QUALITY

The site is split into Basins C, D and the offsite basin(s) tributary to Vollmer Road. The tributary area for the site is serviced by an extended full spectrum water quality / detention pond. The pond has been designed per Section 13.3.2.1 of Resolution 15-042 of the El Paso County Drainage Criteria Manual. For additional information on pond storage and outlet characteristics see the MHFD sheets within Appendix C.

Since sections of Briargate Parkway and Sterling Ranch Road are being graded with this Final Plat, discuss how permanent WQ treatment will be addressed for those areas of disturbance.

do you mean "areas" plural?

clarify that this is "Pond C"

## EROSION CONTROL PLAN

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate must be submitted with each Final Drainage Report. The Erosion Control Plan for Sterling Ranch Homestead North Filing No. 1 has been submitted with this report.



## OPERATION & MAINTENANCE

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. The property owner shall be responsible for the inspection, maintenance, rehabilitation and repair of stormwater and erosion control facilities located on the property unless another party accepts such responsibility in writing and responsibility is properly assigned through legal documentation. Access is provided from onsite facilities and easements for proposed infrastructure located offsite. We respectfully request that the Operation & Maintenance Manual be submitted in conjunction with the construction documents, prior to obtaining a grading permit.

## DRAINAGE AND BRIDGE FEES

The site lies within the Sand Creek Drainage Basin. An approximate estimate is presented below, exact fees to be determined at time of final plat.

This is the final plat

Provide calculation summary or  
reference appendix sheet

2022 DRAINAGE AND BRIDGE FEES – HOMESTEAD NORTH FILING 1				
Impervious Acres (ac)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	HN F1 Drainage Fee	HN F1 Bridge Fee
23.0	\$21,814	\$8,923	\$501,722	\$205,229

## CONSTRUCTION COST OPINION

JR Engineering, LLC cannot and does not guarantee the construction cost will not vary from these opinions of probable cost. These opinions represent our best judgement as design professionals familiar with the construction industry and this development in particular. The cost estimate for the storm sewer infrastructure has also been provided in the Financial Assurance Estimate.

Swapping of DBPS improvements for proposed improvements is being proposed for this project. A map demonstrating the DBPS improvements costs are being swapped is found in Appendix E.

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 169, 186 and the Briargate Bridge shown in the below table exceed the drainage and bridge fee estimate shown above.



DRAINAGE REPORT FOR  
HOMESTEAD NORTH AT STERLING RANCH FILING NO. 1

March, 2022

**Homestead North Filing No. 1 (Public Non-Reimbursable)**

Item	Description	Quantity	Unit	Unit Price	Cost
1	18" RCP	835	L.F.	\$ 67	\$ 55,945.00
2	24" RCP	1372	L.F.	\$ 81	\$ 111,132.00
3	30" RCP	88	L.F.	\$ 100	\$ 8,800.00
4	36" RCP	651	L.F.	\$ 124	\$ 80,724.00
5	20' CDOT Type R Inlet < 10 ft deep	2	Ea.	\$ 12,075	\$ 24,150.00
6	15' CDOT Type R Inlet < 10 ft deep	3	Ea.	\$ 11,005	\$ 33,015.00
7	15' CDOT Type R Inlet < 5 ft deep	1	Ea.	\$ 10,265	\$ 10,265.00
8	10' CDOT Type R Inlet < 10 ft deep	2	Ea.	\$ 8,136	\$ 16,272.00
9	5' CDOT Type R Inlet < 10 ft deep	4	Ea.	\$ 7,440	\$ 29,760.00
10	Grated Inlet Type D	3	Ea.	\$ 5,392	\$ 16,176.00
11	Storm Sewer MH, slab base	8	Ea.	\$ 6,619	\$ 52,952.00
				Sub-Total	\$ 439,191.00

**Homestead North Filing No. 1 (Public - Reimbursable - Agreed to at Drainage Board meeting of 6/3/21)**

Item	Description	Quantity	Unit	Unit Price	Cost	Reimbursable Cost
1	42" RCP	41	L.F.	\$ 166	\$ 6,806.00	\$ 6,806.00
2	48" RCP	260	L.F.	\$ 202	\$ 52,520.00	\$ 52,520.00
3	60" RCP	1402	L.F.	\$ 298	\$ 417,796.00	\$ 417,796.00
4	Grated Inlet Type D	1	Ea.	\$ 5,392	\$ 5,392.00	\$ 5,392.00
5	48" FES	1	Ea.	\$ 750	\$ 750.00	\$ 750.00
6	Storm Sewer MH, box base	5	Ea.	\$ 12,034	\$ 60,170.00	\$ 60,170.00
7	*Detention Pond C (50% reimb)	1	Ea.	\$ 150,000	\$ 150,000.00	\$ 75,000.00
				Sub-Total	\$ 686,628.00	\$ 611,628.00

Grand Total	\$ 1,125,819.00	\$ 611,628.00
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**Homestead North Filing No. 1 (Bridge - Reimbursable- Agreed to at Drainage Board meeting of 6/3/21)**

Item	Description	Quantity	Unit	Unit Price	Cost	Reimbursable Cost
1	58S Bridge (see FAE CDR 2113)	1	Ea.	\$ 750,000	\$ 750,000.00	\$ 750,000.00
				Sub-Total	\$ 750,000.00	\$ 750,000.00

## SUMMARY

The proposed Homestead North at Sterling Ranch Filing No. 1 drainage improvements were designed to meet or exceed the El Paso County Drainage Criteria. The proposed development's ponds are designed to release less than 90% of the predeveloped runoff study associated with the subject site. The proposed development will not adversely affect the offsite drainageways or surrounding development. This report is in conformance and meets the latest El Paso County Storm Drainage Criteria requirements.

## REFERENCES

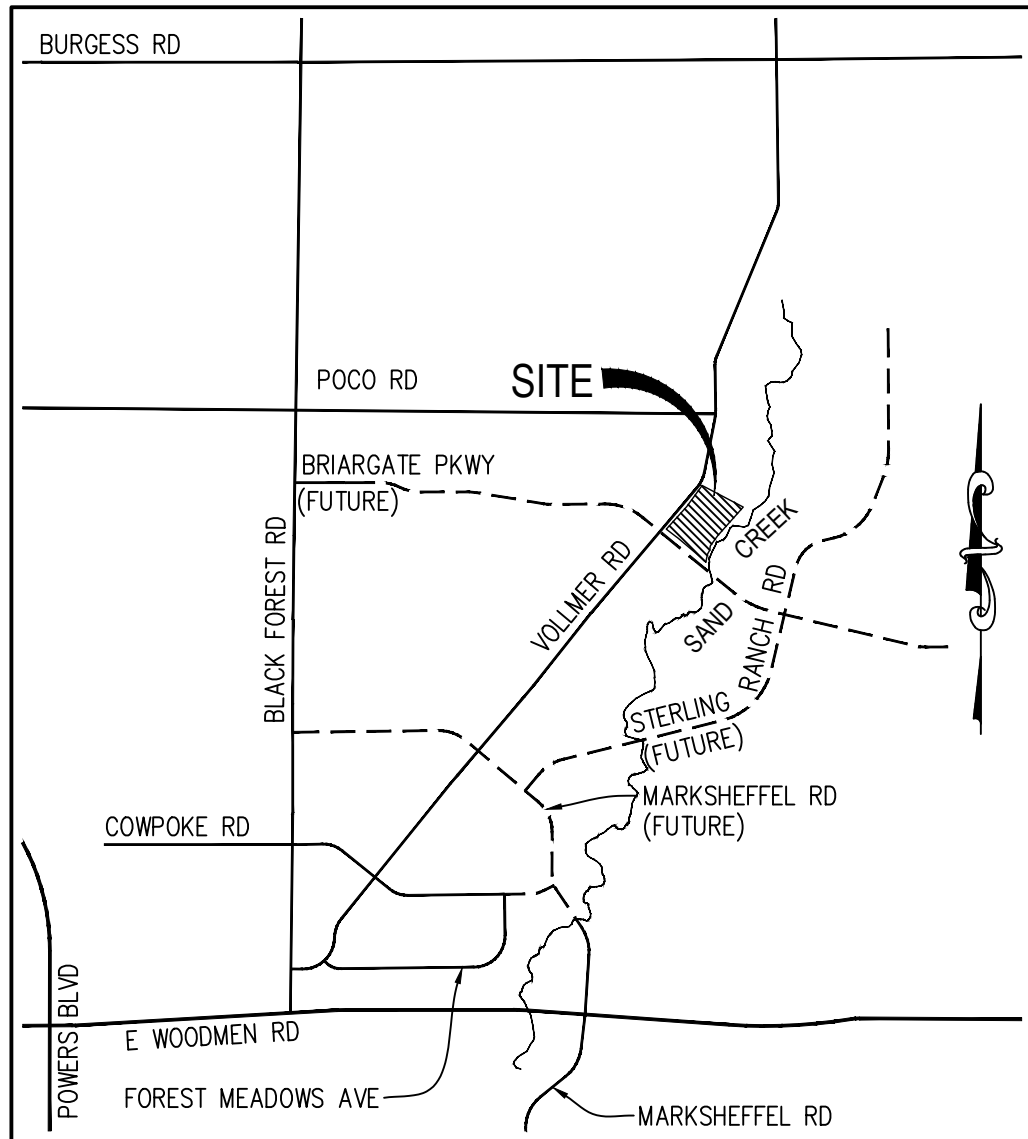
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1. "El Paso County and City of Colorado Springs Drainage Criteria Manual, Vol I & II".
  2. El Paso County ECM, 2019
  3. El Paso County DCM Vol. 1 Update, 2015
  4. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.
  5. Upper Sand Creek Detention Evaluation Study, Wilson and Company'
  6. Final Drainage Report For Retreat at Timberridge Filing No. 1, Classic Consulting Engineers & Surveyors
  7. Sand Creek Channel Design Report JR Engineering, 2021-Draft
-

## **Appendix A**

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





## VICINITY MAP

N.T.S.

VICINITY MAP  
HOMESTEAD NORTH FIL. 1  
JOB NO. 25188.00  
08/24/21  
SHEET 1 OF 1



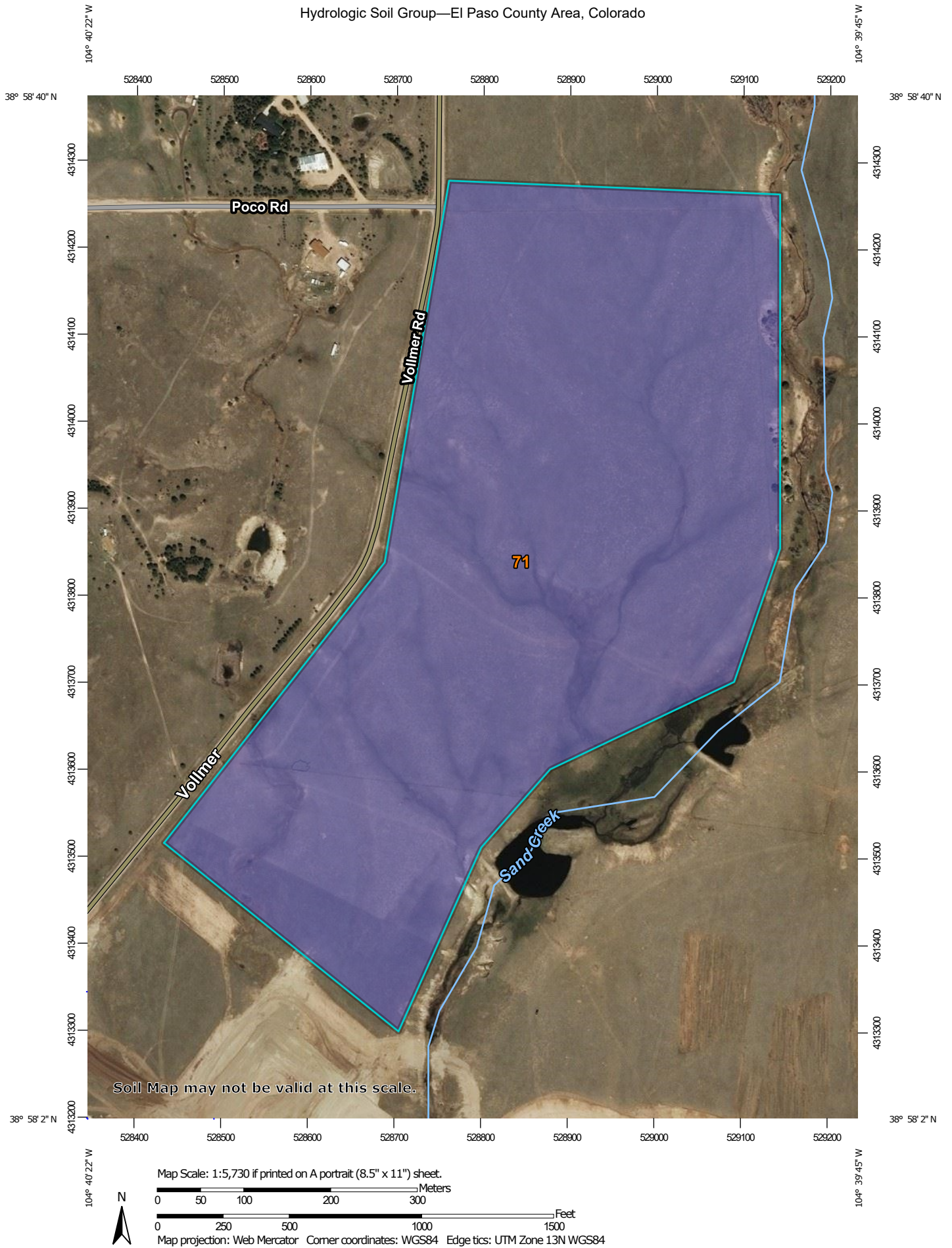
**J·R ENGINEERING**

A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593  
Fort Collins 970-491-9888 • [www.jrengineering.com](http://www.jrengineering.com)



# Hydrologic Soil Group—El Paso County Area, Colorado



## 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: Sep 8, 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
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	90.2	100.0%
<b>Totals for Area of Interest</b>			<b>90.2</b>	<b>100.0%</b>

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule: Higher*



NOTES TO USERS

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

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

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

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

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

NGS Information Services  
NOAA, NINGS12  
National Geodetic Survey  
SSMC-3, #9202  
1315 East-West Highway  
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at <http://www.ngs.noaa.gov/>.

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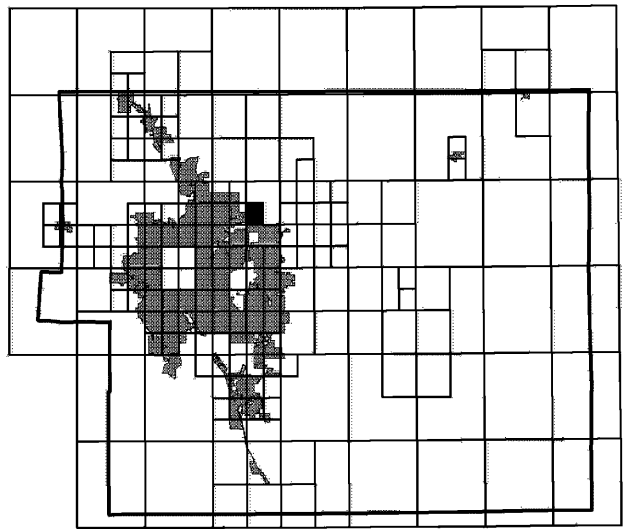
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Contact FEMA Map Service Center (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance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

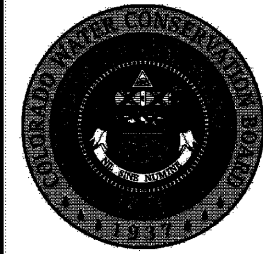
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El Paso County Vertical Datum Offset Table	
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

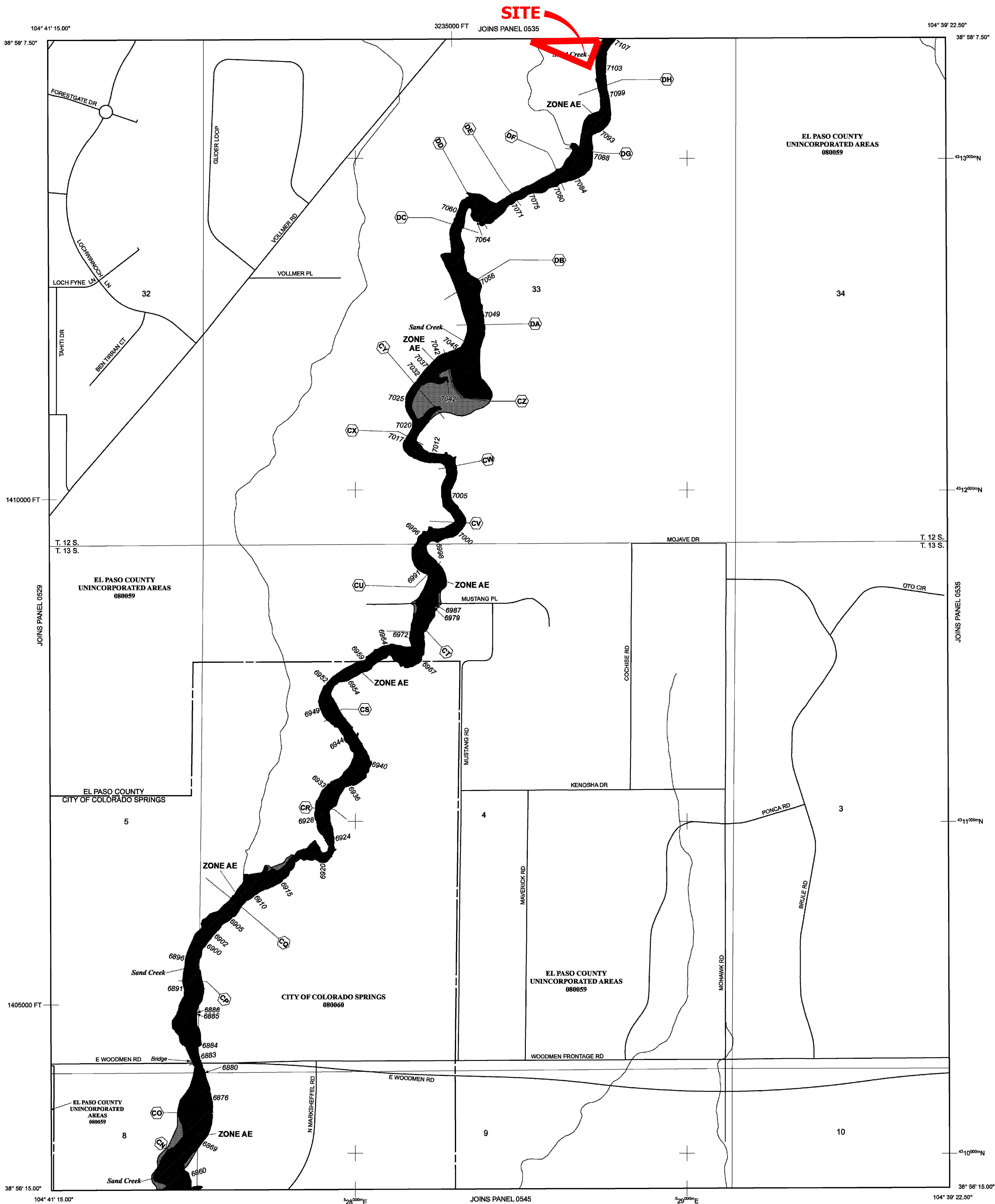
Panel Location Map



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



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



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

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard areas of different Base Flood Elevations, flood depths or flood velocities.
- Base Flood Elevation line and value; elevation in feet\*
- Base Flood Elevation value where uniform within zone; elevation in feet\*

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

- Cross section line
- Transect line
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- DX5510
- M1.5 River Mile

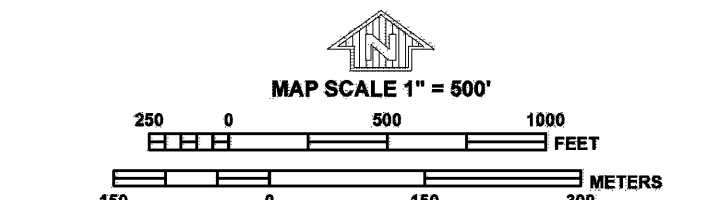
MAP REPOSITORIES  
Refer to Map Repositories list on Map Index

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

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

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

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



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	08030	0531	0
EL PASO COUNTY	08059	0533	0

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

MAP NUMBER  
08041C0533G

MAP REVISED  
DECEMBER 7, 2018

Federal Emergency Management Agency



## NOTES TO USERS

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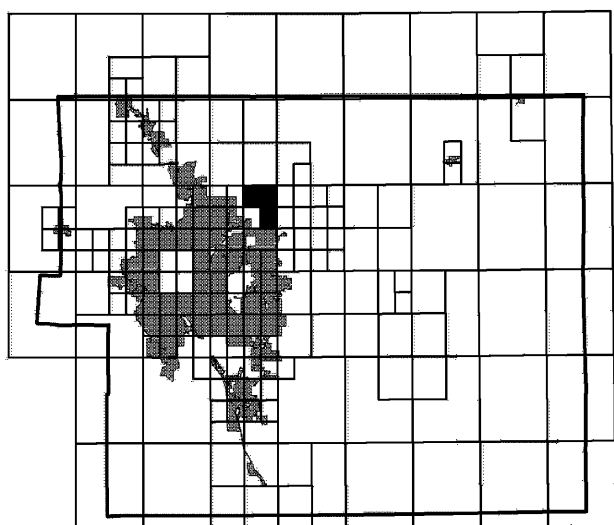
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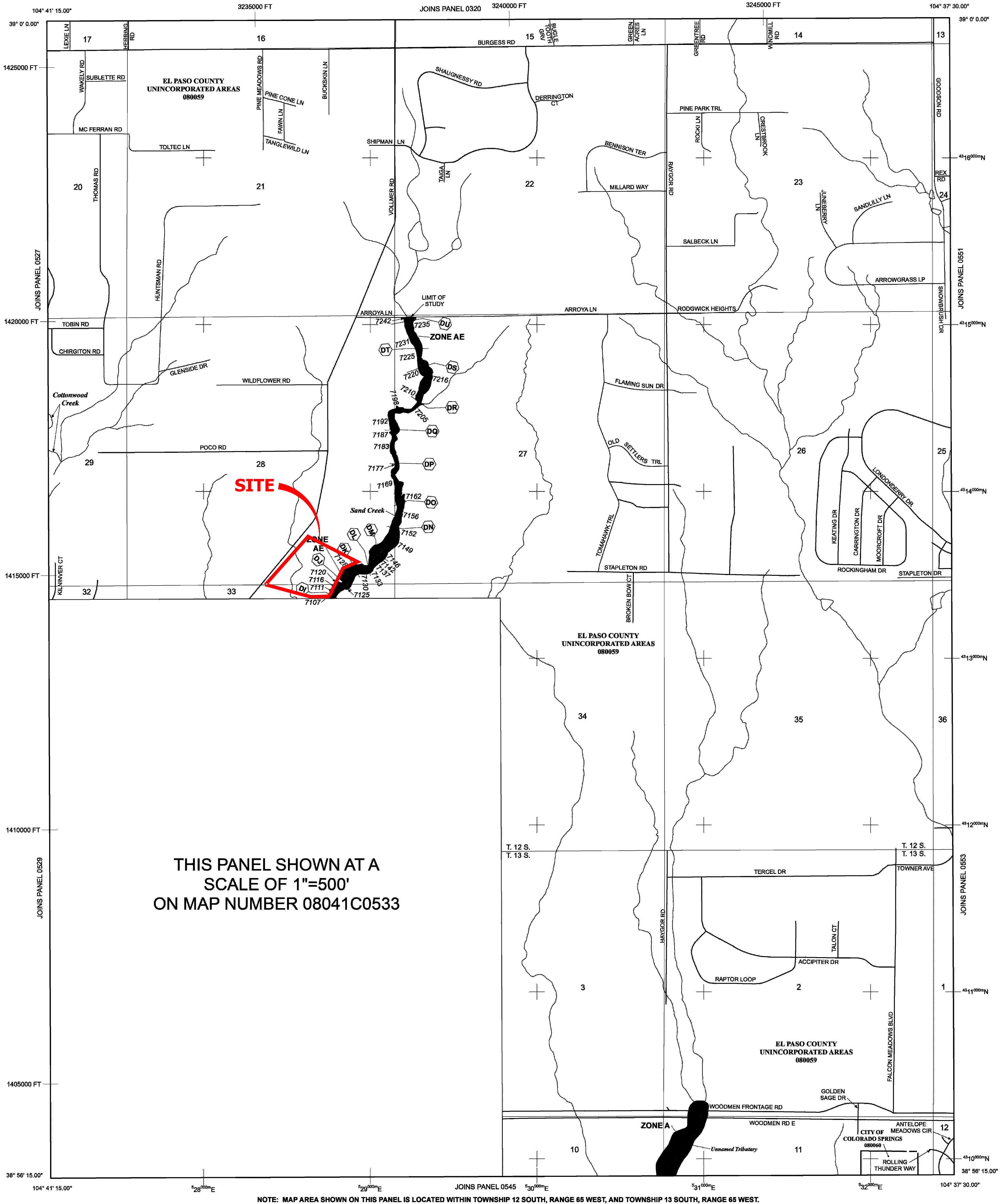
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Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



THIS PANEL SHOWN AT A  
SCALE OF 1"=500'  
ON MAP NUMBER 08041C0533

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

## LEGEND

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- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
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- ZONE AR** Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

**FLOODWAY AREAS IN ZONE AE**

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

**OTHER FLOOD AREAS**

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

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

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

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Base Flood Elevation line and value; elevation in feet\*  
Base Flood Elevation value where uniform within zone;  
elevation in feet\*

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

Cross section line

Traverse line

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

1000-meter Universal Transverse Mercator grid ticks, zone 13

5000-foot grid ticks: Colorado State Plane coordinate system, central zone (TFPSZONE 0502), Lambert Conformal Conic Projection

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

River Mile

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

PANEL 0535G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 535 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY NUMBER PANEL SUFFIX

COLORADO SPRINGS CITY OF 080005 0535 G

EL PASO COUNTY 080059 0535 G

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

MAP NUMBER 08041C0535G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency



## **Appendix B**

### **Hydrologic Calculations**

# COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Existing Conditions Homestead Fil. 1 Project Name: Homestead North  
 Location: El Paso County Project No.: 25188.00  
 Calculated By: ARJ  
 Checked By:   
 Date: 11/30/21

Basin ID	Total Area (ac)	Streets/Paved (100% Impervious)				Residential (45%-65% Impervious)				Lawns (2% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	
E-1	4.50	0.90	0.96	0.31	6.8%	0.45	0.59	0.00	0.0%	0.08	0.35	4.19	1.9%	0.14	0.39	8.7%
E-2	180.30	0.90	0.96	1.46	0.8%	0.45	0.59	0.00	0.0%	0.08	0.35	178.84	2.0%	0.09	0.35	2.8%
E-3	12.39	0.90	0.96	0.31	2.5%	0.45	0.59	0.00	0.0%	0.08	0.35	12.08	2.0%	0.10	0.37	4.4%
E-4	70.50	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	70.50	2.0%	0.08	0.35	2.0%
E-5	18.80	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	18.80	2.0%	0.08	0.35	2.0%
E6.1	125.30	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	125.30	2.0%	0.08	0.35	2.0%
E6.2	49.61	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	49.61	2.0%	0.08	0.35	2.0%
H1	45.30	0.90	0.96	0.38	0.8%	0.45	0.59	0.00	0.0%	0.08	0.35	44.92	2.0%	0.09	0.36	2.8%
H2	15.90	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	15.90	2.0%	0.08	0.35	2.0%
H3	29.10	0.90	0.96	0.22	0.7%	0.45	0.59	0.00	0.0%	0.08	0.35	28.88	2.0%	0.09	0.35	2.7%

# STANDARD FORM SF-2 TIME OF CONCENTRATION

Subdivision: Existing Conditions Homestead Fil. 1  
Location: El Paso County

Project Name: Homestead North  
Project No.: 25188.00  
Calculated By: ARJ  
Checked By:  
Date: 11/30/21

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					tc CHECK			FINAL
DATA						(Ti)			(Ti)					(URBANIZED BASINS)			
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C <sub>5</sub>	C <sub>100</sub>	L (ft)	S <sub>o</sub> (%)	t <sub>i</sub> (min)	L <sub>t</sub> (ft)	S <sub>t</sub> (%)	K	VEL. (ft/s)	t <sub>t</sub> (min)	COMP. t <sub>c</sub> (min)	TOTAL LENGTH (ft)	Urbanized t <sub>c</sub> (min)	t <sub>c</sub> (min)
E-1	4.50	B	9%	0.14	0.39	600	1.0%	42.6	3006	4.1%	7.0	3.2	15.7	58.3	3606.0	48.7	48.7
E-2	180.30	B	3%	0.09	0.35	300	1.0%	31.7	3007	1.7%	7.0	3.2	15.7	47.4	3307.0	66.1	47.4
E-3	12.39	B	4%	0.10	0.37	300	1.0%	31.3	3008	1.8%	7.0	3.2	15.7	46.9	3308.0	64.3	46.9
E-4	70.50	B	2%	0.08	0.35	500	1.0%	41.2	2300	3.1%	7.0	4.2	9.1	50.3	2800.0	49.0	49.0
E-5	18.80	B	2%	0.08	0.35	300	1.0%	31.9	930	1.5%	7.0	5.2	3.0	34.9	1230.0	39.3	34.9
E6.1	125.30	B	2%	0.08	0.35	500	1.0%	41.2	2584	1.9%	7.0	6.2	6.9	48.1	3084.0	59.4	48.1
E6.2	49.61	B	2%	0.08	0.35	370	1.0%	35.4	3783	2.5%	7.0	7.2	8.8	44.2	4153.2	68.6	44.2
H1	45.30	B	3%	0.09	0.36	150	2.0%	17.8	1074	2.3%	7.0	1.1	16.9	34.7	1224.0	38.1	34.7
H2	15.90	B	2%	0.08	0.35	150	2.0%	17.9	425	2.0%	7.0	1.0	7.2	25.1	575.0	31.1	25.1
H3	29.10	B	3%	0.09	0.35	150	1.4%	20.3	645	1.9%	7.0	1.0	11.1	31.3	795.0	33.8	31.3

NOTES:

$$t_c = t_i + t_t$$

Where:

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

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

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

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

Where:

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

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

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

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

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

Equation 6-2

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

Where:

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

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

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

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

Equation 6-4

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

Where:

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

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

i = imperviousness (expressed as a decimal)

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

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

Equation 6-5

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

Subdivision: Existing Conditions Homestead Fil. 1  
Location: El Paso County  
Design Storm: 5-Year

Project Name: Homestead North  
Project No.: 25188.00  
Calculated By: ARJ  
Checked By:  
Date: 11/30/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	1o	E-1	4.50	0.14	48.7	0.61	1.76	1.1															
	1h	H1	45.30	0.09	34.7	3.93	2.26	8.9	48.7	4.54	1.76	8.0											Drains to swale H1 and E1
	2h	H2	15.90	0.08	25.1	1.27	2.75	3.5	48.7	5.81	1.76	10.2											Accepts runoff from H1, H2 and E-1
	2o	E-2	180.30	0.09	47.4	15.62	1.80	28.1															
	3h	H3	29.10	0.09	31.3	2.51	2.42	6.1	47.4	18.13	1.80	32.6											Total Runoff; E-2 and H3
	3o	E-3	12.39	0.10	46.9	1.24	1.81	2.2															Runoff: E-3 Runoff in Vollmer rd side swale
	4o	E-4	70.50	0.08	49.0	5.64	1.75	9.9															
	5o	E-5	18.80	0.08	34.9	1.50	2.26	3.4	49.0	7.14	1.75	12.5											Total Runoff; E-4 and E-5
	6.2o	E6.2	49.61	0.08	44.2	3.97	1.90	7.5															To low point
	6.1o	E6.1	125.30	0.08	48.1	10.02	1.77	17.8	49.0	21.13	1.75	36.9											Total Runoff E-6, E-4, E-5 Runoff makes it's way into sand creek



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

Subdivision: Existing Conditions Homestead Fil. 1  
 Location: El Paso County  
 Design Storm: 100-Year

Project Name: Homestead North  
 Project No.: 25188.00  
 Calculated By: ARJ  
 Checked By:  
 Date: 11/30/21

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	$Q_{pipe}$ (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	$t_t$ (min)	
	1o	E-1	4.50	0.39	48.7	1.76	2.94	5.2															
	1h	H1	45.30	0.36	34.7	16.08	3.80	61.1	48.7	17.84	2.94	52.5											Drains to swale H1 and E1
	2h	H2	15.90	0.35	25.1	5.57	4.61	25.7	48.7	23.41	2.94	68.9											Accepts runoff from H1, H2 and E-1
	2o	E-2	180.30	0.35	47.4	64.00	3.01	192.9															
	3h	H3	29.10	0.35	31.3	10.32	4.05	41.8	47.4	74.32	3.01	224.0											Total Runoff: E-2 and H3
	3o	E-3	12.39	0.37	46.9	4.52	3.04	13.7															Runoff: E-3 Runoff in Vollmer rd side swale
	4o	E-4	70.50	0.35	49.0	24.68	2.93	72.3															
	5o	E-5	18.80	0.35	34.9	6.58	3.78	24.9	49.0	31.26	2.93	91.6											Total Runoff: E-4 and E-5
	6.2o	E6.2	49.61	0.35	44.2	17.36	3.19	55.4															To low point
	6.1o	E6.1	125.30	0.35	48.1	43.86	2.97	130.4	49.0	92.48	2.93	270.9											Total Runoff E-6, E-4, E-5 Runoff makes it's way into sand creek

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

## COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Homestead Fil. 3  
 Location: El Paso County

Project Name: Homestead North-Filing 1  
 Project No.: 25188.00  
 Calculated By: ARJ  
 Checked By: \_\_\_\_\_  
 Date: 11/19/21

Basin ID	Total Area (ac)	Streets/Paved (100% Impervious)				Residential (45%-65% Impervious)				Lawns (2% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	
C1	2.82	0.90	0.96	0.49	17.2%	0.45	0.59	2.25	51.7%	0.08	0.35	0.09	0.1%	0.52	0.65	69.0%
C2.1	0.20	0.90	0.96	0.18	90.5%	0.45	0.59	0.00	0.0%	0.08	0.35	0.02	0.2%	0.82	0.90	90.7%
C2.2	4.69	0.90	0.96	1.26	26.9%	0.45	0.59	3.33	46.1%	0.08	0.35	0.10	0.0%	0.56	0.68	73.0%
C2.3	0.83	0.90	0.96	0.28	34.1%	0.45	0.59	0.41	32.4%	0.08	0.35	0.13	0.3%	0.54	0.68	66.9%
C3.1	0.35	0.90	0.96	0.25	72.8%	0.45	0.59	0.00	0.0%	0.08	0.35	0.09	0.5%	0.68	0.79	73.3%
C3.2	1.46	0.90	0.96	0.42	28.4%	0.45	0.59	0.96	42.8%	0.08	0.35	0.08	0.1%	0.56	0.68	71.3%
C4.1	6.35	0.90	0.96	1.04	16.4%	0.45	0.59	4.76	48.8%	0.08	0.35	0.55	0.2%	0.49	0.63	65.3%
C4.2	3.44	0.90	0.96	0.59	17.1%	0.45	0.59	2.20	41.6%	0.08	0.35	0.65	0.4%	0.46	0.61	59.1%
C5	0.16	0.90	0.96	0.13	80.9%	0.45	0.59	0.00	0.0%	0.08	0.35	0.03	0.4%	0.74	0.84	81.3%
C6	2.48	0.90	0.96	0.27	11.0%	0.45	0.59	0.32	8.5%	0.08	0.35	1.89	1.5%	0.22	0.45	21.0%
D1	1.83	0.90	0.96	0.69	37.5%	0.45	0.59	0.00	0.0%	0.08	0.35	1.14	1.2%	0.39	0.58	38.8%
D2	1.77	0.90	0.96	0.75	42.1%	0.45	0.59	0.00	0.0%	0.08	0.35	1.02	1.2%	0.43	0.61	43.3%
D3	0.18	0.90	0.96	0.12	67.0%	0.45	0.59	0.00	0.0%	0.08	0.35	0.06	0.7%	0.63	0.76	67.6%
D4	0.19	0.90	0.96	0.11	56.6%	0.45	0.59	0.00	0.0%	0.08	0.35	0.08	0.9%	0.54	0.70	57.5%
D5	0.91	0.90	0.96	0.70	76.5%	0.45	0.59	0.00	0.0%	0.08	0.35	0.21	0.5%	0.71	0.82	77.0%
D6	0.83	0.90	0.96	0.57	68.4%	0.45	0.59	0.00	0.0%	0.08	0.35	0.26	0.6%	0.64	0.77	69.0%
D7	0.73	0.90	0.96	0.59	81.0%	0.45	0.59	0.00	0.0%	0.08	0.35	0.14	0.4%	0.74	0.84	81.4%
D8	0.66	0.90	0.96	0.49	74.7%	0.45	0.59	0.00	0.0%	0.08	0.35	0.17	0.5%	0.69	0.81	75.2%
OffSite Basins																
OS1	2.85	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	2.85	2.0%	0.08	0.35	2.0%
OS2	179.61	0.90	0.96	0.91	0.5%	0.45	0.59	0.00	0.0%	0.08	0.35	178.71	2.0%	0.08	0.35	2.5%
OS3	11.99	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	11.99	2.0%	0.08	0.35	2.0%
Pond C	224.34															10.3%

Also provide a version of this sheet for fee calculations

# STANDARD FORM SF-2 TIME OF CONCENTRATION

Subdivision: Homestead Fil. 3  
Location: El Paso County

Project Name: Homestead North-Filing 1  
Project No.: 25188.00  
Calculated By: ARJ  
Checked By:  
Date: 11/19/21

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					t <sub>c</sub> CHECK			FINAL
DATA						(T <sub>i</sub> )			(T <sub>i</sub> )					(URBANIZED BASINS)			
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C <sub>5</sub>	C <sub>100</sub>	L (ft)	S <sub>o</sub> (%)	t <sub>i</sub> (min)	L <sub>t</sub> (ft)	S <sub>t</sub> (%)	K	VEL. (ft/s)	t <sub>t</sub> (min)	COMP. t <sub>c</sub> (min)	TOTAL LENGTH (ft)	Urbanized t <sub>c</sub> (min)	
C1	2.82	B	69%	0.52	0.65	130	2.0%	9.6	690	2.6%	20.0	3.2	3.6	13.1	820.0	18.1	13.1
C2.1	0.20	B	91%	0.82	0.90	7.5	2.0%	1.1	300	1.0%	20.0	2.0	2.5	3.6	307.5	12.9	5.0
C2.2	4.69	B	73%	0.56	0.68	150	2.0%	9.5	630	2.5%	20.0	3.2	3.3	12.8	780.0	17.0	12.8
C2.3	0.83	B	67%	0.54	0.68	100	2.0%	8.0	462	3.3%	20.0	3.6	2.1	10.1	562.0	16.9	10.1
C3.1	0.35	B	73%	0.68	0.79	9.5	2.0%	1.9	460	2.6%	20.0	3.2	2.4	4.2	469.5	16.0	5.0
C3.2	1.46	B	71%	0.56	0.68	50	2.0%	5.5	365	1.1%	20.0	2.1	2.9	8.4	415.0	16.9	8.4
C4.1	6.35	B	65%	0.49	0.63	150	2.0%	10.7	366	4.8%	21.0	4.6	1.3	12.0	516.0	16.4	12.0
C4.2	3.44	B	59%	0.46	0.61	150	2.0%	11.3	367	4.6%	22.0	4.7	1.3	12.6	517.0	17.6	12.6
C5	0.16	B	81%	0.74	0.84	9.5	2.0%	1.6	368	0.3%	23.0	1.3	4.9	6.4	377.5	17.7	6.4
C6	2.48	B	21%	0.22	0.45	15	2.0%	4.9	160	0.5%	20.0	1.4	1.9	6.8	175.0	25.6	6.8
D1	1.83	B	39%	0.39	0.58	30	1.0%	7.0	1365	2.5%	15.0	2.4	9.6	16.6	1395.0	29.4	16.6
D2	1.77	B	43%	0.43	0.61	30	1.0%	6.7	1365	2.5%	15.0	2.4	9.6	16.3	1395.0	28.2	16.3
D3	0.18	B	68%	0.63	0.76	30	1.0%	4.7	150	1.7%	20.0	3.2	0.8	5.4	180.0	15.5	5.4
D4	0.19	B	57%	0.54	0.70	30	1.0%	5.5	150	1.7%	20.0	3.2	0.8	6.3	180.0	17.4	6.3
D5	0.91	B	77%	0.71	0.82	15	2.0%	2.2	740	3.4%	20.0	3.2	3.9	6.0	755.0	16.3	6.0
D6	0.83	B	69%	0.64	0.77	15	2.0%	2.6	740	3.4%	20.0	3.2	3.9	6.4	755.0	17.8	6.4
D7	0.52	B	81%	0.74	0.84	15	2.0%	2.0	550	2.0%	20.0	4.2	2.2	4.2	565.0	15.3	5.0
D8	0.66	B	75%	0.69	0.81	15	2.0%	2.3	550	2.0%	20.0	5.2	1.8	4.0	565.0	16.5	5.0
OS1	2.85	B	2%	0.08	0.35	50	1.0%	13.0	280	3.9%	7.0	3.2	1.5	14.5	330.0	28.2	14.5
OS2	179.61	B	2%	0.08	0.35	300	1.0%	31.8	3007	1.7%	7.0	3.2	15.7	47.4	3307.0	66.7	47.4
OS3	11.99	B	2%	0.08	0.35	300	1.0%	31.9	3008	1.8%	7.0	3.2	15.7	47.6	3308.0	65.9	47.6

## NOTES:

$$t_c = t_i + t_t$$

Where:

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

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

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

Equation 6-2

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

Where:

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

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

L = length of overland flow (ft)

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

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

Subdivision: Homestead Fil. 3  
 Location: El Paso County  
 Design Storm: 5-Year

Project Name: Homestead North-Filing 1  
 Project No.: 25188.00  
 Calculated By: ARJ  
 Checked By:  
 Date: 11/19/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	1c	C1	2.82	0.52	13.1	1.46	3.72	5.4															
	2.3c	C2.3	0.83	0.54	10.1	0.45	4.11	1.9	13.1	1.91	3.72	7.1	0.1	0.03	1.6					185	2.5	1.2	On-Grade Type R Inlet, Street runoff from basin C1 and basin C2.3
	2.3i								13.1	1.88	3.72	7.0											Captured runoff from on-grade inlet from basin C1 and basin C2.3
	2.1C	C2.1	0.20	0.82	5.0	0.16	5.17	0.8					0.0	0	2.83					630	3.4	3.1	On-Grade Type R Inlet
	2.1i								5.0	0.16	5.17	0.8											Captured runoff from on-grade type R -Inlet DP 2.1C
	2.2C	C2.2	4.69	0.56	12.8	2.64	3.76	9.9	13.1	2.64	3.72	9.8											Runoff from basins 1c, 2.3c, 2.1c and 2.2c
	4.2c	C4.2	3.44	0.46	12.6	1.57	3.78	5.9					0.00	0	2.84					1010	3.4	5.0	On-Grade Type R Inlet, by pass to 4.2c
	4.2i								12.6	1.57	3.78	5.9											Captured runoff from on-grade type R -Inlet DP 4.2C
	4C	C4.1	6.35	0.49	12.0	3.13	3.85	12.1	17.6	5.77	3.28	18.9											Sump Inlet
	3.1								12.6	1.28	3.78	4.8				4.8							Tributary to basins C2.1 and C4.2 Piped in 18" conduit
	3.1c	C3.1	0.35	0.68	5.0	0.24	5.17	1.2					0.00	0	2.84					200	3.4	1.0	On-Grade Type R inlet, By pass flow to DP 3.2c
	3.1i								5.0	0.24	5.17	1.2											Captured runoff from on-grade type R -Inlet DP 3.1C
	3.2								13.1	2.12	3.72	7.9				7.9							Tributary to basins C1 C3.1, C2.3 Piped in 18" conduit
	3.3								25.7	3.40	2.71	9.2				9.2							Tributary to basins C1 C3.1, C2.3 and C2.1 and C4.2 piped in xx" conduit
	3.4								25.7	9.65	2.71	26.2				26.2							Runoff at manhole 3.4
	3.2c	C3.2	1.46	0.56	8.4	0.82	4.39	3.6	8.4	0.82	4.39	3.6											Recives by-pass flow from DP 3.1c
	5C	C5	0.16	0.74	6.4	0.12	4.79	0.6	8.4	0.94	4.39	4.1											Sump Inlet
	3.5								25.7	11.41	2.71	30.9											Runoff into Forebay
	6C	C6	2.48	0.22	6.8	0.54	4.71	2.5															
	o1	OS1	2.85	0.08	14.5	0.23	3.57	0.8															offsite basin to type D inlet
	1d	D1	1.83	0.39	16.6	0.71	3.37	2.4															Tributary basin D1 NW portion of Vollmer in Swale
	1.1d								16.6	0.94	3.37	3.2											Tributary basin D1 and OS1 NW portion of Vollmer in Swale

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

Subdivision: Homestead Fil. 3  
Location: El Paso County  
Design Storm: 5-Year

Project Name: Homestead North-Filing 1  
Project No.: 25188.00  
Calculated By: ARJ  
Checked By:  
Date: 11/19/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	2d	D2	1.77	0.43	16.3	0.75	3.40	2.5															Tributary basin D2 SE portion of Vollmer in Swale
	1.2d								16.6	1.69	3.37	5.7											
	3d	D3	0.18	0.63	5.4	0.11	5.04	0.6															Tributary basins: 3d Runoff capture on on grade inlet
	4d	D4	0.19	0.54	6.3	0.10	4.83	0.5					0.00	0	2.25					750	3.0	4.2	Tributary basins: D4 Runoff captured on on-grade inlet
	4.1d								6.3	0.10	4.83	0.5											Piped runoff from basin D4
	1.3d								6.3	0.21	4.83	1.0											Tributary basin: D4 and D3 Runoff captured on on grade inlet
	1.4d								16.6	1.90	3.37	6.4											Tributary basins: D1-D4 and OS1 Runoff piped
	2o	OS2	179.61	0.08	47.4	15.11	1.79	27.1															
	6d	D6	0.83	0.64	6.4	0.53	4.80	2.5	10.6	0.53	4.05	2.1	0.00	0	3					555	3.5	2.7	Tributary basins: D6 Runoff captured on on-grade inlet by passed to DP 8
	6.1d								47.4	15.64	1.79	28.1											6D and OS2 Runoff piped
	5d	D5	0.91	0.71	6.0	0.64	4.89	3.1					0.00	0	3					555	3.5	2.7	Tributary Basin 5D Runoff captured and by-passed to DP 7
	1.5d								47.4	16.28	1.79	29.2											Tributary basins: 5D-6D and OS2 Runoff piped
	1.6d								47.4	18.18	1.79	32.6											Tributary basins: 1D-6D and OS1 and OS2 Runoff piped
	3o	OS3	11.99	0.08	47.6	0.96	1.79	1.7															
	8d	D8	0.66	0.69	5.0	0.46	5.17	2.4	47.6	1.42	1.79	2.5	0.00	0	2.2								Tributary basins: OS3 and D8 Runoff captured on on grade inlet, by flow goes down stream
	2.1d								47.6	1.42	1.79	2.5											Runoff piped in inlet
	7d	D7	0.52	0.74	5.0	0.39	5.17	2.0	7.7	0.39	4.53	1.8											Runoff captured on ongrade inlet
	2.2d								47.6	1.81	1.79	3.2											Tributary basins: D7,D8 and OS1 Runoff piped
	1.7d								47.6	19.99	1.79	35.8											Tributary basins: 1D-4D and OS1, OS2 and OS3 Runoff piped to Sand Creek
	5								47.6	31.12	1.79	55.7											Total runoff into pond

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**  
**STORM DRAINAGE SYSTEM DESIGN**  
**(RATIONAL METHOD PROCEDURE)**

Subdivision: Homestead Fil. 3  
 Location: El Paso County  
 Design Storm: 100-Year

Project Name: Homestead North-Filing 1  
 Project No.: 25188.00  
 Calculated By: ARJ  
 Checked By:  
 Date: 11/19/21

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	$t_c$ (min)	$C^*A$ (ac)	$I$ (in/hr)	$Q$ (cfs)	$t_{tc}$ (min)	$C^*A$ (ac)	$I$ (in/hr)	$Q$ (cfs)	$Q_{street/swale}$ (cfs)	$C^*A$ (ac)	Slope (%)	$Q_{pipe}$ (cfs)	$C^*A$ (ac)	Slope (%)	Pipe Size (Inches)	Length (ft)	Velocity (fps)	$t_t$ (min)	
	1c	C1	2.82	0.65	13.1	1.82	6.25	11.4															
	2.3c	C2.3	0.83	0.68	10.1	0.56	6.91	3.9	13.1	2.38	6.25	14.9	3.4	0.54	1.6					185	2.5	1.2	On-Grade Type R Inlet, Street runoff from basin C1 and basin C2.3
	2.3i								13.1	1.84	6.25	11.5											Captured runoff from on-grade inlet from basin C1 and basin C2.3
	2.1C	C2.1	0.20	0.90	5.0	0.18	8.68	1.6					0.1	0.01	2.83					630	3.4	3.1	On-Grade Type R Inlet for basin C2.1
	2.1i								5.0	0.17	8.68	1.5											Captured runoff from on-grade type R -Inlet DP 2.1C
	2.2C	C2.2	4.69	0.68	12.8	3.21	6.32	20.3	13.1	3.22	6.25	20.1											Runoff from basins 1c, 2.3c, 2.1c and 2.2c
	4.2c	C4.2	3.44	0.61	12.6	2.09	6.35	13.3					2.60	0.41	2.84					1010	3.4	5.0	On-Grade Type R Inlet, by pass to 4c
	4.2i								12.6	1.68	6.35	10.7											Captured runoff from on-grade type R -Inlet DP 4.2C
	4C	C4.1	6.35	0.63	12.0	4.00	6.47	25.9	17.6	7.64	5.51	42.1											Sump Inlet runoff piped to DP 3.4
	3.1								12.6	1.85	6.35	11.7				11.7							Tributary to basins C2.1 and C4.2 Piped in 18" conduit
	3.1c	C3.1	0.35	0.79	5.0	0.28	8.68	2.4					0.50	0.06	2.84					200	3.4	1.0	On-Grade Type R Inlet, By pass flow to DP 3.2c
	3.1i								5.0	0.22	8.68	1.9											Captured runoff from on-grade type R -Inlet DP 3.1C
	3.2								13.1	2.06	6.25	12.9				12.9							Tributary to basins C1 C3.1, C2.3 Piped in 18" conduit
	3.3								25.7	3.91	4.55	17.8				17.8							Tributary to basins C1 C3.1, C2.3 and C2.1 and C4.2 piped in xx" conduit
	3.4								25.7	12.14	4.55	55.3				55.3							Runoff at manhole 3.4
	3.2c	C3.2	1.46	0.68	8.4	1.00	7.37	7.4	8.4	1.06	7.37	7.8											Recives by-pass flow from DP 3.1c
	5C	C5	0.16	0.84	6.4	0.13	8.04	1.0	8.4	1.19	7.37	8.7											Sump Inlet runoff piped to DP 3.5
	3.5								25.7	14.39	4.55	65.5											Runoff into Forebay
	6C	C6	2.48	0.45	6.8	1.11	7.91	8.8															Runoff from pond

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

Subdivision: Homestead Fil. 3  
 Location: El Paso County  
 Design Storm: 100-Year

Project Name: Homestead North-Filing 1  
 Project No.: 25188.00  
 Calculated By: ARJ  
 Checked By:  
 Date: 11/19/21

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	t <sub>c</sub> (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q <sub>street/swale</sub> (cfs)	C*A (ac)	Slope (%)	Q <sub>pipe</sub> (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t <sub>t</sub> (min)	
	o1	OS1	2.85	0.35	14.5	1.00	6.00	6.0															offsite basin to type D inlet
	1d	D1	1.83	0.58	16.6	1.06	5.65	6.0															Tributary basin D1 NW portion of Vollmer in Swale
	1.1d								16.6	2.06	5.65	11.6											Tributary basin D1 and OS1 NW portion of Vollmer in Swale
	2d	D2	1.77	0.61	16.3	1.07	5.71	6.1															Tributary basin D2 SE portion of Vollmer in Swale
	1.2d								16.6	3.13	5.65	17.7											
	3d	D3	0.18	0.76	5.4	0.14	8.47	1.2															Tributary basins: 3d Runoff capture on on grade inlet
	4d	D4	0.19	0.70	6.3	0.13	8.11	1.1					0.00	0	2.25					750	3.0	4.2	Tributary basins: D4 Runoff captured on on-grade inlet
	4.1d								6.3	0.13	8.11	1.1											Piped runoff from basin D4
	1.3d								6.3	0.27	8.11	2.2											Tributary basin: D4 and D3 Runoff captured on on grade inlet
	1.4d								16.6	3.40	5.65	19.2											Tributary basins: D1-D4 and OS1 Runoff piped
	2o	OS2	179.61	0.35	47.4	63.42	3.01	190.9															
	6d	D6	0.83	0.77	6.4	0.64	8.05	5.2	10.6	0.64	6.79	4.3	0.20	0.02	3					555	3.5	2.7	Tributary basins: D6 Runoff captured on on-grade inlet by passed to DP 8
	6.1d								47.4	64.04	3.01	192.5											6D and OS2 Runoff piped
	5d	D5	0.91	0.82	6.0	0.74	8.20	6.1					0.70	0.09	3					555	3.5	2.7	Tributary Basin 5D Runoff captured and by-passed to DP 7
	1.5d								47.4	64.80	3.01	195.0											Tributary basins: 5D-6D and OS2 Runoff piped
	1.6d								47.4	68.20	3.01	205.3											Tributary basins: 1D-6D and OS1 and OS2 Runoff piped
	3o	OS3	11.99	0.35	47.6	4.20	3.00	12.6															
	8d	D8	0.66	0.81	5.0	0.53	8.68	4.6	47.6	4.75	3.00	14.3	0.80	0.09	2.2								Tributary basins: OS3 and D8 Runoff captured on on grade inlet, by flow goes down stream
	2.1d								47.6	4.66	3.00	13.2											Runoff piped in inlet
	7d	D7	0.52	0.84	5.0	0.44	8.68	3.8	7.7	0.53	7.60	4.0											Runoff captured on ongrade inlet
	2.2d								47.6	5.17	3.00	15.5											Tributary basins: D7,D8 and OS1 Runoff piped
	1.7d								47.6	73.37	3.00	220.3											Tributary basins: 1D-4D and OS1, OS2 and OS3 Runoff piped to Sand Creek
	5								47.6	87.75	3.00	263.5											Total runoff into pond

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

## **Appendix C**

### **Hydraulic Calculations**



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

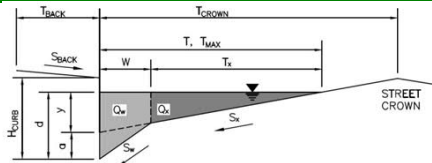
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 3D

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 25.0$  ft

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

 $S_{BACK} = 0.020$  ft/ft

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

 $n_{BACK} = 0.016$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 26.5$  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

 $S_O = 0.023$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.0	25.0	ft
$d_{MAX} =$	6.0	8.0	inches

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

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

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

	Minor Storm	Major Storm	
$Q_{allow} =$	12.0	41.9	cfs

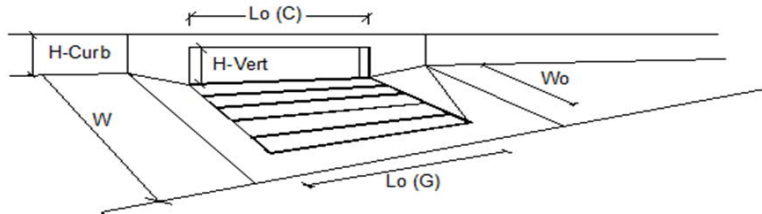
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} = 3.0$	$3.0$	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	$N_o = 1$	$1$	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$	$5.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r \cdot G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r \cdot C = 0.10$	$0.10$	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	$Q = 0.6$	$1.2$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.0$	$0.0$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 100$	$99$	%

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

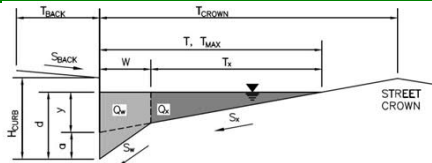
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 4D

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 15.0$  ft

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

 $S_{BACK} = 0.020$  ft/ft

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

 $n_{BACK} = 0.016$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 36.0$  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

 $S_o = 0.023$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	15.0	25.0	ft

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

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

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

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

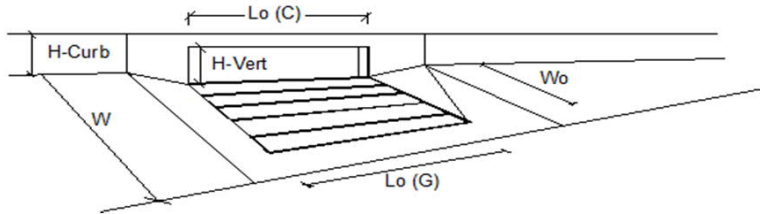
	Minor Storm	Major Storm	
$Q_{allow} =$	12.0	19.4	cfs

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	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)	5.00	5.00	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	
<b>Street Hydraulics: OK - Q &lt; Allowable Street Capacity*</b>			
Total Inlet Interception Capacity	0.5	1.1	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.0	cfs
Capture Percentage = $Q_i/Q_o$ =	100	100	%

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

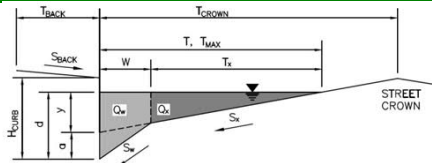
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 5D

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 15.0$  ft

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

 $S_{BACK} = 0.020$  ft/ft

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

 $n_{BACK} = 0.016$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 33.0$  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

 $S_O = 0.030$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	33.0	33.0	ft
$d_{MAX} =$	6.0	6.0	inches

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

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

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

	Minor Storm	Major Storm	
$Q_{allow} =$	17.8	17.8	cfs

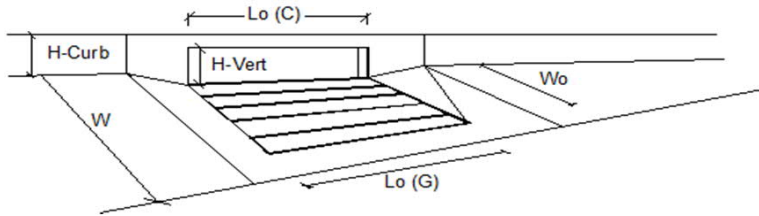
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		$a_{LOCAL}$ =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		$N_o$ =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		$L_o$ =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		$W_o$ =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		$C_r \cdot G$ =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		$C_r \cdot C$ =	0.10	0.10	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>		MINOR		MAJOR	
Total Inlet Interception Capacity		$Q$ =	3.1	5.4	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		$Q_b$ =	0.0	0.7	cfs
Capture Percentage = $Q_i/Q_o$ =		$C\%$ =	100	88	%

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

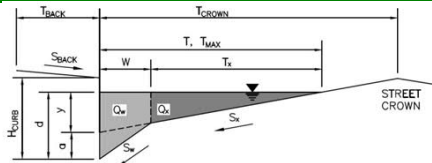
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 6D

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 20.0$  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

 $T_{CROWN} = 33.0$  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

 $S_O = 0.030$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	33.0	33.0	ft

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

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

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

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

	Minor Storm	Major Storm	
$Q_{allow} =$	17.8	17.8	cfs

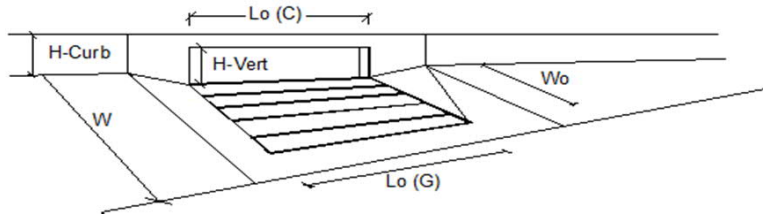
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} = 3.0$	$3.0$	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	$N_o = 1$	$1$	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 10.00$	$10.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r-G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r-C = 0.10$	$0.10$	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	$Q = 2.5$	$4.4$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.0$	$0.2$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 100$	$96$	%



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

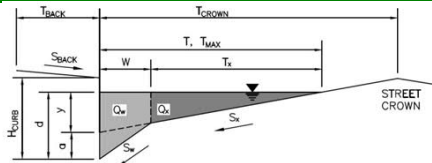
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 7D

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 15.0$  ft

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

 $S_{BACK} = 0.020$  ft/ft

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

 $n_{BACK} = 0.016$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 33.0$  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

 $S_o = 0.020$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	33.0	33.0	ft

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

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

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

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

	Minor Storm	Major Storm	
$Q_{allow} =$	19.5	19.5	cfs

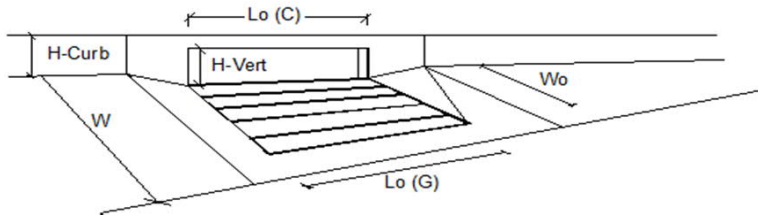
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		$a_{LOCAL} =$	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		$N_o =$	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		$L_o =$	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		$W_o =$	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		$C_r-G =$	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		$C_r-C =$	0.10	0.10	
<b>Street Hydraulics: OK - Q &lt; Allowable Street Capacity*</b>		MINOR		MAJOR	
Total Inlet Interception Capacity		$Q =$	1.8	3.9	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		$Q_b =$	0.0	0.1	cfs
Capture Percentage = $Q_i/Q_o =$		$C\% =$	100	99	%

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

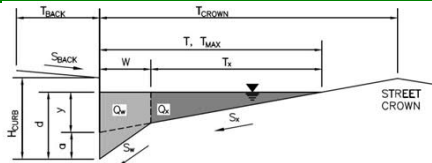
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 8D

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 15.0$  ft

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

 $S_{BACK} = 0.020$  ft/ft

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

 $n_{BACK} = 0.013$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 33.0$  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

 $S_O = 0.020$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	33.0	33.0	ft

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

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

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

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

	Minor Storm	Major Storm	
$Q_{allow} =$	19.5	19.5	cfs

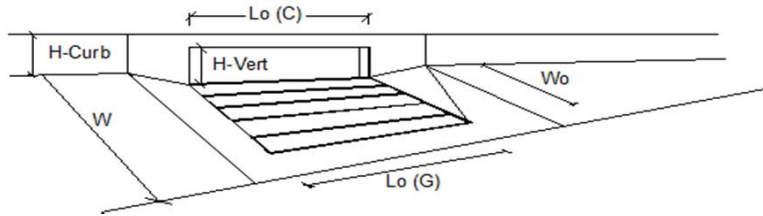
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} = 3.0$	$3.0$	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	$N_o = 1$	$1$	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 20.00$	$20.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r \cdot G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r \cdot C = 0.10$	$0.10$	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	$Q = 2.5$	$13.6$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.0$	$0.8$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 100$	$95$	%

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

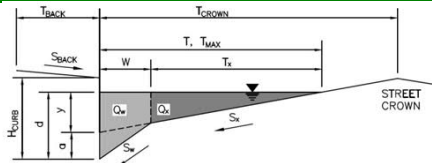
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 2.3C

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 9.5$  ft

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

 $S_{BACK} = 0.020$  ft/ft

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

 $n_{BACK} = 0.020$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 18.0$  ft

Gutter Width

 $W = 1.17$  ft

Street Transverse Slope

 $S_X = 0.020$  ft/ft

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

 $S_W = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_O = 0.027$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	18.0	18.0	ft
$d_{MAX} =$	6.0	8.0	inches

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

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

☒ ☒ check = yes
**MINOR STORM Allowable Capacity is based on Depth Criterion**

	Minor Storm	Major Storm	
$Q_{allow} =$	24.2	44.5	cfs

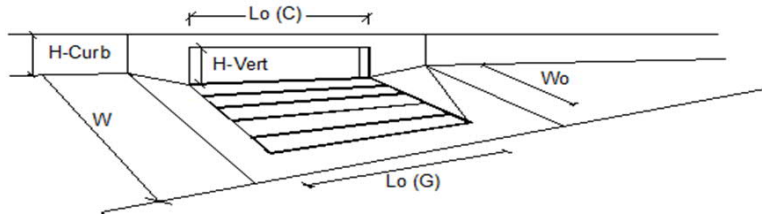
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} = 3.0$	$3.0$	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	$N_o = 3$	$3$	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$	$5.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r \cdot G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r \cdot C = 0.10$	$0.10$	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	$Q = 7.0$	$11.5$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.1$	$3.4$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 99$	$77$	%

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

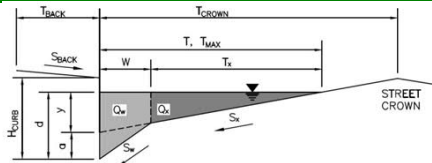
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 2.1C

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 7.5$  ft

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

 $S_{BACK} = 0.020$  ft/ft

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

 $n_{BACK} = 0.020$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 18.0$  ft

Gutter Width

 $W = 1.17$  ft

Street Transverse Slope

 $S_x = 0.020$  ft/ft

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

 $S_w = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_o = 0.020$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	18.0	18.0	ft
$d_{MAX} =$	6.0	8.0	inches

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

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

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

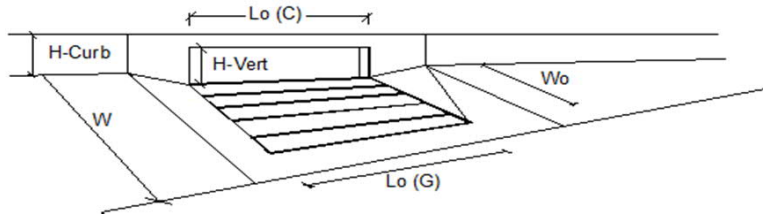
	Minor Storm	Major Storm	
$Q_{allow} =$	16.7	16.7	cfs

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

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

## INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



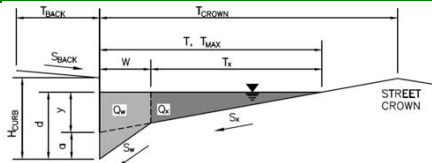
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of 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	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	0.8	1.5	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.1	cfs
Capture Percentage = $Q_i/Q_o =$	100	91	%



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

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

Project: **Homestead North**  
 Inlet ID: **Inlet DP 4.2C**

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

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

$T_{BACK} = 7.5$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.020$

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)

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 18.0$  ft  
 $W = 1.17$  ft  
 $S_x = 0.020$  ft/ft  
 $S_w = 0.083$  ft/ft  
 $S_o = 0.020$  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 (leave blank for no)

	Minor Storm	Major Storm	
$T_{MAX} =$	18.0	18.0	ft
$d_{MAX} =$	6.0	8.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	check = yes

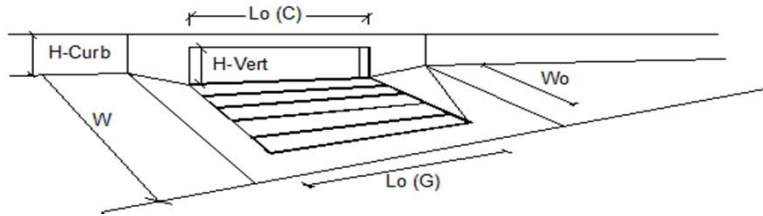
**MINOR STORM Allowable Capacity is based on Spread Criterion**  
**MAJOR STORM Allowable Capacity is based on Spread Criterion**

	Minor Storm	Major Storm	
$Q_{allow} =$	16.7	16.7	cfs

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} = 3.0$	$3.0$	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	$N_o = 3$	$3$	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$	$5.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r \cdot G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r \cdot C = 0.10$	$0.10$	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	$Q = 5.9$	$10.7$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.0$	$2.6$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 100$	$81$	%

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

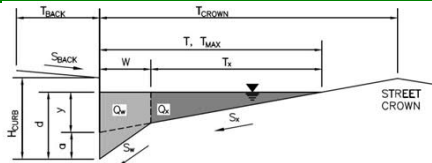
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Homestead North

Inlet ID:

Inlet DP 3.1C

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

Maximum Allowable Width for Spread Behind Curb

 $T_{BACK} = 9.5$  ft

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

 $S_{BACK} = 0.020$  ft/ft

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

 $n_{BACK} = 0.020$ 

Height of Curb at Gutter Flow Line

 $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown

 $T_{CROWN} = 18.0$  ft

Gutter Width

 $W = 1.17$  ft

Street Transverse Slope

 $S_x = 0.020$  ft/ft

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

 $S_w = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition

 $S_o = 2.000$  ft/ft

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

 $n_{STREET} = 0.016$ 

Max. Allowable Spread for Minor &amp; Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	18.0	18.0	ft
$d_{MAX} =$	6.0	8.0	inches

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

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

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

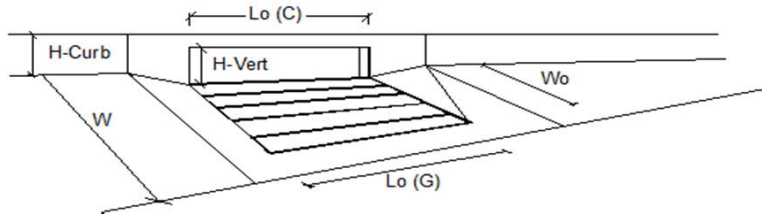
	Minor Storm	Major Storm	
$Q_{allow} =$	6.7	12.3	cfs

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

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

# INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017

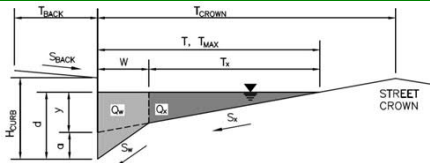


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	$a_{LOCAL} = 3.0$	$3.0$	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	$N_o = 1$	$1$	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$	$5.00$	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_r \cdot G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_r \cdot C = 0.10$	$0.10$	
<b>Street Hydraulics: OK - <math>Q &lt; \text{Allowable Street Capacity}</math></b>			
Total Inlet Interception Capacity	$Q = 1.2$	$1.9$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.0$	$0.5$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 98$	$81$	%

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

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

Project: \_\_\_\_\_  
 Inlet ID: \_\_\_\_\_  
 Homestead North  
 Inlet DP 4C

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

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

$T_{BACK} = 9.5$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.020$

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 18.0$  ft  
 $W = 2.00$  ft  
 $S_x = 0.020$  ft/ft  
 $S_w = 0.083$  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	
$T_{MAX} =$	18.0	18.0	ft
$d_{MAX} =$	6.0	8.3	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

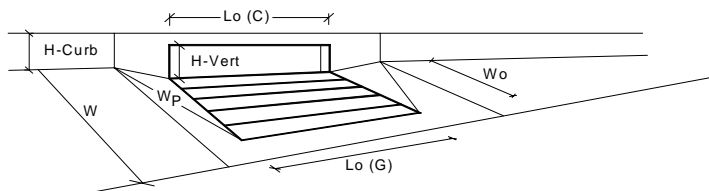
**MINOR STORM Allowable Capacity is based on Depth Criterion**  
**MAJOR STORM Allowable Capacity is based on Depth Criterion**

$Q_{allow} =$ 

Minor Storm	Major Storm	
SUMP	SUMP	cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



## Design Information (Input)

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

## Grate Information

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

## Curb Opening Information

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

## Low Head Performance Reduction (Calculated)

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

## Total Inlet Interception Capacity (assumes clogged condition)

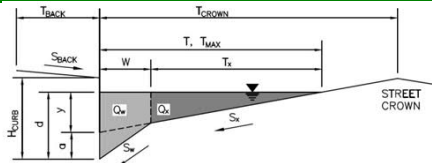
**Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)**

	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
$a_{local}$ =	3.00	3.00	inches
No =	4	4	
Ponding Depth =	6.1	12.0	inches
	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
$L_o$ (G) =	N/A	N/A	feet
$W_o$ =	N/A	N/A	feet
$A_{ratio}$ =	N/A	N/A	
$C_r$ (G) =	N/A	N/A	
$C_w$ (G) =	N/A	N/A	
$C_o$ (G) =	N/A	N/A	
	MINOR	MAJOR	
$L_o$ (C) =	5.00	5.00	feet
$H_{vert}$ =	6.00	6.00	inches
$H_{throat}$ =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
$W_p$ =	2.00	2.00	feet
$C_r$ (C) =	0.10	0.10	
$C_w$ (C) =	3.60	3.60	
$C_o$ (C) =	0.67	0.67	
	MINOR	MAJOR	
$d_{Grate}$ =	N/A	N/A	ft
$d_{Curb}$ =	0.34	0.83	ft
$RF_{Combination}$ =	0.58	1.00	
$RF_{Curb}$ =	0.79	1.00	
$RF_{Grate}$ =	N/A	N/A	
	MINOR	MAJOR	
$Q_a$ =	19.0	52.7	cfs
$Q_{PEAK REQUIRED}$ =	18.9	42.0	cfs

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

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

Project: **Homestead North**  
Inlet ID: **Inlet DP 5C**



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

Maximum Allowable Width for Spread Behind Curb

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

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

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

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

Street Longitudinal Slope - Enter 0 for sump condition

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

$T_{BACK} = 9.5$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.020$

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 18.0$  ft  
 $W = 2.00$  ft  
 $S_x = 0.020$  ft/ft  
 $S_w = 0.083$  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	
$T_{MAX} =$	18.0	18.0	ft
$d_{MAX} =$	6.0	8.3	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

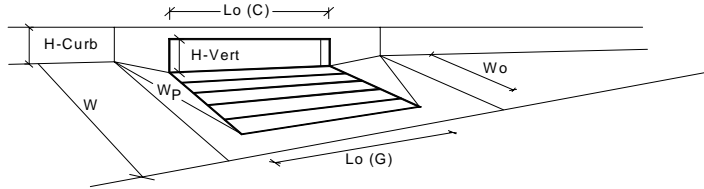
$Q_{allow} =$ 

Minor Storm	Major Storm
SUMP	SUMP

 cfs

# INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



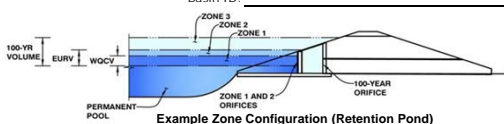
Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a <sub>local</sub> =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	3	3	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.8	5.8	inches
<b>Grate Information</b>			MINOR	MAJOR	<input type="checkbox"/> Override Depths
Length of a Unit Grate		L <sub>g</sub> (G) =	N/A	N/A	feet
Width of a Unit Grate		W <sub>o</sub> =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A <sub>ratio</sub> =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C <sub>r</sub> (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C <sub>w</sub> (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C <sub>o</sub> (G) =	N/A	N/A	
<b>Curb Opening Information</b>			MINOR	MAJOR	
Length of a Unit Curb Opening		L <sub>c</sub> (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H <sub>vert</sub> =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H <sub>throat</sub> =	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 <sub>p</sub> =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C <sub>r</sub> (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C <sub>w</sub> (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C <sub>o</sub> (C) =	0.67	0.67	
<b>Low Head Performance Reduction (Calculated)</b>			MINOR	MAJOR	
Depth for Grate Midwidth		d <sub>grate</sub> =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d <sub>curb</sub> =	0.32	0.32	ft
Combination Inlet Performance Reduction Factor for Long Inlets		RF <sub>Combination</sub> =	0.55	0.55	
Curb Opening Performance Reduction Factor for Long Inlets		RF <sub>Curb</sub> =	0.78	0.78	
Grated Inlet Performance Reduction Factor for Long Inlets		RF <sub>Grate</sub> =	N/A	N/A	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>			MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		Q <sub>a</sub> =	12.5	12.5	cfs
		Q <sub>PEAK REQUIRED</sub> =	4.1	8.8	cfs

Provide calculations for the Type D inlets



## MHFD-Detention, Version 4.04 (February 2021)

Basin ID:



### Example Zone Configuration (Retention Pond)

Selected BMP Type =	EDB	
Watershed Area =	224.34	acres
Watershed Length =	5,645	ft
Watershed Length to Centroid =	3,387	ft
Watershed Slope =	0.034	ft/ft
Watershed Imperviousness =	10.30%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

Water Quality Capture Volume (WQCV) =	1.285	acre-feet			acre-feet
Excess Urban Runoff Volume (EURV) =	2.177	acre-feet			acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.053	acre-feet		1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	6.690	acre-feet		1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	10.314	acre-feet		1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	16.752	acre-feet		2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	21.154	acre-feet		2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	27.479	acre-feet		2.52	inches
500-yr Runoff Volume (P1 = 4 in.) =	55.481	acre-feet		4.00	inches
Approximate 2-yr Detention Volume =	1.394	acre-feet			
Approximate 5-yr Detention Volume =	2.181	acre-feet			
Approximate 10-yr Detention Volume =	4.470	acre-feet			
Approximate 25-yr Detention Volume =	6.213	acre-feet			
Approximate 50-yr Detention Volume =	6.504	acre-feet			
Approximate 100-yr Detention Volume =	8.393	acre-feet			

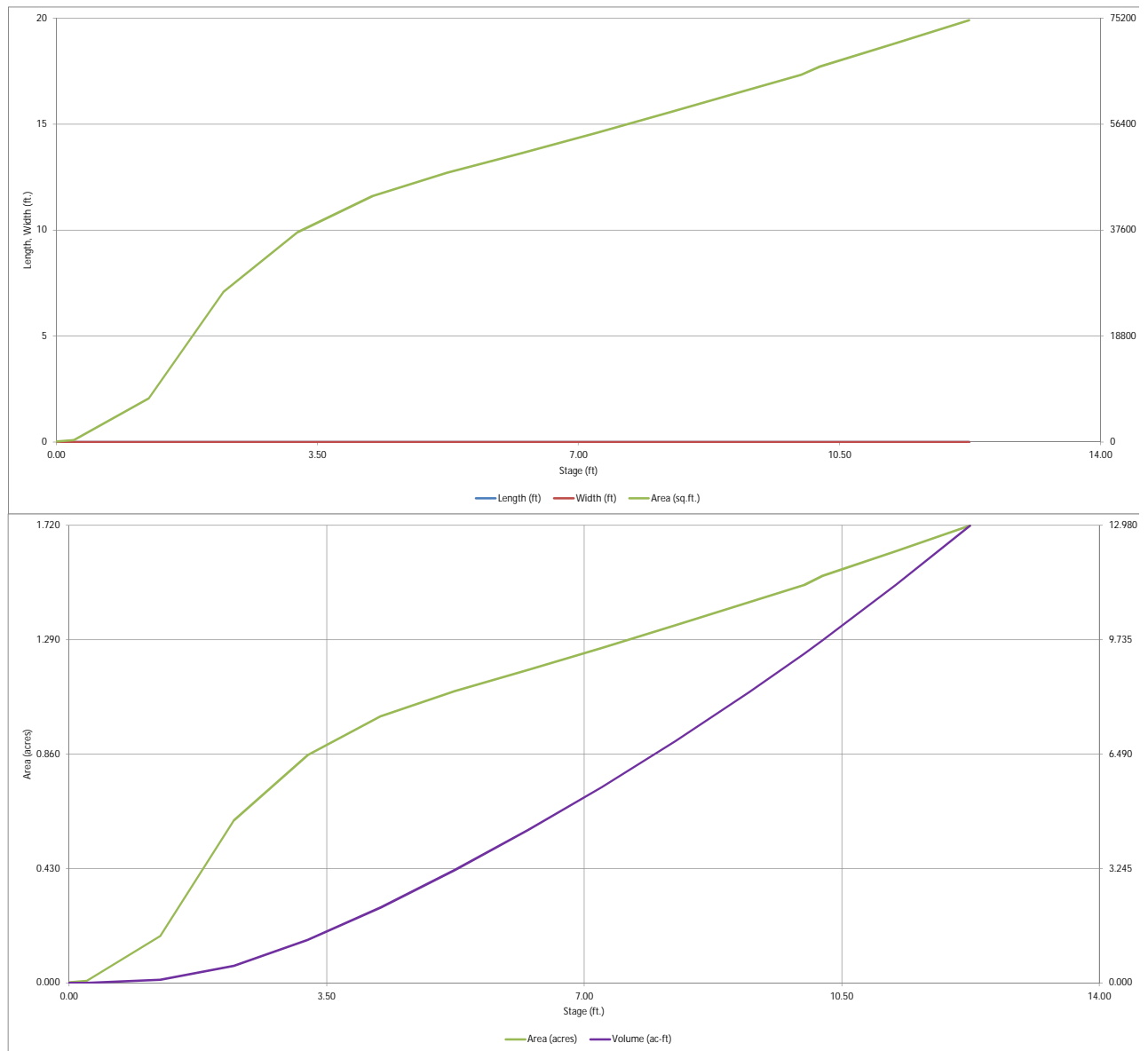
Zone 1 Volume (WOCV) =	1.285	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.892	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	6.216	acre-feet
Total Detention Basin Volume =	8.393	acre-feet
Initial Surge Volume (ISV) =	user	ft <sup>3</sup>
Initial Surge Depth (ISD) =	user	ft
Total Available Detention Depth ( $H_{TAD}$ ) =	user	ft
Depth of Trickle Channel ( $H_{TC}$ ) =	user	ft
Slope of Trickle Channel ( $S_{TC}$ ) =	user	ft/ft
Slopes of Main Basin Sides ( $S_{MB}$ ) =	user	H-V
Basin Length-to-Width Ratio ( $R_{LW}$ ) =	user	

Initial Surcharge Area ( $A_{ISU}$ )	=	user	ft <sup>2</sup>
Surcharge Volume Length ( $L_{ISU}$ )	=	user	ft
Surcharge Volume Width ( $W_{ISU}$ )	=	user	ft
Depth of Basin Floor ( $H_{FLOOR}$ )	=	user	ft
Length of Basin Floor ( $L_{FLOOR}$ )	=	user	ft
Width of Basin Floor ( $W_{FLOOR}$ )	=	user	ft
Area of Basin Floor ( $A_{FLOOR}$ )	=	user	ft <sup>2</sup>
Volume of Basin Floor ( $V_{FLOOR}$ )	=	user	ft <sup>3</sup>
Depth of Main Basin ( $H_{MAIN}$ )	=	user	ft
Length of Main Basin ( $L_{MAIN}$ )	=	user	ft
Width of Main Basin ( $W_{MAIN}$ )	=	user	ft
Area of Main Basin ( $A_{MAIN}$ )	=	user	ft <sup>2</sup>
Volume of Main Basin ( $V_{MAIN}$ )	=	user	ft <sup>3</sup>
Calculated Total Basin Volume ( $V_{BAS}$ )	=	user	acre-feet

[illegible]

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

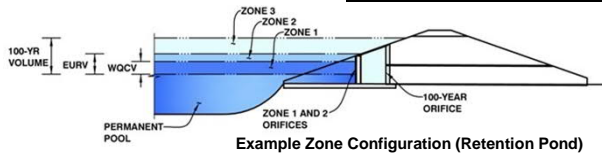


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Pond C with offsite flow

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.32	1.285	Orifice Plate
Zone 2 (EURV)	4.27	0.892	Orifice Plate
Zone 3 (100-year)	9.35	6.216	Weir&Pipe (Restrict)
Total (all zones)		8.393	

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

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

Calculated Parameters for Underdrain  
Underdrain Orifice Area = N/A ft<sup>2</sup>  
Underdrain Orifice Centroid = N/A feet

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

Invert of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Orifice Plate = 4.27 ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing = N/A inches  
Orifice Plate: Orifice Area per Row = 4.69 sq. inches (use rectangular openings)

Calculated Parameters for Plate  
WQ Orifice Area per Row = 3.257E-02 ft<sup>2</sup>  
Elliptical Half-Width = N/A feet  
Elliptical Slot Centroid = N/A feet  
Elliptical Slot Area = N/A ft<sup>2</sup>

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.25	2.50					
Orifice Area (sq. inches)	4.69	4.69	4.69					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = Not Selected Not Selected ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Vertical Orifice = Not Selected Not Selected ft (relative to basin bottom at Stage = 0 ft)  
Vertical Orifice Diameter = Not Selected Not Selected inches

Calculated Parameters for Vertical Orifice  
Vertical Orifice Area = Not Selected Not Selected ft<sup>2</sup>  
Vertical Orifice Centroid = Not Selected Not Selected feet

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

Check this elev on Sht 12 of CD's

Overflow Weir Front Edge Height, H<sub>o</sub> = 4.36 ft (relative to basin bottom at Stage = 0 ft)  
Overflow Weir Front Edge Length = 7.00 feet  
Overflow Weir Grate Slope = 4.00 H:V  
Horiz. Length of Weir Sides = 12.42 feet  
Overflow Grate Type = Close Mesh Grate  
Debris Clogging % = 75%

Calculated Parameters for Overflow Weir  
Height of Grate Upper Edge, H<sub>u</sub> = 7.47 feet  
Overflow Weir Slope Length = 12.80 feet  
Grate Open Area / 100-yr Orifice Area = 7.70  
Overflow Grate Open Area w/o Debris = 70.89 ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris = 17.72 ft<sup>2</sup>

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

Depth to Invert of Outlet Pipe = 6.29 ft (distance below basin bottom at Stage = 0 ft)  
Outlet Pipe Diameter = 48.00 inches  
Restrictor Plate Height Above Pipe Invert = 33.00 inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
Outlet Orifice Area = 9.21 ft<sup>2</sup>  
Outlet Orifice Centroid = 1.54 feet  
Half-Central Angle of Restrictor Plate on Pipe = 1.96 radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = 9.99 ft (relative to basin bottom at Stage = 0 ft)  
Spillway Crest Length = 123.00 feet  
Spillway End Slopes = 4.00 H:V  
Freeboard above Max Water Surface = 1.00 feet

Internal note to check these values against the requested missing spillway details with R2.

Calculated Parameters for Spillway  
Spillway Design Flow Depth = 0.74 feet  
Stage at Top of Freeboard = 11.73 feet  
Basin Area at Top of Freeboard = 1.67 acres  
Basin Volume at Top of Freeboard = 12.10 acre-ft

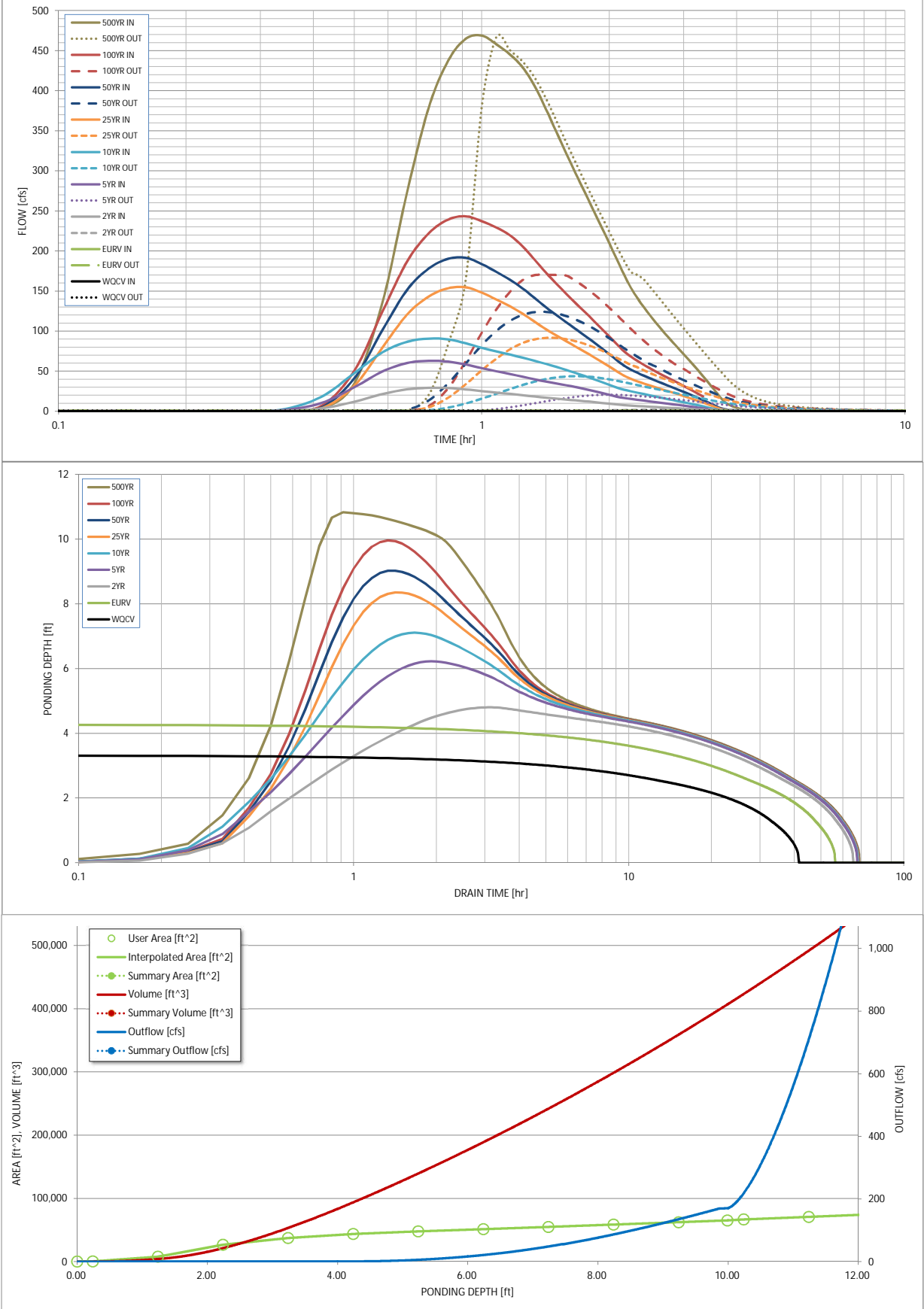
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	4.00
One-Hour Rainfall Depth (in)	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	4.00
CUHP Runoff Volume (acre-ft)	1.285	2.177	3.053	6.690	10.314	16.752	21.154	27.479	55.481
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	3.053	6.690	10.314	16.752	21.154	27.479	55.481
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	17.6	49.5	77.1	142.3	179.0	229.8	455.6
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.08	0.22	0.34	0.63	0.80	1.02	2.03
Peak Inflow Q (cfs)	N/A	N/A	29.2	62.9	90.7	154.6	191.5	243.2	468.8
Peak Outflow Q (cfs)	0.7	0.8	2.3	20.6	43.8	91.5	124.0	170.1	467.1
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.4	0.6	0.6	0.7	0.7	1.0
Structure Controlling Flow	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps)	N/A	N/A	0.02	0.3	0.6	1.3	1.7	2.4	2.4
Max Velocity through Grate 2 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours)	38	50	58	55	51	45	41	37	21
Time to Drain 99% of Inflow Volume (hours)	40	54	62	62	60	57	55	53	44
Maximum Ponding Depth (ft)	3.32	4.27	4.80	6.22	7.11	8.35	9.02	9.96	10.83
Area at Maximum Ponding Depth (acres)	0.87	1.01	1.06	1.17	1.25	1.35	1.41	1.49	1.58
Maximum Volume Stored (acre-ft)	1.288	2.178	2.724	4.310	5.376	7.001	7.928	9.278	10.635

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)



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

# DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

## Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.08
	0:15:00	0.00	0.00	0.09	0.15	0.19	0.13	0.17	0.16	0.44
	0:20:00	0.00	0.00	0.46	1.05	1.75	0.51	0.62	0.65	3.37
	0:25:00	0.00	0.00	3.52	9.98	17.68	3.45	4.47	6.28	34.88
	0:30:00	0.00	0.00	11.92	30.04	47.68	31.82	41.26	50.74	137.01
	0:35:00	0.00	0.00	21.51	49.75	73.74	79.89	101.79	125.03	274.15
	0:40:00	0.00	0.00	27.37	60.19	86.63	120.85	151.63	187.24	379.49
	0:45:00	0.00	0.00	29.24	62.95	90.68	143.30	178.16	222.16	437.55
	0:50:00	0.00	0.00	28.90	61.88	89.65	153.54	190.25	239.24	464.73
	0:55:00	0.00	0.00	27.30	58.28	84.80	154.61	191.49	243.24	468.76
	1:00:00	0.00	0.00	25.17	53.74	79.17	147.99	183.59	237.12	457.76
	1:05:00	0.00	0.00	23.29	49.81	74.62	139.41	173.77	229.21	445.04
	1:10:00	0.00	0.00	21.66	46.44	70.63	130.89	164.01	219.46	428.91
	1:15:00	0.00	0.00	19.99	43.11	66.77	121.59	153.14	205.51	405.76
	1:20:00	0.00	0.00	18.32	39.84	62.89	111.70	141.25	189.08	377.53
	1:25:00	0.00	0.00	16.88	37.04	59.15	102.45	129.91	173.15	348.76
	1:30:00	0.00	0.00	15.70	34.68	55.36	94.62	120.15	159.22	321.92
	1:35:00	0.00	0.00	14.61	32.41	51.51	87.41	111.09	146.56	296.87
	1:40:00	0.00	0.00	13.57	30.11	47.69	80.68	102.59	135.01	273.59
	1:45:00	0.00	0.00	12.53	27.72	43.93	74.24	94.46	124.14	251.54
	1:50:00	0.00	0.00	11.50	25.30	40.26	68.02	86.61	113.65	230.41
	1:55:00	0.00	0.00	10.47	22.89	36.63	61.89	78.90	103.44	209.92
	2:00:00	0.00	0.00	9.42	20.49	32.97	55.86	71.34	93.51	190.03
	2:05:00	0.00	0.00	8.40	18.24	29.53	49.92	63.86	83.78	170.94
	2:10:00	0.00	0.00	7.56	16.53	26.95	44.49	57.05	74.95	154.24
	2:15:00	0.00	0.00	6.99	15.32	24.94	40.52	52.06	68.28	140.98
	2:20:00	0.00	0.00	6.50	14.25	23.11	37.29	47.92	62.75	129.60
	2:25:00	0.00	0.00	6.05	13.24	21.39	34.50	44.30	57.84	119.33
	2:30:00	0.00	0.00	5.61	12.26	19.77	31.95	40.97	53.38	109.93
	2:35:00	0.00	0.00	5.19	11.33	18.20	29.60	37.91	49.27	101.22
	2:40:00	0.00	0.00	4.78	10.42	16.69	27.34	34.98	45.41	93.06
	2:45:00	0.00	0.00	4.38	9.53	15.23	25.17	32.17	41.81	85.44
	2:50:00	0.00	0.00	3.99	8.66	13.83	23.06	29.47	38.40	78.24
	2:55:00	0.00	0.00	3.60	7.80	12.48	20.98	26.81	35.01	71.22
	3:00:00	0.00	0.00	3.22	6.96	11.17	18.93	24.19	31.65	64.33
	3:05:00	0.00	0.00	2.84	6.13	9.88	16.88	21.59	28.30	57.45
	3:10:00	0.00	0.00	2.46	5.30	8.60	14.84	19.00	24.94	50.60
	3:15:00	0.00	0.00	2.09	4.48	7.32	12.80	16.41	21.60	43.76
	3:20:00	0.00	0.00	1.72	3.67	6.05	10.77	13.83	18.26	36.95
	3:25:00	0.00	0.00	1.34	2.86	4.79	8.74	11.26	14.92	30.16
	3:30:00	0.00	0.00	0.98	2.05	3.55	6.72	8.69	11.60	23.41
	3:35:00	0.00	0.00	0.62	1.28	2.37	4.71	6.16	8.31	16.94
	3:40:00	0.00	0.00	0.36	0.78	1.68	2.85	3.84	5.33	11.65
	3:45:00	0.00	0.00	0.24	0.58	1.32	1.82	2.56	3.56	8.31
	3:50:00	0.00	0.00	0.19	0.45	1.05	1.19	1.76	2.42	6.00
	3:55:00	0.00	0.00	0.15	0.37	0.84	0.80	1.23	1.61	4.27
	4:00:00	0.00	0.00	0.12	0.29	0.67	0.52	0.84	1.04	2.97
	4:05:00	0.00	0.00	0.10	0.23	0.52	0.36	0.60	0.63	2.00
	4:10:00	0.00	0.00	0.08	0.18	0.39	0.24	0.41	0.35	1.29
	4:15:00	0.00	0.00	0.06	0.13	0.28	0.16	0.28	0.20	0.83
	4:20:00	0.00	0.00	0.05	0.10	0.20	0.12	0.20	0.15	0.60
	4:25:00	0.00	0.00	0.04	0.07	0.14	0.08	0.15	0.12	0.44
	4:30:00	0.00	0.00	0.03	0.05	0.11	0.06	0.12	0.09	0.35
	4:35:00	0.00	0.00	0.02	0.04	0.08	0.05	0.09	0.07	0.27
	4:40:00	0.00	0.00	0.02	0.02	0.06	0.03	0.06	0.05	0.20
	4:45:00	0.00	0.00	0.01	0.01	0.04	0.02	0.05	0.04	0.14
	4:50:00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.09
	4:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.06
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

## DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

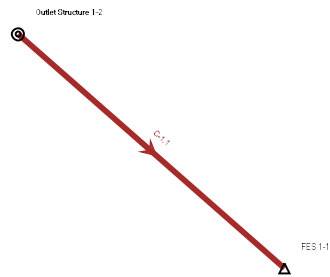
### Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

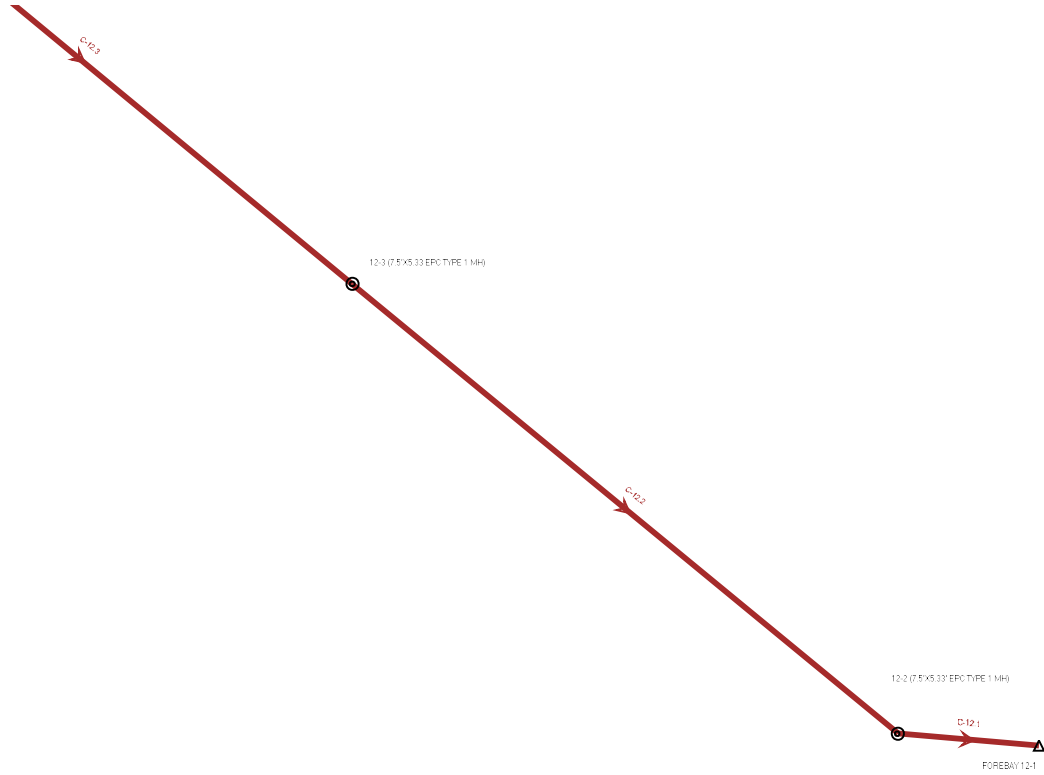
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

## Scenario: 100 - Year

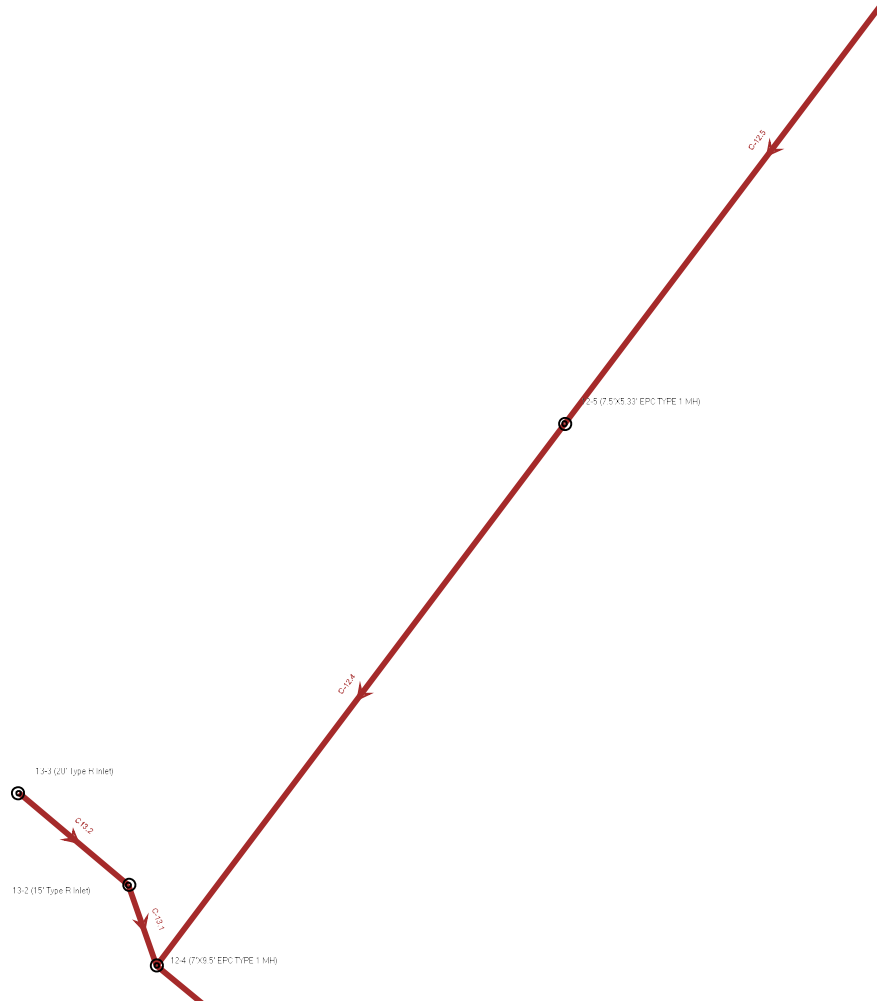


## Scenario: 100 - Year

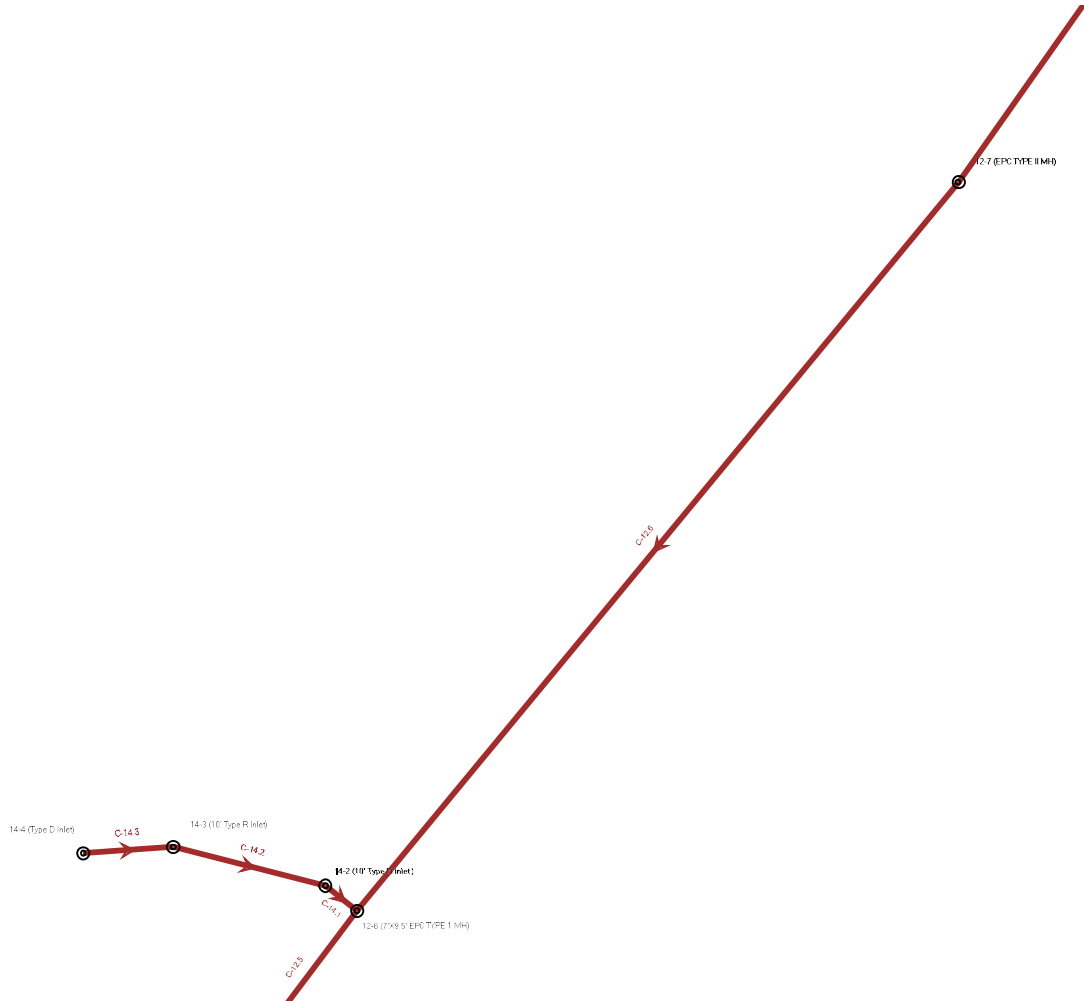




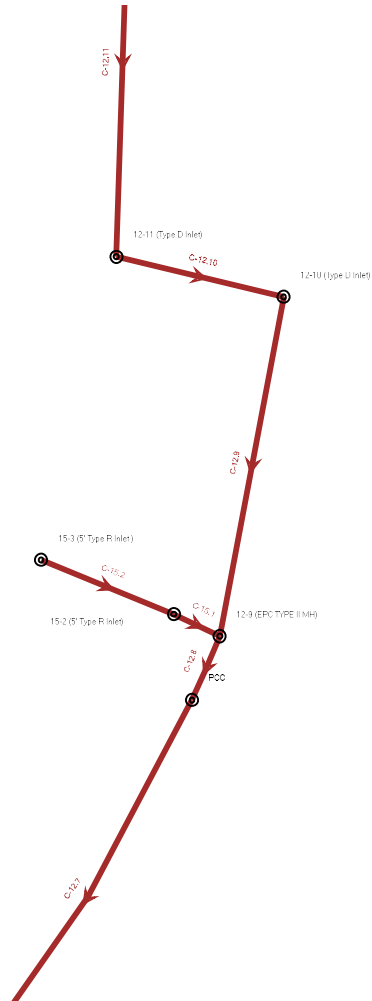
## Scenario: 100 - Year



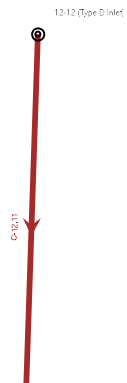
## Scenario: 100 - Year



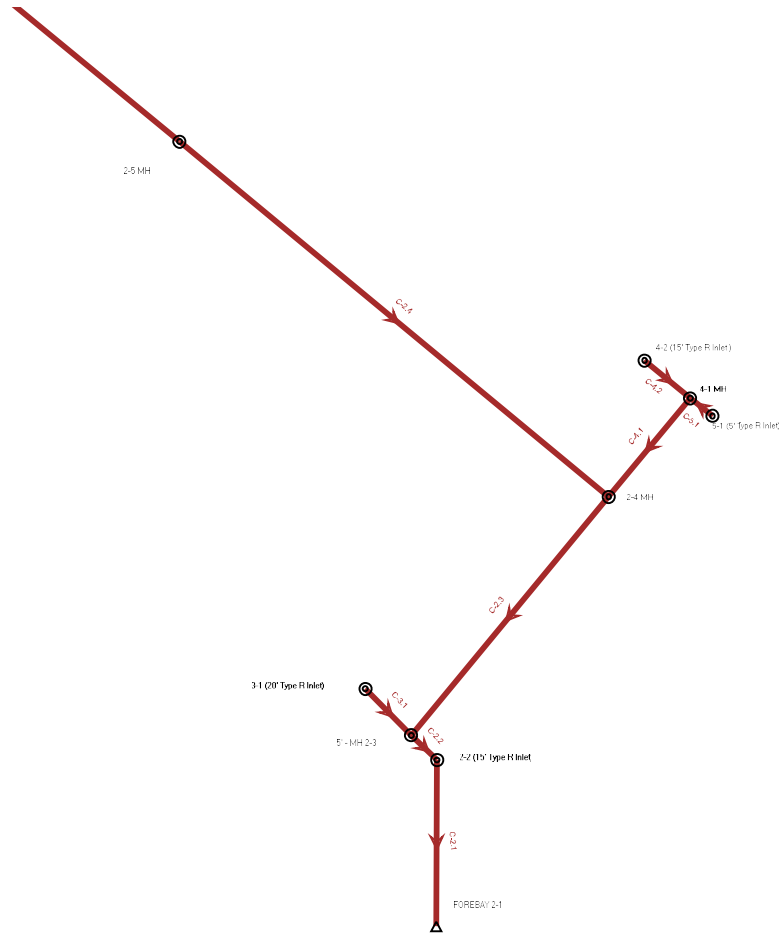
## Scenario: 100 - Year



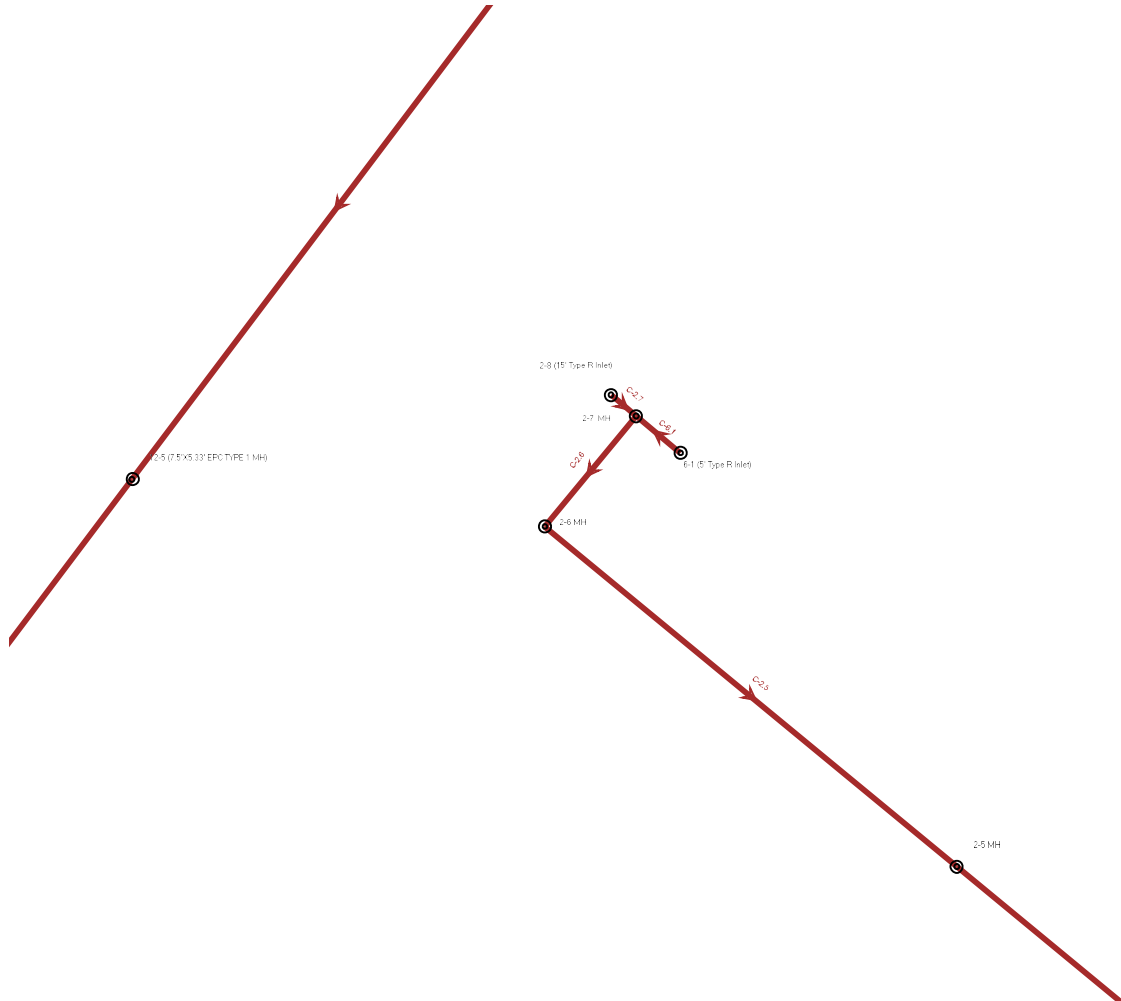
## Scenario: 100 - Year



## Scenario: 100 - Year



## Scenario: 100 - Year



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

Please sort by  
 label

Label	Diameter (in)	Manning's n	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Span (ft)	Rise (ft)
C-6.1	18.0	0.013	7,136.45	7,135.96	26.9	0.018	1.50	0.85	14.19	7,138.39	7,138.38	-	-
C-5.1	18.0	0.013	7,123.51	7,122.94	7.6	0.076	1.90	1.08	28.96	7,125.64	7,125.64	-	-
C-13.1	24.0	0.013	7,128.79	7,128.05	37.3	0.020	15.50	4.93	31.86	7,131.51	7,131.34	-	-
C-15.2	18.0	0.013	7,169.59	7,168.18	68.9	0.020	1.10	4.96	15.03	7,169.98	7,169.32	-	-
C-3.1	24.0	0.013	7,118.20	7,117.83	30.7	0.012	18.10	5.76	25.06	7,121.18	7,120.98	-	-
C-12.11	24.0	0.013	7,171.83	7,170.13	187.1	0.009	6.00	5.88	21.56	7,172.70	7,172.05	-	-
C-15.1	18.0	0.013	7,168.08	7,167.61	23.5	0.020	2.20	6.02	14.85	7,169.32	7,169.32	-	-
C-2.7	18.0	0.013	7,136.58	7,135.96	7.0	0.089	10.70	6.05	31.39	7,138.46	7,138.38	-	-
C-4.2	18.0	0.013	7,123.72	7,122.94	27.5	0.029	11.50	6.51	17.73	7,125.97	7,125.64	-	-
C-12.10	24.0	0.013	7,170.03	7,169.21	81.6	0.010	11.60	7.26	22.68	7,171.69	7,171.54	-	-
C-4.1	18.0	0.013	7,122.81	7,121.27	62.7	0.025	12.90	7.30	16.45	7,124.38	7,123.43	-	-
C-12.9	24.0	0.013	7,169.04	7,167.11	166.4	0.012	17.70	8.46	24.36	7,170.56	7,169.32	-	-
C13.2	24.0	0.013	7,130.01	7,128.89	67.5	0.017	14.30	9.23	29.14	7,132.01	7,131.74	-	-
C-2.1	36.0	0.013	7,112.85	7,109.00	88.4	0.044	65.50	9.27	139.11	7,117.57	7,116.72	-	-
C-2.4	18.0	0.013	7,127.27	7,121.27	272.9	0.022	11.70	9.67	15.58	7,128.58	7,123.43	-	-
C-2.5	18.0	0.013	7,133.91	7,127.37	261.9	0.025	11.70	10.18	16.61	7,135.22	7,128.30	-	-
C-2.3	24.0	0.013	7,120.77	7,117.83	152.1	0.019	17.80	10.33	31.49	7,122.29	7,120.98	-	-
C-2.6	18.0	0.013	7,135.86	7,134.01	70.2	0.026	11.70	10.40	17.06	7,137.17	7,136.27	-	-
C-12.1	60.0	0.013	7,111.18	7,108.87	65.4	0.035	220.30	11.22	489.00	7,117.19	7,116.72	-	-
C-12.8	24.0	0.013	7,167.01	7,166.06	34.2	0.028	19.20	12.06	37.72	7,168.59	7,168.04	-	-
C-12.7	24.0	0.013	7,166.06	7,159.93	218.2	0.028	19.20	12.11	37.92	7,167.64	7,161.81	-	-
C-12.6	24.0	0.013	7,159.83	7,144.31	460.1	0.034	19.20	12.97	41.55	7,161.41	7,145.26	-	-
C-2.2	36.0	0.013	7,116.63	7,116.53	4.8	0.020	55.30	13.87	94.31	7,119.04	7,118.71	-	-
C-14.2	48.0	0.013	7,139.99	7,138.50	74.9	0.020	192.50	15.32	202.60	7,148.12	7,146.77	-	-
C-14.1	48.0	0.013	7,138.40	7,137.96	13.1	0.034	195.00	15.52	263.54	7,144.53	7,144.29	-	-
C-12.5	60.0	0.013	7,136.87	7,132.31	330.0	0.014	205.30	16.72	306.13	7,140.96	7,135.36	-	-
C-12.2	60.0	0.013	7,119.72	7,115.00	340.1	0.014	220.30	17.00	306.92	7,123.94	7,118.19	-	-
C-12.4	60.0	0.013	7,129.91	7,125.05	325.2	0.015	205.30	17.24	318.54	7,134.00	7,131.34	-	-
C-12.3	60.0	0.013	7,124.95	7,119.83	341.3	0.015	220.30	17.52	318.88	7,129.16	7,125.15	-	-
C-1.1	48.0	0.013	7,101.49	7,098.01	173.7	0.020	170.10	18.10	203.11	7,105.21	7,100.96	-	-
C-14.3	42.0	0.013	7,140.78	7,140.58	40.6	0.005	190.90	19.84	70.60	7,151.77	7,150.31	-	-

X:\2510000.all\2518800\StormCAD\Sterling Ranch Homestead\2518800\StormCAD (Sterling Ranch - Homestead North).stsw

Verify that all of these  
 match the CDs - only a few  
 spot checks were done.

Velocity is >18 fps

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

Label	Flow (Total Out) (cfs)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Known) (cfs)	Headloss Method
12-12 (Type D Inlet)	6.00	7,173.04	7,173.03	0.050	7,172.71	7,172.70	7,176.01	7,171.84	6.00	Standard
12-11 (Type D Inlet)	11.60	7,172.10	7,171.96	1.320	7,172.05	7,171.69	7,175.64	7,170.04	11.60	Standard
12-10 (Type D Inlet)	17.70	7,171.75	7,171.30	1.320	7,171.54	7,170.56	7,175.35	7,169.05	17.70	Standard
12-9 (EPC TYPE II MH)	19.20	7,169.81	7,169.40	0.900	7,169.32	7,168.59	7,174.21	7,167.01	19.20	Standard
15-3 (5' Type R Inlet )	1.10	7,170.13	7,170.12	0.050	7,169.99	7,169.98	7,173.75	7,169.60	1.10	Standard
15-2 (5' Type R Inlet)	2.20	7,169.33	7,169.35	0.050	7,169.32	7,169.32	7,173.74	7,168.10	2.20	Standard
12-7 (EPC TYPE II MH)	19.20	7,162.42	7,162.22	0.500	7,161.81	7,161.41	7,165.11	7,159.83	19.20	Standard
14-2 (10' Type R Inlet )	195.00	7,150.42	7,148.27	0.600	7,146.77	7,144.53	7,151.71	7,138.40	195.00	Standard
12-6 (7'X9.5' EPC TYPE 1 MH)	205.30	7,148.03	7,143.18	1.500	7,144.29	7,140.96	7,151.27	7,136.87	205.30	Standard
14-3 (10' Type R Inlet)	192.50	7,156.42	7,151.76	0.600	7,150.31	7,148.12	7,151.00	7,139.99	192.50	Standard
14-4 (Type D Inlet)	190.90	7,153.94	7,153.63	0.050	7,147.82	7,147.51	7,147.51	7,141.67	190.90	Standard
12-5 (7.5'X5.33' EPC TYPE 1 MH)	205.30	7,139.27	7,136.22	0.500	7,135.11	7,134.00	7,142.09	7,129.91	205.30	Standard
6-1 (5' Type R Inlet)	1.50	7,138.40	7,138.40	0.050	7,138.39	7,138.39	7,141.19	7,136.45	1.50	Standard
2-8 (15' Type R Inlet)	10.70	7,139.06	7,139.03	0.050	7,138.49	7,138.46	7,141.19	7,136.58	10.70	Standard
2-7 MH	11.70	7,138.95	7,137.97	1.520	7,138.38	7,137.17	7,140.87	7,135.86	11.70	Standard
2-6 MH	11.70	7,136.96	7,136.02	1.320	7,136.27	7,135.22	7,139.45	7,133.71	11.70	Standard
13-3 (20' Type R Inlet)	14.30	7,132.49	7,132.33	0.500	7,132.17	7,132.01	7,136.00	7,130.01	14.30	Standard
13-2 (15' Type R Inlet)	15.50	7,132.06	7,131.89	0.600	7,131.74	7,131.51	7,134.43	7,128.54	15.50	Standard
12-4 (7'X9.5' EPC TYPE 1 MH)	220.30	7,133.03	7,131.58	0.900	7,131.34	7,129.16	7,133.81	7,124.95	220.30	Standard
2-5 MH	11.70	7,130.23	7,129.38	0.050	7,128.62	7,128.58	7,133.28	7,127.27	11.70	Standard
12-3 (7.5'X5.33 EPC TYPE 1 MH)	220.30	7,127.10	7,126.36	0.500	7,125.15	7,123.94	7,130.74	7,119.72	220.30	Standard
4-2 (15' Type R Inlet )	11.50	7,126.66	7,126.62	0.050	7,126.00	7,125.97	7,128.03	7,123.72	11.50	Standard
5-1 (5' Type R Inlet)	1.90	7,125.66	7,125.66	0.050	7,125.64	7,125.64	7,128.02	7,123.51	1.90	Standard
4-1 MH	12.90	7,125.65	7,125.21	1.520	7,125.64	7,124.38	7,127.76	7,122.81	12.90	Standard
2-4 MH	17.80	7,124.26	7,123.04	1.520	7,123.43	7,122.29	7,126.50	7,120.77	17.80	Standard
3-1 (20' Type R Inlet)	18.10	7,121.72	7,121.70	0.050	7,121.21	7,121.18	7,124.35	7,118.20	18.10	Standard
2-2 (15' Type R Inlet)	65.50	7,119.83	7,118.91	0.520	7,118.27	7,117.57	7,124.35	7,112.85	65.50	Standard
5' - MH 2-3	55.30	7,121.50	7,120.32	1.520	7,120.98	7,119.04	7,124.02	7,116.63	55.30	Standard
12-2 (7.5'X5.33' EPC TYPE 1 MH)	220.30	7,122.69	7,119.14	0.600	7,118.36	7,117.19	7,123.42	7,110.61	220.30	Standard
Outlet Structure 1-2	170.10	7,108.24	7,108.24	0.000	7,105.21	7,105.21	7,111.12	7,100.49	170.10	Standard
PCC	19.20	7,168.62	7,168.45	0.500	7,168.04	7,167.64	7,173.56	7,166.06	19.20	Standard

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

Label	Diameter (in)	Manning's n	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Span (ft)	Rise (ft)
C-12.11	24.0	0.013	7,171.83	7,170.13	187.1	0.009	0.80	3.27	21.56	7,172.15	7,170.96	-	-
C-15.2	18.0	0.013	7,169.59	7,168.18	68.9	0.020	0.50	3.93	15.03	7,169.86	7,168.49	-	-
C-6.1	18.0	0.013	7,136.45	7,135.96	26.9	0.018	0.80	4.34	14.19	7,137.22	7,137.23	-	-
C-15.1	18.0	0.013	7,168.08	7,167.61	23.5	0.020	1.10	4.92	14.85	7,168.49	7,168.21	-	-
C-12.10	24.0	0.013	7,170.03	7,169.21	81.6	0.010	3.20	5.08	22.68	7,170.67	7,170.31	-	-
C13.2	24.0	0.013	7,130.01	7,128.89	67.5	0.017	2.50	5.67	29.14	7,130.56	7,129.55	-	-
C-12.9	24.0	0.013	7,169.04	7,167.11	166.4	0.012	5.70	6.34	24.36	7,169.89	7,168.21	-	-
C-13.1	24.0	0.013	7,128.79	7,128.05	37.3	0.020	3.20	6.49	31.86	7,129.42	7,128.48	-	-
C-14.3	42.0	0.013	7,140.78	7,140.58	40.6	0.005	27.10	6.85	70.60	7,142.38	7,142.09	-	-
C-2.4	18.0	0.013	7,127.27	7,121.27	272.9	0.022	4.80	7.76	15.58	7,128.12	7,122.52	-	-
C-5.1	18.0	0.013	7,123.51	7,122.94	7.6	0.076	1.20	8.08	28.96	7,124.68	7,124.68	-	-
C-2.5	18.0	0.013	7,133.91	7,127.37	261.9	0.025	4.80	8.13	16.61	7,134.76	7,127.92	-	-
C-2.6	18.0	0.013	7,135.86	7,134.01	70.2	0.026	4.80	8.29	17.06	7,136.71	7,135.21	-	-
C-2.3	24.0	0.013	7,120.77	7,117.83	152.1	0.019	9.20	8.70	31.49	7,121.85	7,119.30	-	-
C-3.1	24.0	0.013	7,118.20	7,117.83	30.7	0.012	18.90	8.76	25.06	7,119.77	7,119.18	-	-
C-12.8	24.0	0.013	7,167.01	7,166.06	34.2	0.028	6.40	8.94	37.72	7,167.91	7,167.13	-	-
C-12.7	24.0	0.013	7,166.06	7,159.93	218.2	0.028	6.40	8.98	37.92	7,166.96	7,160.90	-	-
C-4.1	18.0	0.013	7,122.81	7,121.27	62.7	0.025	7.90	9.22	16.45	7,123.90	7,122.52	-	-
C-4.2	18.0	0.013	7,123.72	7,122.94	27.5	0.029	7.00	9.44	17.73	7,124.75	7,124.68	-	-
C-12.6	24.0	0.013	7,159.83	7,144.31	460.1	0.034	6.40	9.59	41.55	7,160.73	7,144.84	-	-
C-12.5	60.0	0.013	7,136.87	7,132.31	330.0	0.014	32.60	10.16	306.13	7,138.46	7,133.41	-	-
C-1.1	48.0	0.013	7,101.49	7,098.01	173.7	0.020	20.60	10.38	203.11	7,102.82	7,098.87	-	-
C-12.4	60.0	0.013	7,129.91	7,125.05	325.2	0.015	32.60	10.45	318.54	7,131.50	7,127.16	-	-
C-12.2	60.0	0.013	7,119.72	7,115.00	340.1	0.014	35.80	10.45	306.92	7,121.39	7,116.15	-	-
C-12.3	60.0	0.013	7,124.95	7,119.83	341.3	0.015	35.80	10.74	318.88	7,126.61	7,121.69	-	-
C-14.2	48.0	0.013	7,139.99	7,138.50	74.9	0.020	28.10	11.34	202.60	7,141.56	7,140.36	-	-
C-2.2	36.0	0.013	7,116.63	7,116.53	4.8	0.020	26.20	11.42	94.31	7,118.28	7,117.97	-	-
C-2.7	18.0	0.013	7,136.58	7,135.96	7.0	0.089	5.90	13.63	31.39	7,137.52	7,137.23	-	-
C-14.1	48.0	0.013	7,138.40	7,137.96	13.1	0.034	29.20	13.82	263.54	7,140.00	7,139.15	-	-
C-12.1	60.0	0.013	7,111.18	7,108.87	65.4	0.035	35.80	14.53	489.00	7,112.84	7,112.98	-	-
C-2.1	36.0	0.013	7,112.85	7,109.00	88.4	0.044	30.90	15.83	139.11	7,114.65	7,112.98	-	-

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

Label	Flow (Total Out) (cfs)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Known) (cfs)	Headloss Method
12-12 (Type D Inlet)	0.80	7,172.26	7,172.25	0.050	7,172.15	7,172.15	7,176.01	7,171.84	0.80	Standard
12-11 (Type D Inlet)	3.20	7,170.97	7,170.89	1.320	7,170.96	7,170.67	7,175.64	7,170.04	3.20	Standard
12-10 (Type D Inlet)	5.70	7,170.37	7,170.21	1.320	7,170.31	7,169.89	7,175.35	7,169.05	5.70	Standard
12-9 (EPC TYPE II MH)	6.40	7,168.37	7,168.25	0.900	7,168.21	7,167.91	7,174.21	7,167.01	6.40	Standard
15-3 (5' Type R Inlet )	0.50	7,169.96	7,169.95	0.050	7,169.87	7,169.86	7,173.75	7,169.60	0.50	Standard
15-2 (5' Type R Inlet )	1.10	7,168.55	7,168.63	0.050	7,168.49	7,168.49	7,173.74	7,168.10	1.10	Standard
12-7 (EPC TYPE II MH)	6.40	7,161.18	7,161.07	0.500	7,160.90	7,160.73	7,165.11	7,159.83	6.40	Standard
14-2 (10' Type R Inlet )	29.20	7,140.74	7,140.60	0.600	7,140.36	7,140.00	7,151.71	7,138.40	29.20	Standard
12-6 (7'X9.5' EPC TYPE 1 MH)	32.60	7,140.67	7,139.03	1.500	7,139.32	7,138.46	7,151.27	7,136.87	32.60	Standard
14-3 (10' Type R Inlet)	28.10	7,142.63	7,142.15	0.600	7,141.91	7,141.56	7,151.00	7,139.99	28.10	Standard
14-4 (Type D Inlet)	27.10	7,143.03	7,143.00	0.050	7,142.42	7,142.38	7,147.51	7,141.67	27.10	Standard
12-5 (7.5'X5.33' EPC TYPE 1 MH)	32.60	7,133.39	7,132.07	0.500	7,131.79	7,131.50	7,142.09	7,129.91	32.60	Standard
6-1 (5' Type R Inlet)	0.80	7,137.24	7,137.23	0.050	7,137.22	7,137.22	7,141.19	7,136.45	0.80	Standard
2-8 (15' Type R Inlet)	5.90	7,137.94	7,137.92	0.050	7,137.54	7,137.52	7,141.19	7,136.58	5.90	Standard
2-7 MH	4.80	7,137.44	7,137.05	1.520	7,137.23	7,136.71	7,140.87	7,135.86	4.80	Standard
2-6 MH	4.80	7,135.37	7,135.10	1.320	7,135.21	7,134.76	7,139.45	7,133.71	4.80	Standard
13-3 (20' Type R Inlet)	2.50	7,130.86	7,130.76	0.500	7,130.66	7,130.56	7,136.00	7,130.01	2.50	Standard
13-2 (15' Type R Inlet)	3.20	7,129.67	7,129.64	0.600	7,129.55	7,129.42	7,134.43	7,128.54	3.20	Standard
12-4 (7'X9.5' EPC TYPE 1 MH)	35.80	7,127.42	7,127.22	0.900	7,127.16	7,126.61	7,133.81	7,124.95	35.80	Standard
2-5 MH	4.80	7,129.16	7,128.46	0.050	7,128.13	7,128.12	7,133.28	7,127.27	4.80	Standard
12-3 (7.5'X5.33 EPC TYPE 1 MH)	35.80	7,122.14	7,122.00	0.500	7,121.69	7,121.39	7,130.74	7,119.72	35.80	Standard
4-2 (15' Type R Inlet )	7.00	7,125.23	7,125.21	0.050	7,124.77	7,124.75	7,128.03	7,123.72	7.00	Standard
5-1 (5' Type R Inlet)	1.20	7,124.69	7,124.69	0.050	7,124.68	7,124.68	7,128.02	7,123.51	1.20	Standard
4-1 MH	7.90	7,124.69	7,124.41	1.520	7,124.68	7,123.90	7,127.76	7,122.81	7.90	Standard
2-4 MH	9.20	7,122.91	7,122.29	1.520	7,122.52	7,121.85	7,126.50	7,120.77	9.20	Standard
3-1 (20' Type R Inlet)	18.90	7,120.61	7,120.57	0.050	7,119.81	7,119.77	7,124.35	7,118.20	18.90	Standard
2-2 (15' Type R Inlet)	30.90	7,115.99	7,115.40	0.520	7,115.04	7,114.65	7,124.35	7,112.85	30.90	Standard
5' - MH 2-3	26.20	7,120.38	7,118.95	1.520	7,119.30	7,118.28	7,124.02	7,116.63	26.20	Standard
12-2 (7.5'X5.33' EPC TYPE 1 MH)	35.80	7,114.91	7,113.45	0.600	7,113.21	7,112.84	7,123.42	7,110.61	35.80	Standard
Outlet Structure 1-2	20.60	7,103.31	7,103.31	0.000	7,102.82	7,102.82	7,111.12	7,100.49	20.60	Standard
PCC	6.40	7,167.35	7,167.30	0.500	7,167.13	7,166.96	7,173.56	7,166.06	6.40	Standard

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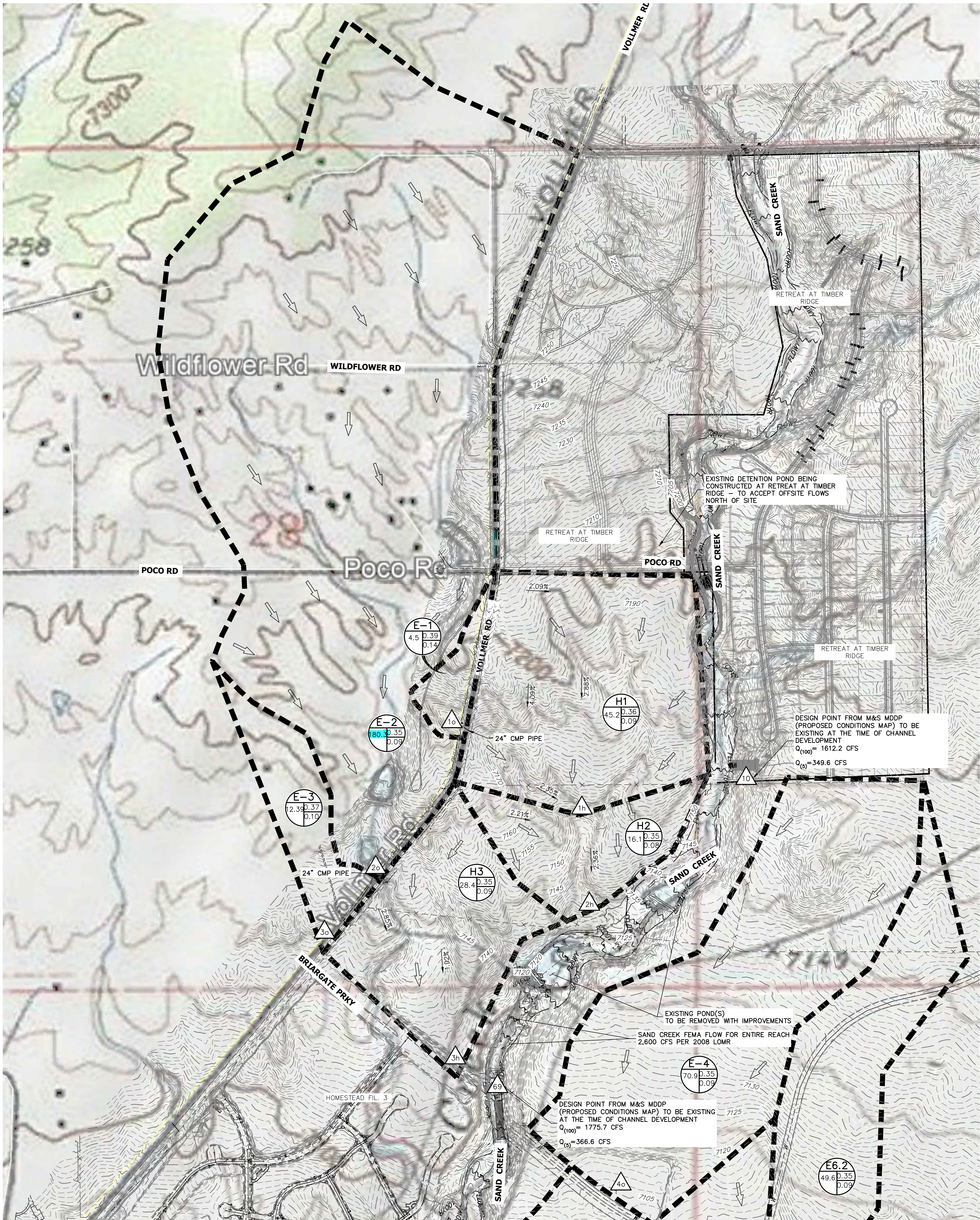
## **Appendix D**

### **Drainage Maps**



# EXISTING DRAINAGE MAP

## HOMESTEAD NORTH



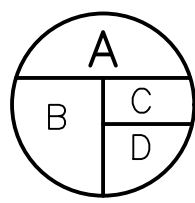
SEE SHEET 2

BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C <sub>s</sub>	C <sub>100</sub>	t <sub>c</sub> (min)	Q <sub>s</sub> (cfs)	Q <sub>100</sub> (cfs)
E-1	4.50	9%	0.14	0.39	48.7	1.1	5.2
E-2	180.30	3%	0.09	0.35	47.4	28.1	192.9
E-3	12.39	4%	0.10	0.37	46.9	2.2	13.7
E-4	70.50	2%	0.08	0.35	49.0	9.9	72.3
E-5	18.80	2%	0.08	0.35	34.9	3.4	24.9
E6.1	125.30	2%	0.08	0.35	48.1	17.8	130.4
E6.2	49.61	2%	0.08	0.35	44.2	7.5	55.4
H1	45.30	3%	0.09	0.36	34.7	8.9	61.1
H2	15.90	2%	0.08	0.35	25.1	3.5	25.7
H3	29.10	3%	0.09	0.35	31.3	6.1	41.8

DESIGN POINT		
DP	Q <sub>5</sub> Total	Q <sub>100</sub> Total
1h	8.0	52.5
2h	10.2	68.9
3h	32.6	224.0
1o	1.1	5.2
2o	28.1	192.9
3o	2.2	13.7
4o	9.9	72.3
5o	12.5	91.6
6.2o	7.5	55.4
6.1o	36.9	270.9

### LEGEND

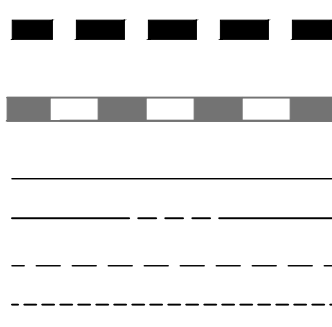
BASIN ID  
A: BASIN LABEL  
B: AREA  
C: C -100 YR  
D: C-5 YR



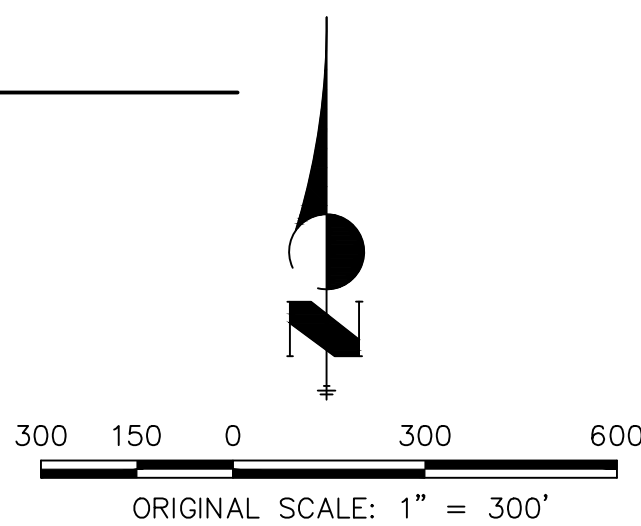
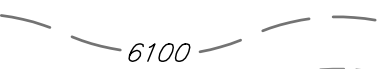
DESIGN POINT  
EXISTING FLOW DIRECTION



BASIN DRAINAGE AREA  
EXISTING STORM SEWER  
EXISTING PROPERTY LINE  
ROW EXISTING  
FL EXISTING  
SIDEWALK EXISTING  
DRAINAGE ACCESS & MAINTENANCE EASEMENT



EXISTING



EX DRAINAGE MAP  
HOMESTEAD NORTH  
JOB NO. 25188.00  
9-25-2021  
SHEET 1 OF 2

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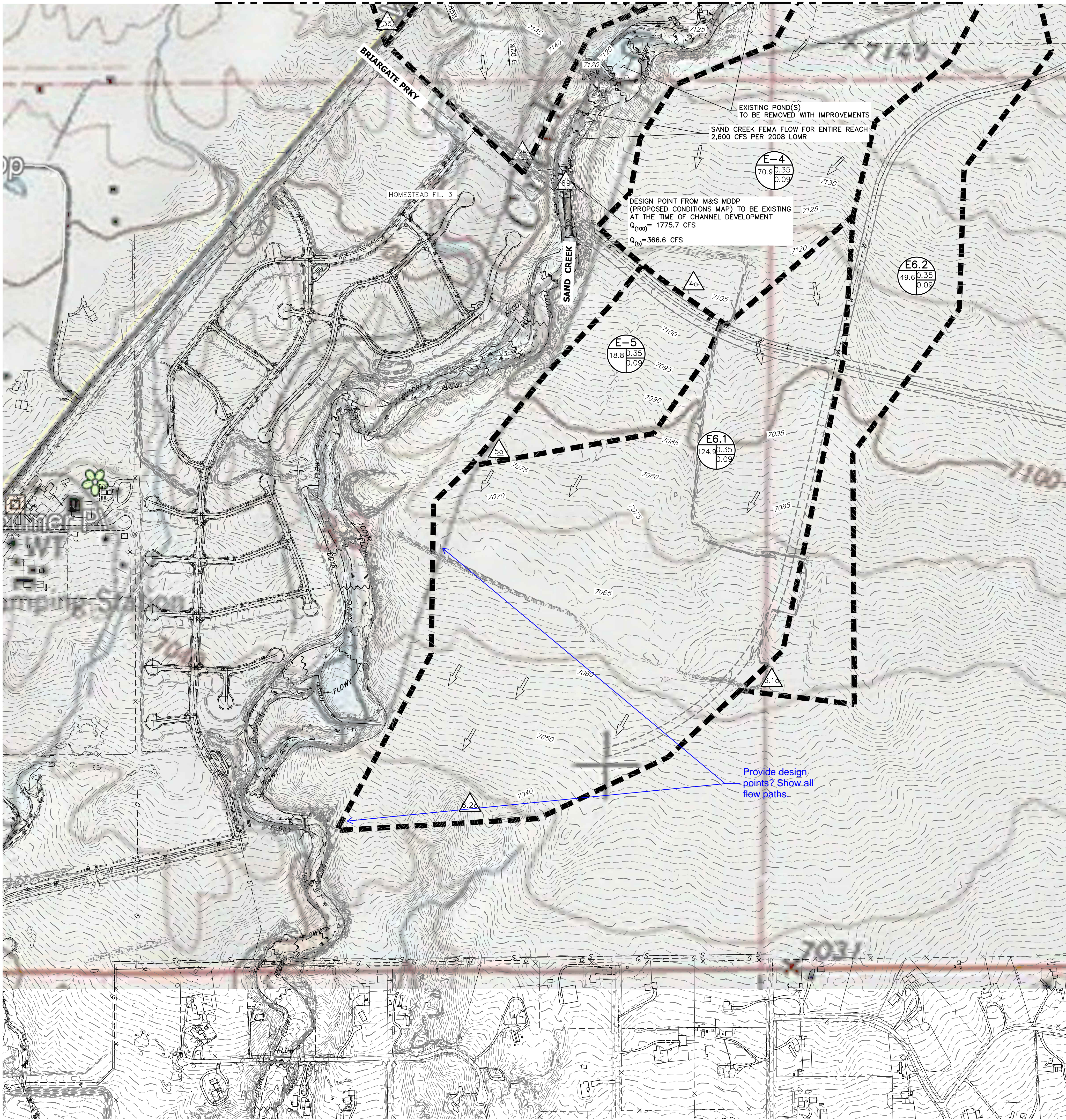
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# EXISTING DRAINAGE MAP

## HOMESTEAD NORTH

SEE SHEET 1

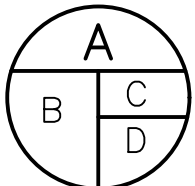


BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C <sub>s</sub>	C <sub>100</sub>	t <sub>c</sub> (min)	Q <sub>s</sub> (cfs)	Q <sub>100</sub> (cfs)
E-1	4.50	9%	0.14	0.39	48.7	1.1	5.2
E-2	180.30	3%	0.09	0.35	47.4	28.1	192.9
E-3	12.39	4%	0.10	0.37	46.9	2.2	13.7
E-4	70.50	2%	0.08	0.35	49.0	9.9	72.3
E-5	18.80	2%	0.08	0.35	34.9	3.4	24.9
E6.1	125.30	2%	0.08	0.35	48.1	17.8	130.4
E6.2	49.61	2%	0.08	0.35	44.2	7.5	55.4
H1	45.30	3%	0.09	0.36	34.7	8.9	61.1
H2	15.90	2%	0.08	0.35	25.1	3.5	25.7
H3	29.10	3%	0.09	0.35	31.3	6.1	41.8

DESIGN POINT		
DP	Q <sub>5</sub>	Q <sub>100</sub>
	Total	Total
1h	8.0	52.5
2h	10.2	68.9
3h	32.6	224.0
1a	1.1	5.2
2a	28.1	192.9
3a	2.2	13.7
4a	9.9	72.3
5a	12.5	91.6
6.2a	7.5	55.4
6.1a	36.9	270.9

### LEGEND

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



DESIGN POINT  
EXISTING FLOW DIRECTION



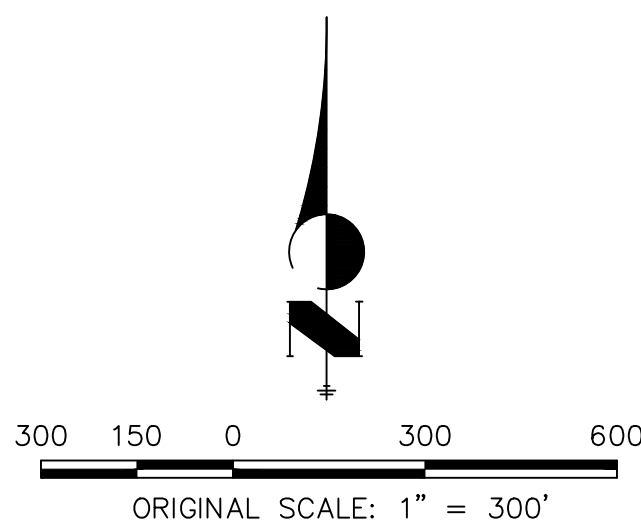
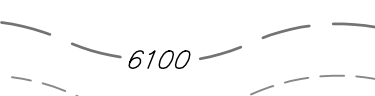
BASIN DRAINAGE AREA



EXISTING STORM SEWER  
EXISTING PROPERTY LINE  
ROW EXISTING  
FL EXISTING  
SIDEWALK EXISTING  
DRAINAGE ACCESS & MAINTENANCE EASEMENT



EXISTING



EX DRAINAGE MAP  
HOMESTEAD NORTH  
JOB NO. 25188.00  
9-15-2021  
SHEET 2 OF 2

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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

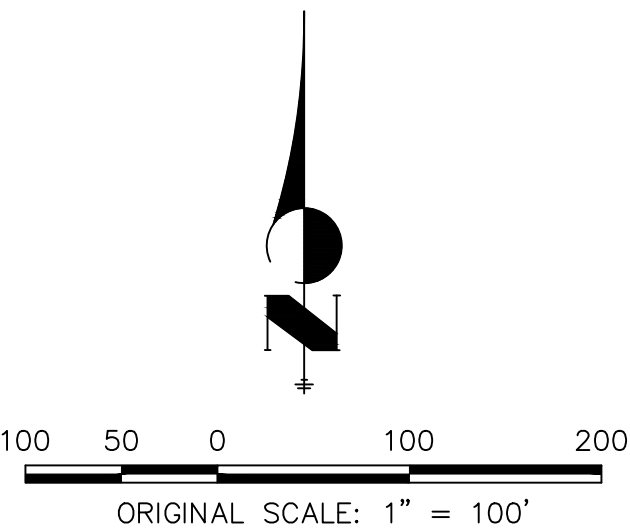
DRAINAGE ACCESS & MAINTENANCE EASEMENT

EXISTING

PROPOSED

BASIN SUMMARY TABLE							
Tributary	Area	Percent			tc	Q5	Q100
Sub-basin	(acres)	Impervious	C5	C100	(min)	(cfs)	(cfs)
C1	2.82	69%	0.52	0.65	13.1	5.4	11.4
C2.1	0.20	91%	0.82	0.90	5.0	0.8	1.6
C2.2	4.69	73%	0.56	0.68	12.8	9.9	20.3
C2.3	0.83	67%	0.54	0.68	10.1	1.9	3.9
C3.1	0.35	73%	0.68	0.79	5.0	1.2	2.4
C3.2	1.46	71%	0.56	0.68	8.4	3.6	7.4
C4.1	6.35	65%	0.49	0.63	12.0	12.1	25.9
C4.2	3.44	59%	0.46	0.61	12.6	5.9	13.3
C5	0.16	81%	0.74	0.84	6.4	0.6	1.0
C6	2.48	21%	0.22	0.45	6.8	2.5	8.8
D1	1.83	39%	0.39	0.58	16.6	2.4	6.0
D2	1.77	43%	0.43	0.61	16.3	2.5	6.1
D3	0.18	68%	0.63	0.76	5.4	0.6	1.2
D4	0.19	57%	0.54	0.70	6.3	0.5	1.1
D5	0.91	77%	0.71	0.82	6.0	3.1	6.1
D6	0.83	69%	0.64	0.77	6.4	2.5	5.2
D7	0.52	81%	0.74	0.84	5.0	2.0	3.8
D8	0.66	75%	0.69	0.81	5.0	2.4	4.6
OS1	2.85	2%	0.08	0.35	14.5	0.8	6.0
OS2	179.61	2%	0.08	0.35	47.4	27.1	190.9
OS3	11.99	2%	0.08	0.35	47.6	1.7	12.6

DESIGN POINT SUMMARY TABLE		
DP	Q5	Q100
	Total	Total
1c	5.4	11.4
2.3c	7.1	14.9
2.3i	7.0	11.5
2.1c	0.8	1.6
2.1i	0.8	1.5
2.2C	9.8	20.1
4.2c	5.9	13.3
4.2i	5.9	10.7
4C	18.9	42.1
3.1	4.8	11.7
3.1c	1.2	2.4
3.1i	1.2	1.9
3.2	7.9	12.9
3.3	9.2	17.8
3.4	26.2	55.3
3.2c	3.6	7.8
5C	4.1	8.7
6C	2.5	8.8
3.5	30.9	65.5
o1	0.8	6.0
1d	2.4	6.0
1.1d	3.2	11.6
2d	2.5	6.1
1.2d	5.7	17.7
3d	0.6	1.2
4d	0.5	1.1
4.1d	0.5	1.1
1.3d	1.0	2.2
1.4d	6.4	19.2
2o	27.1	190.9
6d	2.1	4.3
6.1d	28.1	192.5
1.5d	29.2	195.0
5d	3.1	6.1
1.6d	32.6	205.3
1.7d	35.8	220.3
3o	1.7	12.6
8d	2.5	14.3
2.1d	2.5	13.2
7d	1.8	4.0
2.2d	3.2	15.5
1.7d	35.8	220.3
5	55.7	263.5



DRAINAGE MAP  
HOMESTEAD NORTH - FILLING ONE  
JOB NO. 25188.00  
11/23/21  
SHEET 1 OF 2

SEE SHEET 2

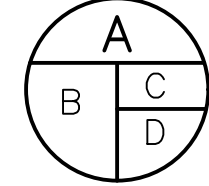


# DRAINAGE MAP

SEE SHEET 1

## 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

6100

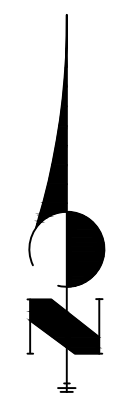
6100

## BASIN SUMMARY TABLE

Tributary	Area	Percent			tc	Q5	Q100
Sub-basin	(acres)	Impervious	C5	C100	(min)	(cfs)	(cfs)
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4.2i	5.9	10.7
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3.1	4.8	11.7
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3.2c	3.6	7.8
5c	4.1	8.7
6c	2.5	8.8
3.5	30.9	65.5
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2d	2.5	6.1
1.2d	5.7	17.7
3d	0.6	1.2
4d	0.5	1.1
4.1d	0.5	1.1
1.3d	1.0	2.2
1.4d	6.4	19.2
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1.7d	35.8	220.3
3o	1.7	12.6
8d	2.5	14.3
2.1d	2.5	13.2
7d	1.8	4.0
2.2d	3.2	15.5
1.7d	35.8	220.3
5	55.7	263.5



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

DRAINAGE MAP  
HOMESTEAD NORTH FILLING NO. 1  
JOB NO. 25188.00  
11/23/21  
SHEET 2 OF 2

**J-R ENGINEERING**  
A Westrian Company

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Fort Collins 970-491-9888 • www.jrengineering.com

Provide a WQ plan showing where all areas are treated



## **Appendix E**

### **Reference Material**

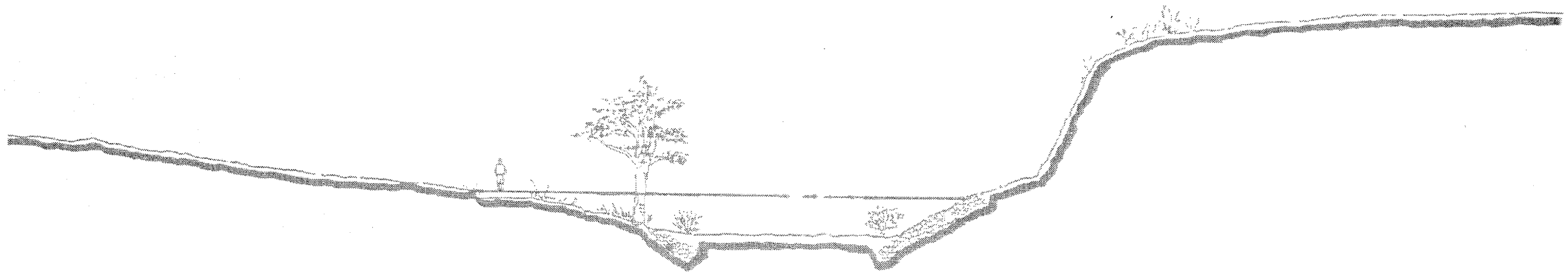


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Fort Collins 970-491-9888 • [www.jengineering.com](http://www.jengineering.com)

**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.

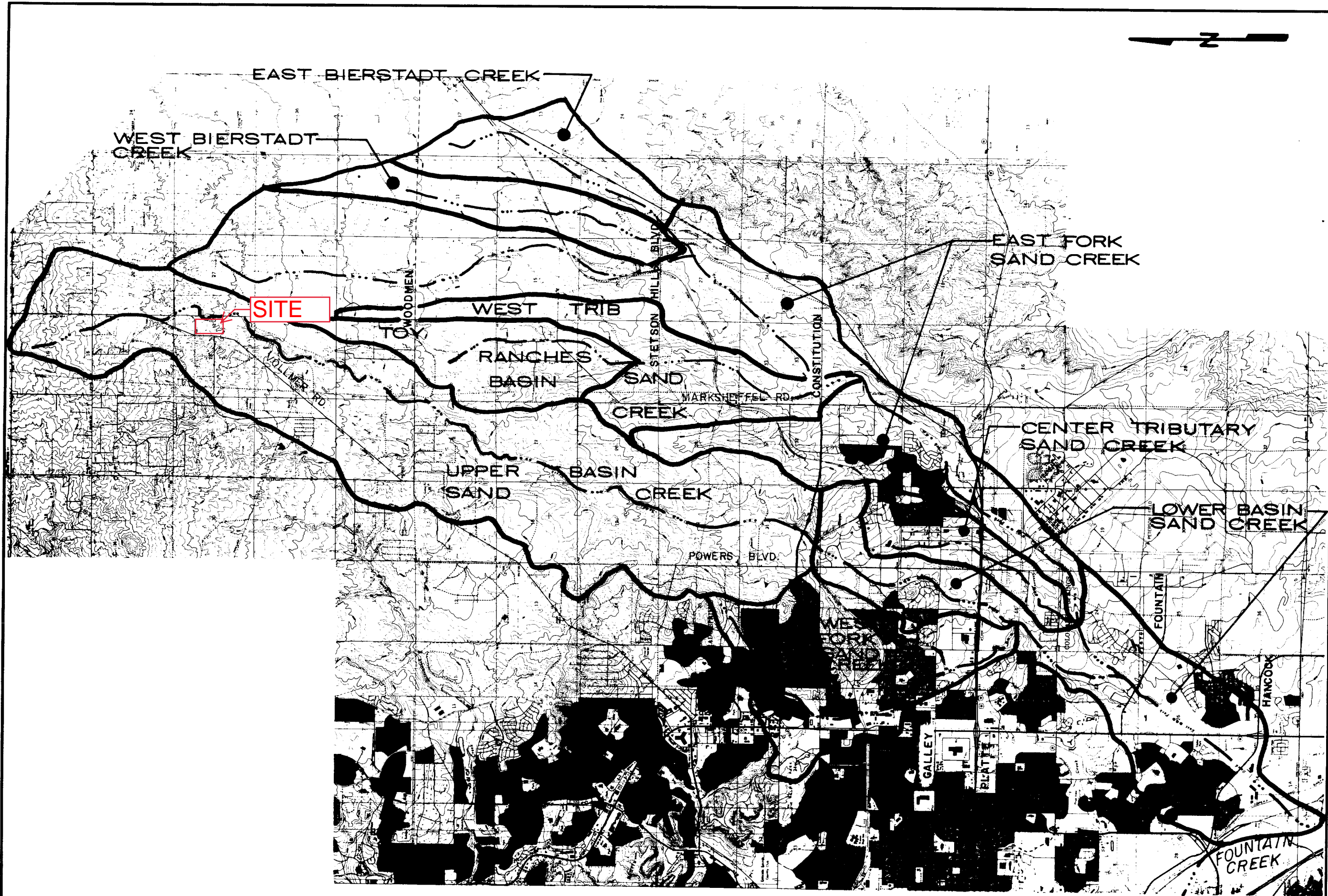
### Property Ownership and Impervious Land Densities

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:	



Fee Development      \*For Information Only

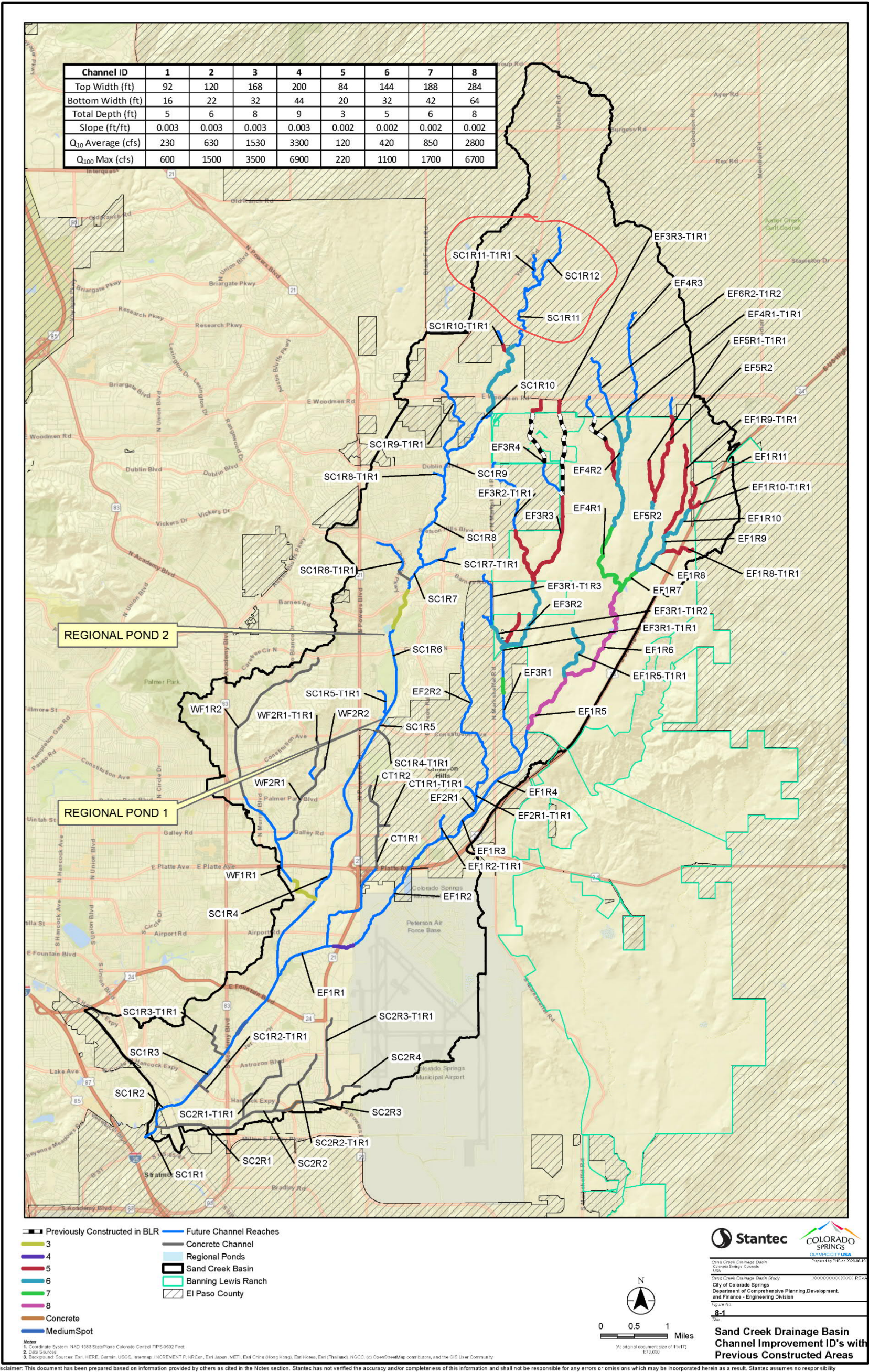


Figure 8-1. Sand Creek Drainage Basin Chanel Improvement IDs with Previous Constructed Areas



DRAINAGE REPORT FOR  
HOMESTEAD NORTH FILING NO. 1 AT STERLING RANCH

December, 2021