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

Prepared For:

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September, 2022
Project No. 25188.00

Prepared By:

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PCD Filing No.:
SF22-13

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

Mike Bramlett, Colorado P.E. 32314
For and On Behalf of JR Engineering, LLC

COLORADO LICENSED MIKE BRAMLETT MB 32314 9/9/22 PROFESSIONAL ENGINEER

DEVELOPER'S STATEMENT:

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

Business Name: SR Land, LLC

By:

Title: MANAGER

Address: 20 Boulder Crescent, Suite 200
Colorado Springs, CO 80903

El Paso County:

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

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

Date

Conditions:

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PURPOSE

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

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, 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 per Sand Creek Channel Design Report JR Engineering, October 2021-Draft; corresponds to PCD project No CD-20-004.

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

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. It is anticipated that the plat for Homestead North Filing No. 1, will be recorded prior to a LOMR for the channel improvements. The floodplain elevations will not adversely impact the site after the LOMR is submitted and are anticipated to meet a no rise condition.

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 offsite basins E1 – E6.2. 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 (Q5 = 1.1 cfs, Q100 = 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, flows through basin H1, and outfalls into Sand Creek.

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, flowing through basin H3 to DP 3h, and outfalls into Sand Creek.

Basin E-3 (Q5 = 2.2 cfs, Q100 = 13.7 cfs) is 12.39 acres of undeveloped land adjacent to the western portion of Vollmer Road. Runoff from this basin drains offsite into a roadside swale adjacent to Vollmer Road, flowing through basin H3 to DP3h.

Basin E-4 (Q5 = 9.9 cfs, Q100 = 72.7 cfs) is 70.9 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 5o to Sand Creek.

Basin E-6.1 (Q5 = 17.7 cfs, Q100 = 130.0 cfs) is 124.9 acres of undeveloped land that drains to the south directly into sand creek at design point 6.1o.

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 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 45.2 acres of undeveloped land covered in native prairie grass at DP 1h.

Basin H2 (Q5 = 3.5 cfs, Q100 = 26.0 cfs) is 16.1 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 = 5.9 cfs, Q100 = 40.8 cfs) is 28.4 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.

PROPOSED DRAINAGE CONDITIONS

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.

Basin C2.1 0.20 acres and 91% percent impervious, is comprised of single-family lots, and the southeastern 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 northwestern 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 15' type R and 5' type R sump inlets. 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 Wheatland Drive and Harvey Logan Drive, single-family lots, and the northwestern 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 1.66 acres and 62.9% 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=3.5 cfs, Q_{100}=7.2 cfs) from basin C3.2 drains to design point 3.2C.

Basin C4.1 6.34 acres and 65% percent impervious, is comprised of single-family lots, and the local residential road Texas Jack Drive 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 15' type R and 5' type R sump inlets. The total runoff from basins C1, C2.1, C2.2, C2.3 and C4.1 is collected within the sump inlet.

Basin C4.2 3.59acres and 57% percent impervious, is comprised of a local road Texas Jack Drive, a right in right out with access to Vollmer Road and single-family lots. Runoff (Q_5=5.9 cfs, Q_{100}=13.1 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 southeastern 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 2.59 acres and 20% 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 224.4 acres and is 10.3 % impervious. Pond C has been graded in to fit the design volume, as shown in Appendix C of this report. This pond will be built in filing 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)
WQCV	3.32	1.288	0.7
5 Year	6.22	4.310	20.6
100 Year	9.94	9.263	173.9

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 1.77 acres and is 40.1% 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 runoff is then piped at design point 1.1D in confluence with upstream runoff from the inlet collect at design point 1o. From here on the runoff is piped with upstream runoff from basin OS1 into the Vollmer storm sewer system.

Basin D2 has a tributary area of 1.44 acres and is 56.4% impervious. Basin D2 consists of the northeast portion of Vollmer road (Rural Cross Section). Runoff from basin D2 (Q_5=2.8 cfs, Q_{100}=6.6 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 OS1and 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 Vollmer road with curb and gutter. 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 Vollmer road with curb and gutter. 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 with curb and gutter. 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 7D in the 100 year event.

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 0.75 Acres and is 79 % impervious. Basin D7 (Q_5=2.8 cfs, Q_{100}=5.3 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 0.72 Acres and is 69% 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 15' 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}=190.9cfs) 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 into pond C where it is detained, treated for water quality and then the runoff is discharged directly into Sand Creek.

Basin OS3 has a tributary area of 11.98 Acres is 2.0 % impervious. The runoff from this basin (Q_5=2.2 cfs, Q_{100}=12.6 cfs) sheet flows towards Vollmer road and is captured within an existing ditch along the west side of Vollmer Road and corresponds to design point 3o. The Existing roadside ditch will channel flow south along Vollmer Road to existing inlets designed with the Homestead at Sterling Ranch Filing No.1 Final Drainage Report, see the associated drainage map in Appendix E. Runoff from this basin was also accounted for in the design of the proposed 15' type r inlet at design pond 8D and associated storm pipe. In the future, this side of Vollmer is expect to have a paved walk and runoff was accounted to drain directly onto Vollmer Road to the inlet at design point 8D and be piped to Pond C. In the interim condition, flow will continue to accumulate in the roadside ditch until the west side of Vollmer Rd is developed.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

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

HYDROLOGIC CRITERIA

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

Table 3 - 1-hr Point Rainfall Data

Storm	Rainfall (in.)
5-year	1.50
100-year	2.52

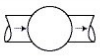
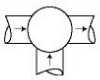
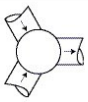
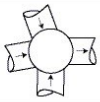
HYDRAULIC CRITERIA

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

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. Runoff from the majority of offsite area will sheet flow into an interim overflow structure at DP 2o at an interim mh with a grate overflow and into a 48 inch RCP pipe. These flows will continue to design point 8D where the rest of the offsite flow is being collected after running through design point 3o. From there, it all flows to pond C through a 60 inch RCP pipe. Runoff from Vollmer is captured within type D inlets and swales at DP 1D and DP 2D for the northern portion of improvements, as shown in the Drainage Map in Appendix D. For the southern portion of Vollmer, ending at Briargate, runoff will be captured in a series of on-grade type r inlets. Runoff in the filing one subdivision will be captured in on-grade type r inlets and flow through 18 inch RCP pipes. Directly north of the pond C the runoff will be captured within two sump inlets at DP 4C and DP 5C; an overflow path has been provided, if the sump inlets clog to pond C. Runoff from Filing One and the offsite runoff, Vollmer improvements are dissipated in two separate forebays. For additional information on design points, runoff, routing of flow, refer to the Drainage Map in Appendix D of this report and the proposed calculations in Appendix B of this report. The proposed pond was 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 700th single family lot within the boundaries of the approved Sterling Ranch Sketch Plan and the completion of all said improvements no later than the 800th 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 areas for the site is serviced by an extended full spectrum water quality / detention pond (i.e) Pond C. 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. Water quality for Sterling Ranch Road and Briargate Parkway is being provided for in the proposed interim detention ponds FSD14A and FSD16 shown in the Sterling Ranch Road and Briargate Parkway GEC plans and the associated drainage letter; PCD CDR221.

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. Maintenance is provided for pond C at two locations with 12-foot access roads. The maintenance is provided off Wheatland Drive for two the two forebays and outlet structure. The maintenance drive for the Sand Creek improvements is provided

off Wheatland drive, and a turnaround is provided directly adjacent to the Sand Creek and Briargate Bridge crossing.

DRAINAGE AND BRIDGE FEES

The site lies within the Sand Creek Drainage Basin. The drainage and bridge fee is presented within the table below; refer to the Drainage and Bridge Fees for Homestead North Filing 1 calculation sheet presented in Appendix B for additional information.

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**
24.81	$21,814	$8,923	$541,225	$221,388

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.

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

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.	$ 1,546,677	$ 1,546,677.00	$ 1,546,677.00
				Sub-Total	$ 1,546,677.00	$ 1,546,677.00

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

Sterling Ranch Deferred Drainage Fees Analysis
Reimbursable Costs associated with DBPS Segment 159 and 164, Segment 169 and 186

Reimbursable Estimate Segment 159 and 164 from SR F2 FDR (SF-2015)	$1,918,065.00
Reimbursable Estimate Segment 169 and 186 from HN F1 FDR (SF-2213)	$611,628.00
Subtotal Reimb. Costs associated with DBPS Segments 159-164, 169-186	**$2,529,693.00**
Earlier Plats Deferred Drainage Fees (Branding Iron F1 & Homestead F1)	$219,540.55
SR F2 (SF-2015) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	$400,855.70
SR F3 (SF-2132) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	$214,430.47
HN F1 (SF-2213) Drainage Fees Deferred per LDC section 8.5.5.C.3.b(ii)	**$541,225.00**
Subtotal Deferred Drainage Fees	**$1,376,051.72**
Unused Reimb. Costs associated with DBPS Segments 159-164, 169-186	$1,153,641.28

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

Financial Assurance Estimate Briargate Parkway Bridge from CDR 2113	$1,546,676.98
Financial Assurance Estimate Sterling Ranch Road Bridge from CDR 226	$990,016.80
Subtotal Reimb. Costs associated with BGP and SR Rd. Bridges	**$2,536,693.78**
SR F3 (SF-2132) Bridge Fees Deferred per LDC section 8.5.5.C.3.b(ii)	$87,709.60
HN F1 (SF-2213) Bridge Fees Deferred per LDC section 8.5.5.C.3.b(ii)	**$221,388.00**
Subtotal Deferred Bridge Fees	**$309,097.60**
Unused Reimb. Costs associated with Briargate Parkway and SR Road Bridges	$2,227,596.18

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 pond was 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

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, October 2021-Draft

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APPENDIX

Appendix A – Vicinity Map, Soil Descriptions, FEMA Floodplain Map
Appendix B – Hydrologic Calculations
Appendix C – Hydraulic Calculations
Appendix D – Drainage Maps
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PURPOSE

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

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, 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 per Sand Creek Channel Design Report JR Engineering, October 2021-Draft; corresponds to PCD project No CD-20-004.

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

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. It is anticipated that the plat for Homestead North Filing No. 1, will be recorded prior to a LOMR for the channel improvements. The floodplain elevations will not adversely impact the site after the LOMR is submitted and are anticipated to meet a no rise condition.

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 offsite basins E1 – E6.2. 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 (Q5 = 1.1 cfs, Q100 = 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, flows through basin H1, and outfalls into Sand Creek.

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, flowing through basin H3 to DP 3h, and outfalls into Sand Creek.

Basin E-3 (Q5 = 2.2 cfs, Q100 = 13.7 cfs) is 12.39 acres of undeveloped land adjacent to the western portion of Vollmer Road. Runoff from this basin drains offsite into a roadside swale adjacent to Vollmer Road, flowing through basin H3 to DP3h.

Basin E-4 (Q5 = 9.9 cfs, Q100 = 72.7 cfs) is 70.9 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 5o to Sand Creek.

Basin E-6.1 (Q5 = 17.7 cfs, Q100 = 130.0 cfs) is 124.9 acres of undeveloped land that drains to the south directly into sand creek at design point 6.1o.

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 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 45.2 acres of undeveloped land covered in native prairie grass at DP 1h.

Basin H2 (Q5 = 3.5 cfs, Q100 = 26.0 cfs) is 16.1 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 = 5.9 cfs, Q100 = 40.8 cfs) is 28.4 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.

PROPOSED DRAINAGE CONDITIONS

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.

Basin C2.1 0.20 acres and 91% percent impervious, is comprised of single-family lots, and the southeastern 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 northwestern 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 15' type R and 5' type R sump inlets. 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 Wheatland Drive and Harvey Logan Drive, single-family lots, and the northwestern 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 1.66 acres and 62.9% 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=3.5 cfs, Q_{100}=7.2 cfs) from basin C3.2 drains to design point 3.2C.

Basin C4.1 6.34 acres and 65% percent impervious, is comprised of single-family lots, and the local residential road Texas Jack Drive 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 15' type R and 5' type R sump inlets. The total runoff from basins C1, C2.1, C2.2, C2.3 and C4.1 is collected within the sump inlet.

Basin C4.2 3.59acres and 57% percent impervious, is comprised of a local road Texas Jack Drive, a right in right out with access to Vollmer Road and single-family lots. Runoff (Q_5=5.9 cfs, Q_{100}=13.1 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 southeastern 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 2.59 acres and 20% 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 224.4 acres and is 10.3 % impervious. Pond C has been graded in to fit the design volume, as shown in Appendix C of this report. This pond will be built in filing 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)
WQCV	3.32	1.288	0.7
5 Year	6.22	4.310	20.6
100 Year	9.94	9.263	173.9

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 1.77 acres and is 40.1% 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 runoff is then piped at design point 1.1D in confluence with upstream runoff from the inlet collect at design point 1o. From here on the runoff is piped with upstream runoff from basin OS1 into the Vollmer storm sewer system.

Basin D2 has a tributary area of 1.44 acres and is 56.4% impervious. Basin D2 consists of the northeast portion of Vollmer road (Rural Cross Section). Runoff from basin D2 (Q_5=2.8 cfs, Q_{100}=6.6 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 OS1and 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 Vollmer road with curb and gutter. 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 Vollmer road with curb and gutter. 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 with curb and gutter. 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 7D in the 100 year event.

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 0.75 Acres and is 79 % impervious. Basin D7 (Q_5=2.8 cfs, Q_{100}=5.3 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 0.72 Acres and is 69% 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 15' 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}=190.9cfs) 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 into pond C where it is detained, treated for water quality and then the runoff is discharged directly into Sand Creek.

Basin OS3 has a tributary area of 11.98 Acres is 2.0 % impervious. The runoff from this basin (Q_5=2.2 cfs, Q_{100}=12.6 cfs) sheet flows towards Vollmer road and is captured within an existing ditch along the west side of Vollmer Road and corresponds to design point 3o. The Existing roadside ditch will channel flow south along Vollmer Road to existing inlets designed with the Homestead at Sterling Ranch Filing No.1 Final Drainage Report, see the associated drainage map in Appendix E. Runoff from this basin was also accounted for in the design of the proposed 15' type r inlet at design pond 8D and associated storm pipe. In the future, this side of Vollmer is expect to have a paved walk and runoff was accounted to drain directly onto Vollmer Road to the inlet at design point 8D and be piped to Pond C. In the interim condition, flow will continue to accumulate in the roadside ditch until the west side of Vollmer Rd is developed.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

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

HYDROLOGIC CRITERIA

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

Table 3 - 1-hr Point Rainfall Data

Storm	Rainfall (in.)
5-year	1.50
100-year	2.52

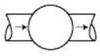
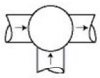
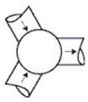
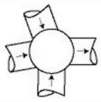
HYDRAULIC CRITERIA

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

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. Runoff from the majority of offsite area will sheet flow into an interim overflow structure at DP 2o at an interim mh with a grate overflow and into a 48 inch RCP pipe. These flows will continue to design point 8D where the rest of the offsite flow is being collected after running through design point 3o. From there, it all flows to pond C through a 60 inch RCP pipe. Runoff from Vollmer is captured within type D inlets and swales at DP 1D and DP 2D for the northern portion of improvements, as shown in the Drainage Map in Appendix D. For the southern portion of Vollmer, ending at Briargate, runoff will be captured in a series of on-grade type r inlets. Runoff in the filing one subdivision will be captured in on-grade type r inlets and flow through 18 inch RCP pipes. Directly north of the pond C the runoff will be captured within two sump inlets at DP 4C and DP 5C; an overflow path has been provided, if the sump inlets clog to pond C. Runoff from Filing One and the offsite runoff, Vollmer improvements are dissipated in two separate forebays. For additional information on design points, runoff, routing of flow, refer to the Drainage Map in Appendix D of this report and the proposed calculations in Appendix B of this report. The proposed pond was 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 700th single family lot within the boundaries of the approved Sterling Ranch Sketch Plan and the completion of all said improvements no later than the 800th 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 areas for the site is serviced by an extended full spectrum water quality / detention pond (i.e) Pond C. 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. Water quality for Sterling Ranch Road and Briargate Parkway is being provided for in the proposed interim detention ponds FSD14A and FSD16 shown in the Sterling Ranch Road and Briargate Parkway GEC plans and the associated drainage letter; PCD CDR221.

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. Maintenance is provided for pond C at two locations with 12-foot access roads. The maintenance is provided off Wheatland Drive for two the two forebays and outlet structure. The maintenance drive for the Sand Creek improvements is provided

off Wheatland drive, and a turnaround is provided directly adjacent to the Sand Creek and Briargate Bridge crossing.

DRAINAGE AND BRIDGE FEES

The site lies within the Sand Creek Drainage Basin. The drainage and bridge fee is presented within the table below; refer to the Drainage and Bridge Fees for Homestead North Filing 1 calculation sheet presented in Appendix B for additional information.

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**
24.81	$21,814	$8,923	$541,225	$221,388

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.

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

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

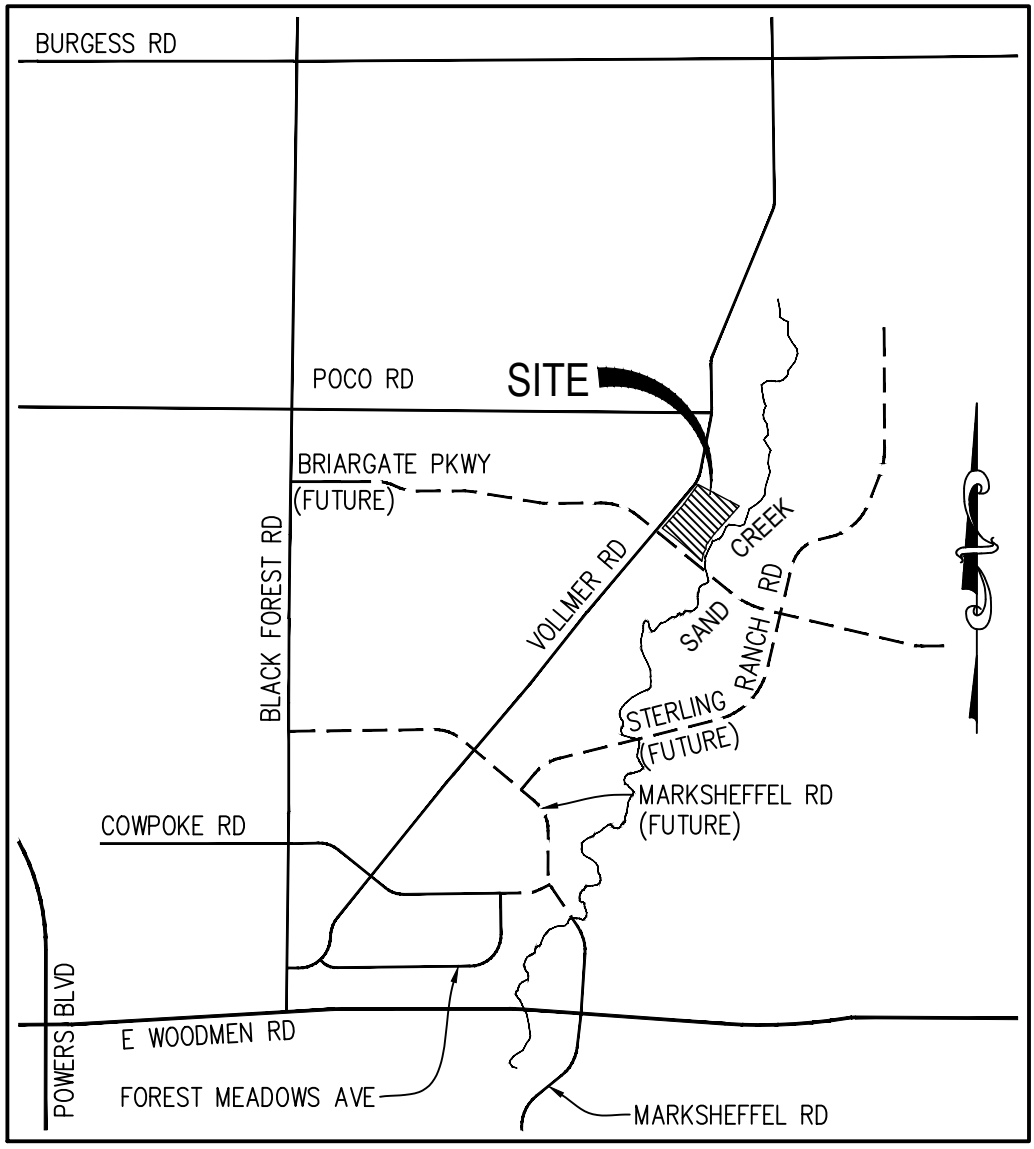
SUMMARY

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 pond was 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

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, October 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

104° 40' 22" W
104° 39' 45" W
38° 58' 40" N
38° 58' 2" N
528400
528500
528600
528700
528800
528900
529000
529100
529200
4314300
4314200
4314100
4314000
4313900
4313800
4313700
4313600
4313500
4313400
4313300
4313200
Poco Rd
Vollmer Rd
Vollmer
71
Sand Creek
Soil Map may not be valid at this scale.
Map Scale: 1:5,730 if printed on A portrait (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 250 500 1000 1500
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

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

Date(s) aerial images were photographed: 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%
Totals for Area of Interest			**90.2**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

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

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

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

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

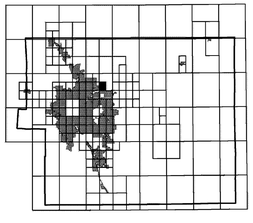
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

El Paso County Vertical Datum Offset Table

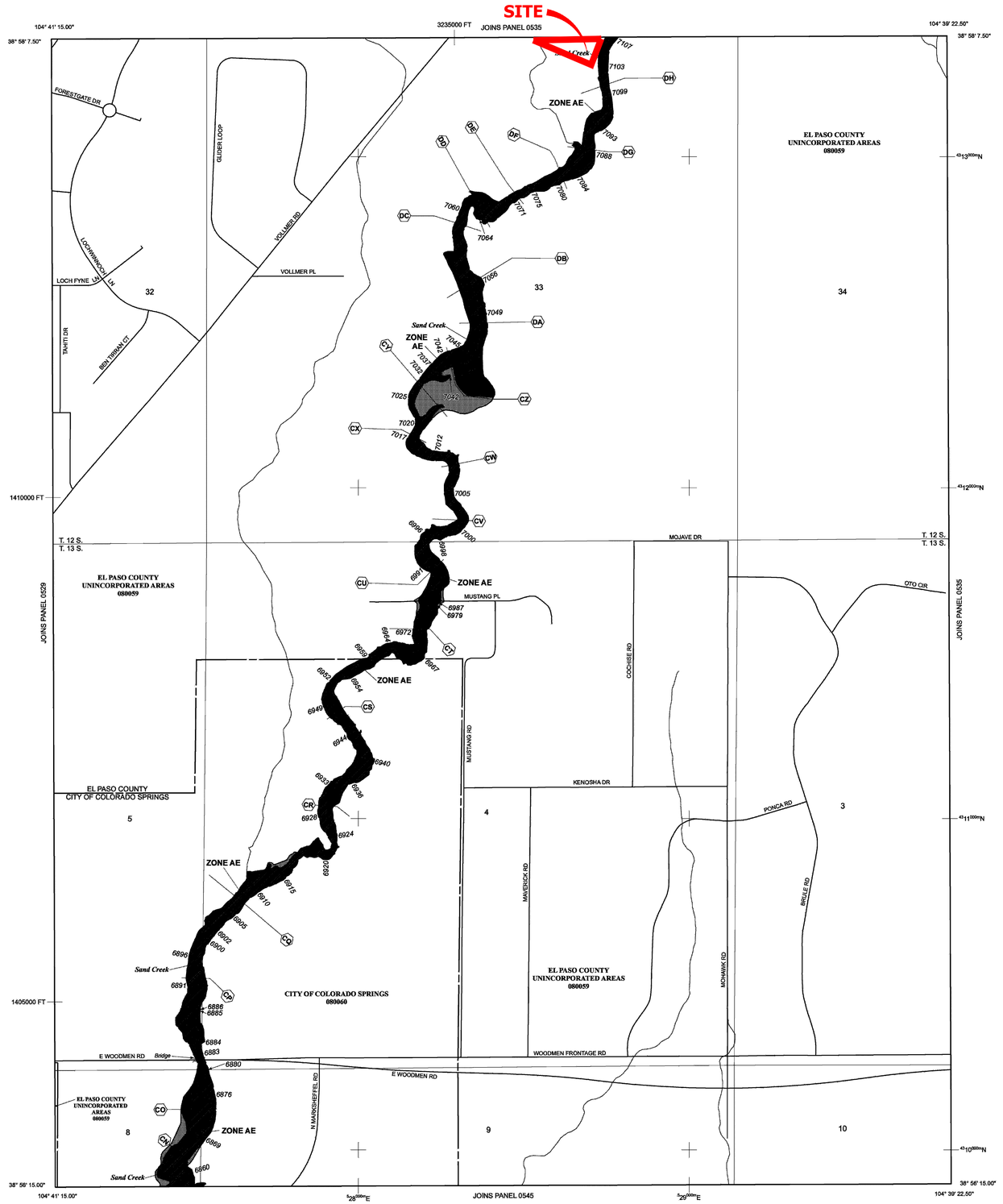
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



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

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



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

LEGEND

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

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

ZONE A No Base Flood Elevations determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

Floodplain boundary

Floodway boundary

Zone D Boundary

CBRS and OPA boundary

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

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

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

A — A — Cross section line

23 — 23 — Transect line

97° 07' 30.00"
32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

4775000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13

6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection

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

M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0533G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 533 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0533	G
EL PASO COUNTY	080059	0533	G

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

MAP NUMBER
08041C0533G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

X:\251000.all\251800\Drawings\Working Dwgs\Andrew Joyce\251800 FIRM MAP.dwg, Sheet 1, 4/20/2020 4:23:28 PM, FC

NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

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

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

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

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

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

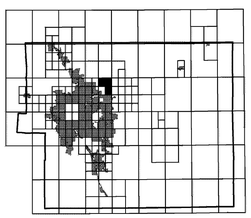
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

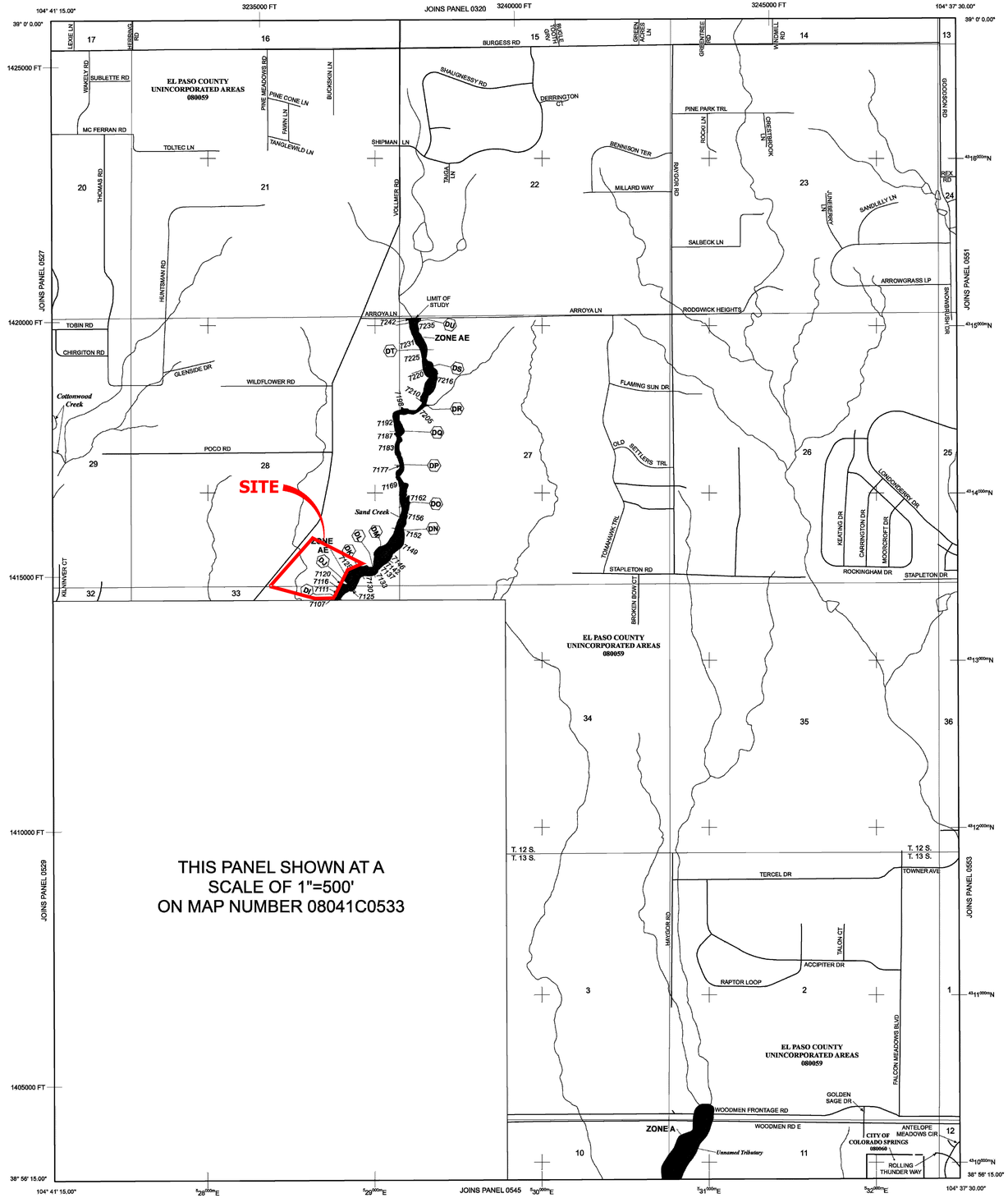
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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



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

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 (EL 987) — 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)

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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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

NFIP — NATIONAL FLOOD INSURANCE PROGRAM

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	080060	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
Location: El Paso County

Project Name: Homestead North
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/13/21

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_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
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	70.90	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	70.90	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	124.90	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	124.90	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	45.20	0.90	0.96	0.38	0.8%	0.45	0.59	0.00	0.0%	0.08	0.35	44.82	2.0%	0.09	0.36	2.8%
H2	16.10	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.08	0.35	16.10	2.0%	0.08	0.35	2.0%
H3	28.40	0.90	0.96	0.22	0.8%	0.45	0.59	0.00	0.0%	0.08	0.35	28.18	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: 6/13/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
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	70.90	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	124.90	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	45.20	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	16.10	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	28.40	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:

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

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

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

Table 6-2. NRCS Conveyance factors, K

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

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

Where:

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

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

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

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: 6/13/21

		DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1o	E-1	4.50	0.14	48.7	0.61	1.76	1.1															
	1h	H1	45.20	0.09	34.7	3.92	2.26	8.9	48.7	4.53	1.76	8.0											Drains to swale H1 and E1
	2h	H2	16.10	0.08	25.1	1.29	2.75	3.5	48.7	5.82	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	28.40	0.09	31.3	2.45	2.42	5.9	47.4	18.07	1.80	32.5											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	70.90	0.08	49.0	5.67	1.75	9.9															
	5o	E-5	18.80	0.08	34.9	1.50	2.26	3.4	49.0	7.17	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	124.90	0.08	48.1	9.99	1.77	17.7	49.0	21.13	1.75	36.9											Total Runoff E-6, E-4, E-5 Runoff makes it's way into sand creek

Notes:

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: 6/13/21

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1o	E-1	4.50	0.39	48.7	1.76	2.94	5.2															
	1h	H1	45.20	0.36	34.7	16.05	3.80	61.0	48.7	17.81	2.94	52.4											Drains to swale H1 and E1
	2h	H2	16.10	0.35	25.1	5.64	4.61	26.0	48.7	23.45	2.94	69.0											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	28.40	0.35	31.3	10.07	4.05	40.8	47.4	74.07	3.01	223.2											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	70.90	0.35	49.0	24.82	2.93	72.7															
	5o	E-5	18.80	0.35	34.9	6.58	3.78	24.9	49.0	31.40	2.93	92.0											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	124.90	0.35	48.1	43.72	2.97	130.0	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 North Fil. 1
Location: El Paso County

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

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_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
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	1.66	0.90	0.96	0.42	25.1%	0.45	0.59	0.96	37.7%	0.08	0.35	0.28	0.3%	0.50	0.64	63.2%
C4.1	6.34	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	65.5%
C4.2	3.59	0.90	0.96	0.59	16.4%	0.45	0.59	2.20	39.8%	0.08	0.35	0.65	0.4%	0.44	0.58	56.6%
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	2.59	0.90	0.96	0.27	10.6%	0.45	0.59	0.32	8.1%	0.08	0.35	1.89	1.5%	0.21	0.43	20.2%
36" Pipe w/ Forebay	23.23															61.3%
D1	1.77	0.90	0.96	0.69	38.8%	0.45	0.59	0.00	0.0%	0.08	0.35	1.14	1.3%	0.40	0.60	40.1%
D2	1.44	0.90	0.96	0.79	54.9%	0.45	0.59	0.00	0.0%	0.08	0.35	1.02	1.4%	0.55	0.78	56.4%
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	0.75	0.90	0.96	0.59	78.5%	0.45	0.59	0.00	0.0%	0.08	0.35	0.14	0.4%	0.72	0.82	78.9%
D8	0.72	0.90	0.96	0.49	68.8%	0.45	0.59	0.00	0.0%	0.08	0.35	0.17	0.5%	0.64	0.74	69.3%
OffSite Basins																
OS1	2.84	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	11.98	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%
60" Pipe w/ Forebay	201.22															4.4%
Pond C	224.4															10.3%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Homestead North Fil. 1
Location: El Paso County

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
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	1.66	B	63%	0.49	0.60	50	2.0%	6.2	365	1.1%	20.0	2.1	2.9	9.1	415.0	18.6	9.1
C4.1	6.34	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	3.59	B	57%	0.44	0.58	150	2.0%	11.6	367	4.6%	22.0	4.7	1.3	12.9	517.0	18.1	12.9
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	2.59	B	20%	0.21	0.43	15	2.0%	5.0	160	0.5%	20.0	1.4	1.9	6.8	175.0	25.8	6.8
D1	1.77	B	40%	0.40	0.60	30	1.0%	6.9	1365	2.5%	15.0	2.4	9.6	16.5	1395.0	29.0	16.5
D2	1.44	B	56%	0.55	0.78	30	1.0%	5.4	1365	2.5%	15.0	2.4	9.6	15.0	1395.0	24.9	15.0
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	0.75	B	79%	0.72	0.82	15	2.0%	2.1	550	2.0%	20.0	4.2	2.2	4.3	565.0	15.8	5.0
D8	0.72	B	69%	0.64	0.74	15	2.0%	2.6	550	2.0%	20.0	5.2	1.8	4.3	565.0	17.7	5.0
OS1	2.84	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	11.98	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_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

Equation 6-2 $$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)

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-2
TIME OF CONCENTRATION

Subdivision: Homestead North Fil. 1
Location: El Paso County

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

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

t_t = channelized flow time (minutes).

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

Grassed waterway	15
Paved areas and shallow paved swales	20

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

Where:

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

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

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

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

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

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

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	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	0.52	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	3.59	0.44	12.9	1.57	3.74	5.9					0.00	0	2.84					1010	3.4	5.0	On-Grade Type R Inlet, by pass to 4.2c
	4.2i								12.9	1.57	3.74	5.9											Captured runoff from on-grade type R -Inlet DP 4.2C
	4C	C4.1	6.34	0.49	12.0	3.13	3.85	12.1	17.9	5.77	3.25	18.8											Sump Inlet
	3.1								12.9	1.26	3.74	4.7				4.7							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								26.1	3.38	2.69	9.1				9.1							Tributary to basins C1 C3.1, C2.3 and C2.1 and C4.2 piped in xx" conduit
	3.4								26.1	9.65	2.69	26.0				26.0							Runoff at manhole 3.4
	3.2c	C3.2	1.66	0.49	9.1	0.82	4.27	3.5	9.1	0.82	4.27	3.5											Recives by-pass flow from DP 3.1c
	5C	C5	0.16	0.74	6.4	0.12	4.79	0.6	9.1	0.94	4.27	4.0											Sump Inlet
	3.5								26.1	11.41	2.69	30.7											Runoff into Forebay
	6C	C6	2.59	0.21	6.8	0.54	4.70	2.5															
	o1	OS1	2.84	0.08	14.5	0.23	3.57	0.8															offsite basin to type D inlet
	1d	D1	1.77	0.40	16.5	0.71	3.38	2.4															Tributary basin D1 NW portion of Vollmer in Swale

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

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

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1.1d								16.5	0.94	3.38	3.2											Tributary basin D1 and OS1 NW portion of Vollmer in Swale
	2d	D2	1.44	0.55	15.0	0.79	3.52	2.8															Tributary basin D2 SE portion of Vollmer in Swale
	1.2d								16.5	1.73	3.38	5.8											
	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								16.5	1.94	3.38	6.6											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 Runofff 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	18.22	1.79	32.7											Tributary basins: 1D-6D and OS1 and OS2 Runoff piped
	3o	OS3	11.98	0.08	47.6	0.96	1.79	1.7															
	8d	D8	0.72	0.64	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	0.75	0.72	5.0	0.54	5.17	2.8	7.7	0.54	4.53	2.4											Runoff captured on ongrade inlet
	2.2d								47.6	1.96	1.79	3.5											Tributary basins: D7,D8 and OS1 Runoff piped
	1.7d								47.6	20.18	1.79	36.1											Tributary basins: 1D-4D and OS1, OS2 and OS3 Runoff piped to Sand Creek
	5								47.6	31.31	1.79	56.0											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 North Fil. 1
Location: El Paso County
Design Storm: 100-Year

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	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	3.59	0.58	12.9	2.09	6.28	13.1					2.60	0.41	2.84					1010	3.4	5.0	On-Grade Type R Inlet, by pass to 4c
	4.2i								12.9	1.68	6.28	10.5											Captured runoff from on-grade type R -Inlet DP 4.2C
	4C	C4.1	6.34	0.63	12.0	4.00	6.47	25.9	17.9	7.65	5.46	41.8											Sump Inlet runoff piped to DP 3.4
	3.1								12.9	1.84	6.28	11.6				11.6							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								26.1	3.90	4.52	17.6				17.6							Tributary to basins C1 C3.1, C2.3 and C2.1 and C4.2 piped in xx" conduit
	3.4								26.1	12.14	4.52	54.9				54.9							Runoff at manhole 3.4
	3.2c	C3.2	1.66	0.60	9.1	1.00	7.18	7.2	9.1	1.06	7.18	7.6											Recives by-pass flow from DP 3.1c
	5C	C5	0.16	0.84	6.4	0.13	8.04	1.0	9.1	1.19	7.18	8.5											Sump Inlet runoff piped to DP 3.5
	3.5								26.1	14.39	4.52	65.0											Runoff into Forebay
	6C	C6	2.59	0.43	6.8	1.11	7.89	8.8															Runoff from pond

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

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

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	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)	
	o1	OS1	2.84	0.35	14.5	1.00	6.00	6.0															offsite basin to type D inlet
	1d	D1	1.77	0.60	16.5	1.06	5.67	6.0															Tributary basin D1 NW portion of Vollmer in Swale
	1.1d								16.5	2.06	5.67	11.7											Tributary basin D1 and OS1 NW portion of Vollmer in Swale - piped in 24" RCP
	2d	D2	1.44	0.78	15.0	1.12	5.91	6.6															Tributary basin D2 SE portion of Vollmer in Swale
	1.2d								16.5	3.18	5.67	18.0											
	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								16.5	3.45	5.67	19.6											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 Runofff 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	68.25	3.01	205.4											Tributary basins: 1D-6D and OS1 and OS2 Runoff piped
	3o	OS3	11.98	0.35	47.6	4.20	3.00	12.6															
	8d	D8	0.72	0.74	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	0.75	0.82	5.0	0.61	8.68	5.3	7.7	0.70	7.60	5.3											Runoff captured on ongrade inlet
	2.2d								47.6	5.34	3.00	16.0											Tributary basins: D7,D8 and OS1 Runoff piped
	1.7d								47.6	73.59	3.00	221.0											Tributary basins: 1D-4D and OS1, OS2 and OS3 Runoff piped to Sand Creek
	5								47.6	87.97	3.00	264.1											Total runoff into pond

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

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

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	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)	

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.

BRIDGE FEE - CALCULATIONS

Subdivision: Homestead North Fil. 1
Location: El Paso County

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

	2022 DRAINAGE AND BRIDGE FEES – HOMESTEAD NORTH FILING 1					
Total Area	**Percent Impervious**	**Impervious Acres (ac)**	**Drainage Fee (Per Imp. Acre)**	**Bridge Fee (Per Imp. Acre)**	**HN F1 Drainage Fee**	**HN F1 Bridge Fee**
43.3	57.3%	24.81	$21,814	$8,923	$541,225	$221,388

Basin ID	Total Platted Area (ac)	Streets/Paved (100% Impervious)		Residential (65% Impervious)		Lawns (2% Impervious)		Basins Total Weighted
		Area (ac)	Weighted % Imp.	Area (ac)	Weighted % Imp.	Area (ac)	Weighted % Imp.	
Homestead Filing 1*	43.32	15.28	35.3%	14.24	21.4%	13.80	0.6%	57.3%

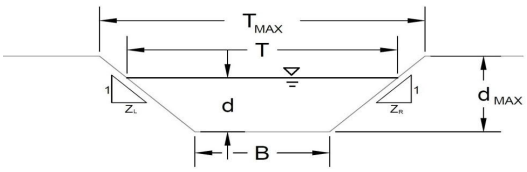
Appendix C
Hydraulic Calculations

Version 4.05 Released March 2017

AREA INLET IN A SWALE

Homestead North

Inlet 1D



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E	B	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0310	ft/ft
Bottom Width	B =	0.10	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	12.00	12.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	1.40	1.49	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	9.2	12.4	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	1.40	1.49	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	2.4	6.0	cfs
Water Depth	d =	1.05	1.33	feet

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'

Version 4.05 Released March 2017

AREA INLET IN A SWALE

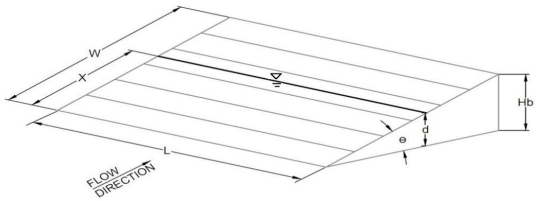
Homestead North

Inlet 1D

Inlet Design Information (Input)

Type of Inlet: CDOT Type D (In Series & Depressed)

Inlet Type = CDOT Type D (In Series & Depressed)



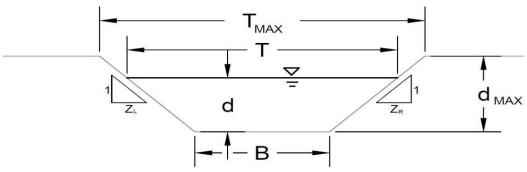
Angle of Inclined Grade (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grade	W =	3.00	feet
Length of Grade	L =	6.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grade	H_B =	0.00	feet
Clogging Factor	C_f =	0.38	
Grate Discharge Coefficient	C_d =	0.72	
Orifice Coefficient	C_o =	0.48	
Weir Coefficient	C_w =	1.53	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	2.05	2.33	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**43.2**	**46.0**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

AREA INLET IN A SWALE

Homestead North

Inlet 2D



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

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D or E	B	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0310	ft/ft
Bottom Width	B =	0.10	ft
Left Side Slope	Z1 =	5.00	ft/ft
Right Side Slope	Z2 =	5.00	ft/ft

Check one of the following soil types:

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

Choose One:
- ○ Non-Cohesive
- ◉ Cohesive
- ○ Paved

		Minor Storm	Major Storm	
Max. Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	12.00	24.00	feet
Max. Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	2.00	2.40	feet

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	4.5	148.0	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	1.19	2.39	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	2.8	6.6	cfs
Water Depth	d =	1.02	1.30	feet

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'

Version 4.05 Released March 2017

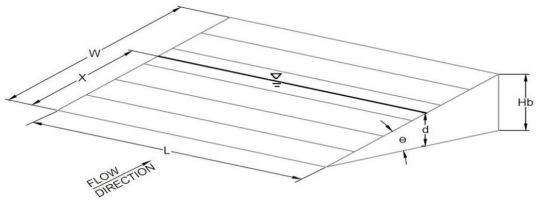
AREA INLET IN A SWALE

Homestead North

Inlet 2D

Inlet Design Information (Input)

Type of Inlet: CDOT Type D (In Series & Depressed) — Inlet Type = CDOT Type D (In Series & Depressed)



Angle of Inclined Grade (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grade	W =	3.00	feet
Length of Grade	L =	6.00	feet
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grade	H_B =	0.00	feet
Clogging Factor	C_f =	0.38	
Grate Discharge Coefficient	C_d =	0.72	
Orifice Coefficient	C_o =	0.48	
Weir Coefficient	C_w =	1.53	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	2.02	2.30	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**42.9**	**45.7**	**cfs**
	Bypassed Flow, Q_b =	**0.0**	**0.0**	**cfs**
	Capture Percentage = Q_a/Q_o = C%	**100**	**100**	**%**

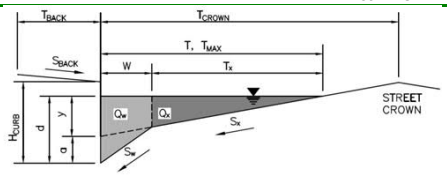
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

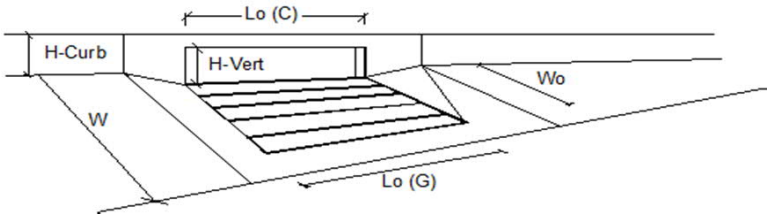
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.0**	**41.9**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	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_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.6**	**1.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**99**	**%**

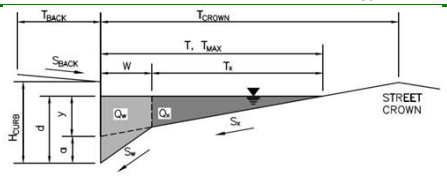
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

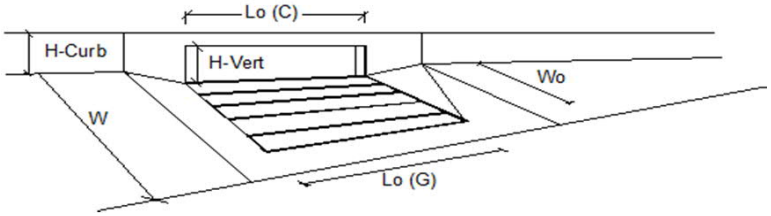
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.0**	**19.4**	**cfs**

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	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	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_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.5**	**1.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

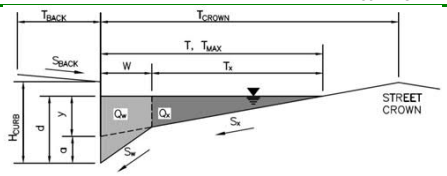
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	33.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

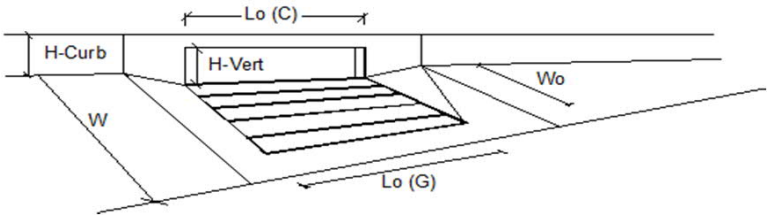
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.8**	**17.8**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.1**	**5.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**88**	**%**

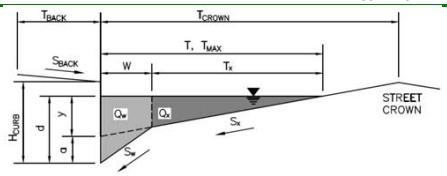
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	33.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

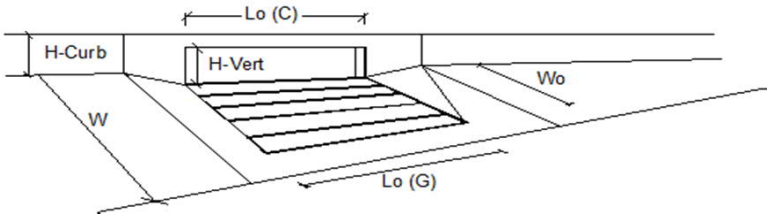
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.8**	**17.8**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.5**	**4.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**96**	**%**

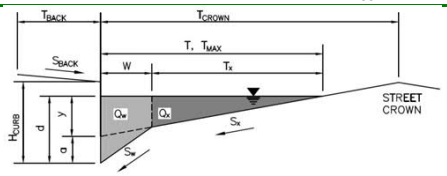
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	33.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

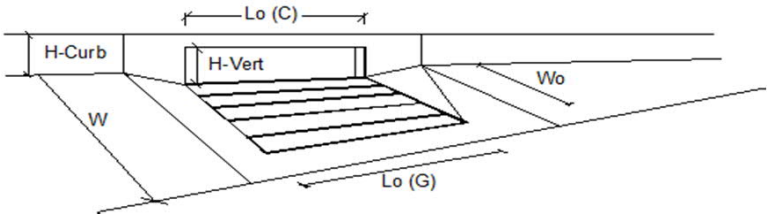
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**19.5**	**19.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.8**	**3.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**99**	**%**

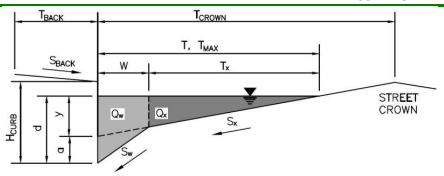
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	33.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

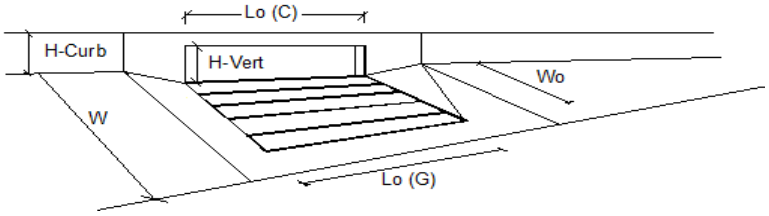
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**19.5**	**19.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.5**	**11.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**81**	**%**

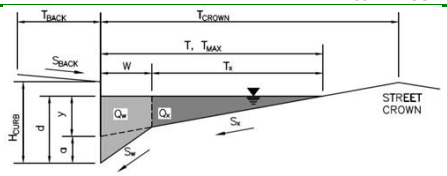
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☑	☑	check = yes

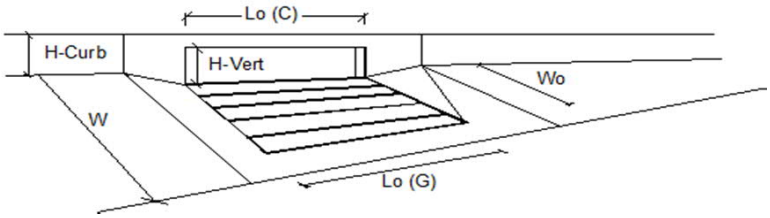
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**24.2**	**44.5**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	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_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**7.0**	**11.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**3.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**99**	**77**	**%**

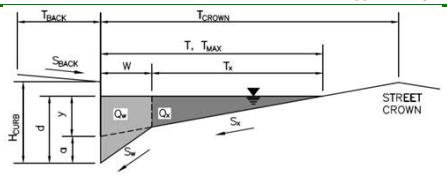
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

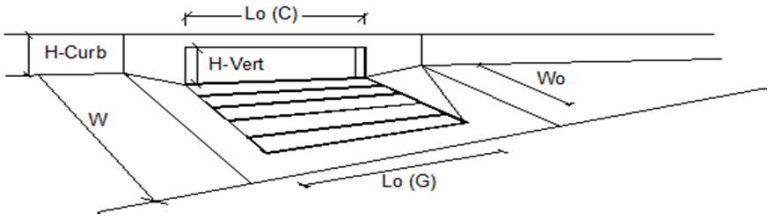
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**16.7**	**16.7**	**cfs**

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	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	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_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.8**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**91**	**%**

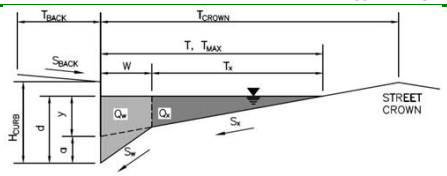
Version 4.05 Released March 2017

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

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

Project: Homestead North

Inlet ID: Inlet DP 4.2C



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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

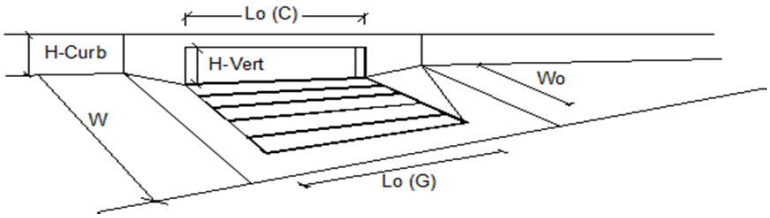
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**16.7**	**16.7**	**cfs**

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	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	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_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.9**	**10.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**81**	**%**

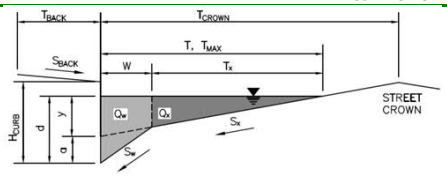
Version 4.05 Released March 2017

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

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

Project: 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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

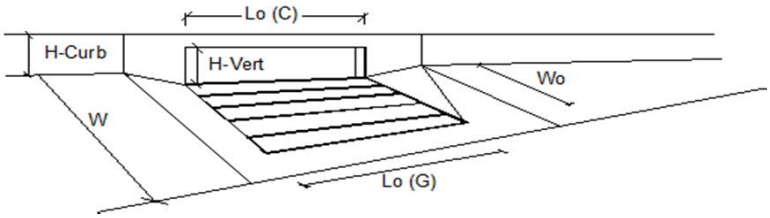
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.7**	**12.3**	**cfs**

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	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	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_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.2**	**1.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**81**	**%**

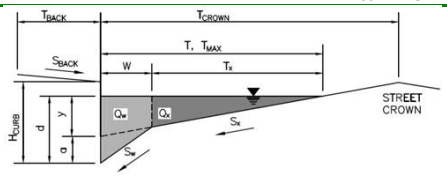
Version 4.05 Released March 2017

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

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

Project: Homestead North

Inlet ID: Inlet DP 4C



Gutter Geometry (Enter data in the blue cells)

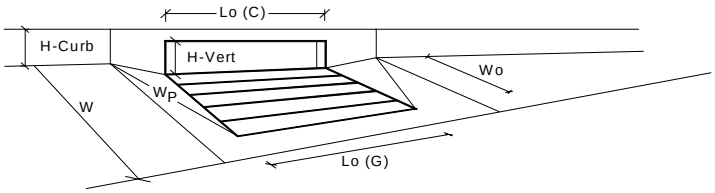
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	9.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.3	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.1	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.34	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.58	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**19.0**	**52.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	18.9	42.0	cfs

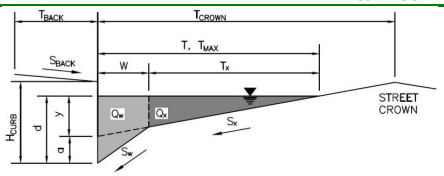
Version 4.05 Released March 2017

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

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

Project: Homestead North

Inlet ID: Inlet DP 5C



Gutter Geometry (Enter data in the blue cells)

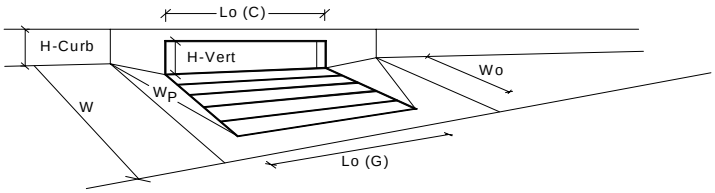
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	9.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.3	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

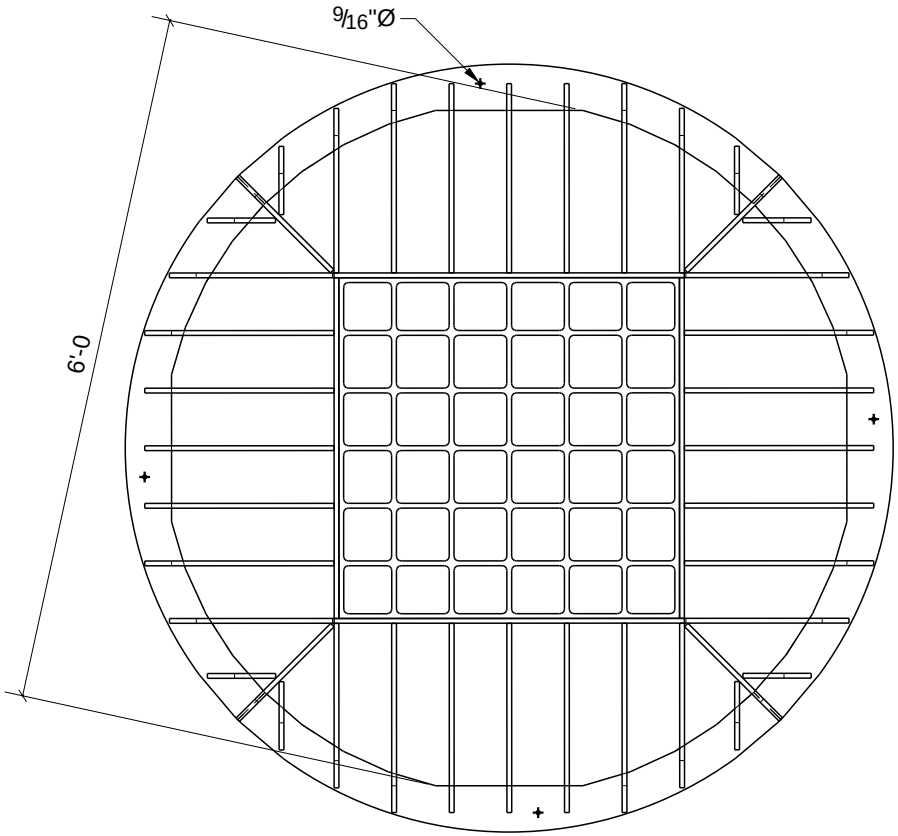


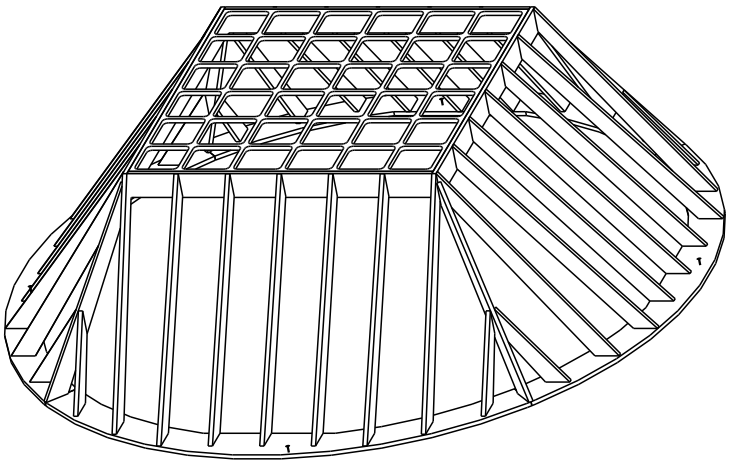
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.8	5.8	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.32	0.32	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.55	0.55	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.78	0.78	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**12.5**	**12.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.0	8.5	cfs

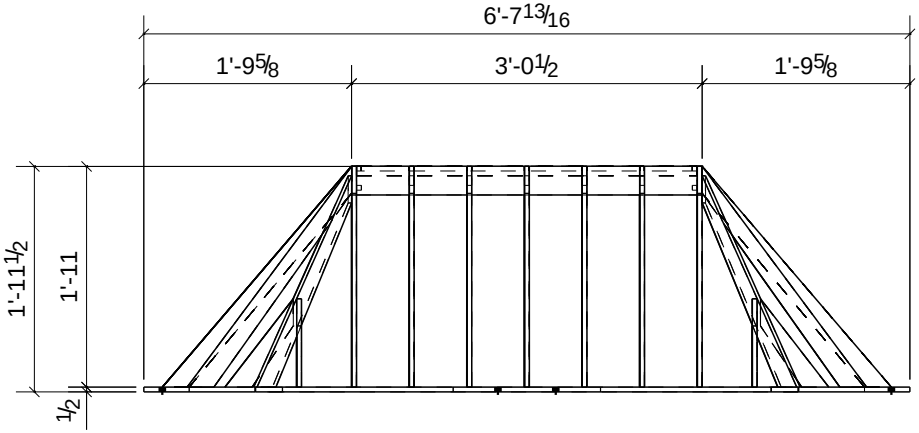
Subdivision: Homestead North - Proposed Conditions
Location: El Paso County
Project Name: Homestead North
Project Number: 25188.00
Calculated By: MAB
Checked By:
Date: 1/12/2022

Design Point - 2o (6 ft. Dia Manhole w/ Trash Rack)
Design flow 190.9 cfs
Orifice Flow Calculation
Q = C*A* square root (2gH)
C = 0.6 A = 28.274 sq ft g = 32.2

Head (ft)	CA	(2GH)	Sqrt (2GH)	Capacity
1	16.9644	64.40	8.025	136.1
2	16.9644	128.80	11.349	192.5
3	16.9644	193.20	13.900	235.8
4	16.9644	257.60	16.050	272.3
5	16.9644	322.00	17.944	304.4
6	16.9644	386.40	19.657	333.5







MADE IN THE U.S.A.

AVAILABLE MATERIALS:
MILD STEEL (NO FINISH) - WGT: 496.7 lbs.
MILD STEEL (GALVANIZED) - WGT: 496.7 lbs.
STAINLESS STEEL - WGT: 496.7 lbs.
ALUMINUM - WGT: 167.8 lbs.

CUSTOM SIZES AVAILABLE

AVAILABLE UPON REQUEST WITH:
ACCESS PORT
ANTI-VORTEX PLATE

TRASHRACKS.com
A DIVISION OF J.R. HOE
101 IRONWOOD ROAD
MIDDLESBORO, KY 40965
PH: (606) 248-5560
FAX: (606) 248-6308
JRHOE.COM

TITLE:
LDR-72
72" ROUND TOP-MOUNT TRASH RACK

SIZE	DWG. NO.	REV.
A	118839	0

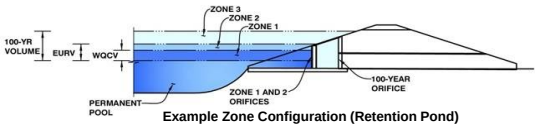
SHEET 1 / 1

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Pond C with offsite flow

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	224.4	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.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.285	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.178	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.) =	6.692	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	10.317	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	16.756	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	21.159	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	27.486	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 4 in.) =	55.496	acre-feet	4.00	inches
Approximate 2-yr Detention Volume =	1.394	acre-feet		
Approximate 5-yr Detention Volume =	2.182	acre-feet		
Approximate 10-yr Detention Volume =	4.471	acre-feet		
Approximate 25-yr Detention Volume =	6.214	acre-feet		
Approximate 50-yr Detention Volume =	6.506	acre-feet		
Approximate 100-yr Detention Volume =	8.395	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.285	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.893	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	6.218	acre-feet
Total Detention Basin Volume =	8.395	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	90	0.002		
7107	--	0.24	--	--	--	331	0.008	51	0.001
7108	--	1.24	--	--	--	7,689	0.177	4,061	0.093
7109	--	2.24	--	--	--	26,604	0.611	21,207	0.487
7110	--	3.24	--	--	--	37,234	0.855	53,126	1.220
7111	--	4.24	--	--	--	43,658	1.002	93,573	2.148
7112	--	5.24	--	--	--	47,762	1.096	139,282	3.197
7113	--	6.24	--	--	--	51,250	1.177	188,788	4.334
7114	--	7.24	--	--	--	54,827	1.259	241,827	5.552
7115	--	8.24	--	--	--	58,544	1.344	298,513	6.853
7116	--	9.24	--	--	--	62,316	1.431	358,943	8.240
7116.75* Spillway	--	9.99	--	--	--	65,152	1.496	406,744	9.338
7117	--	10.24	--	--	--	66,643	1.530	423,218	9.716
7118	--	11.24	--	--	--	70,696	1.623	491,888	11.292
7119	--	12.24	--	--	--	74,859	1.719	564,665	12.963

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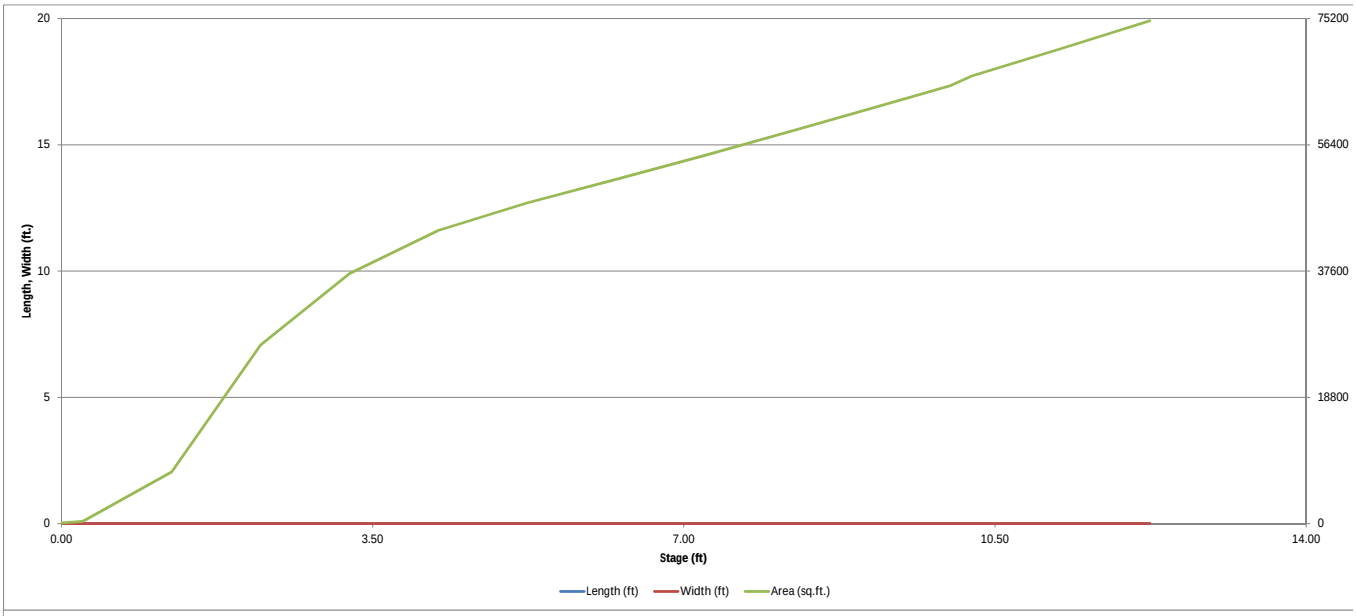
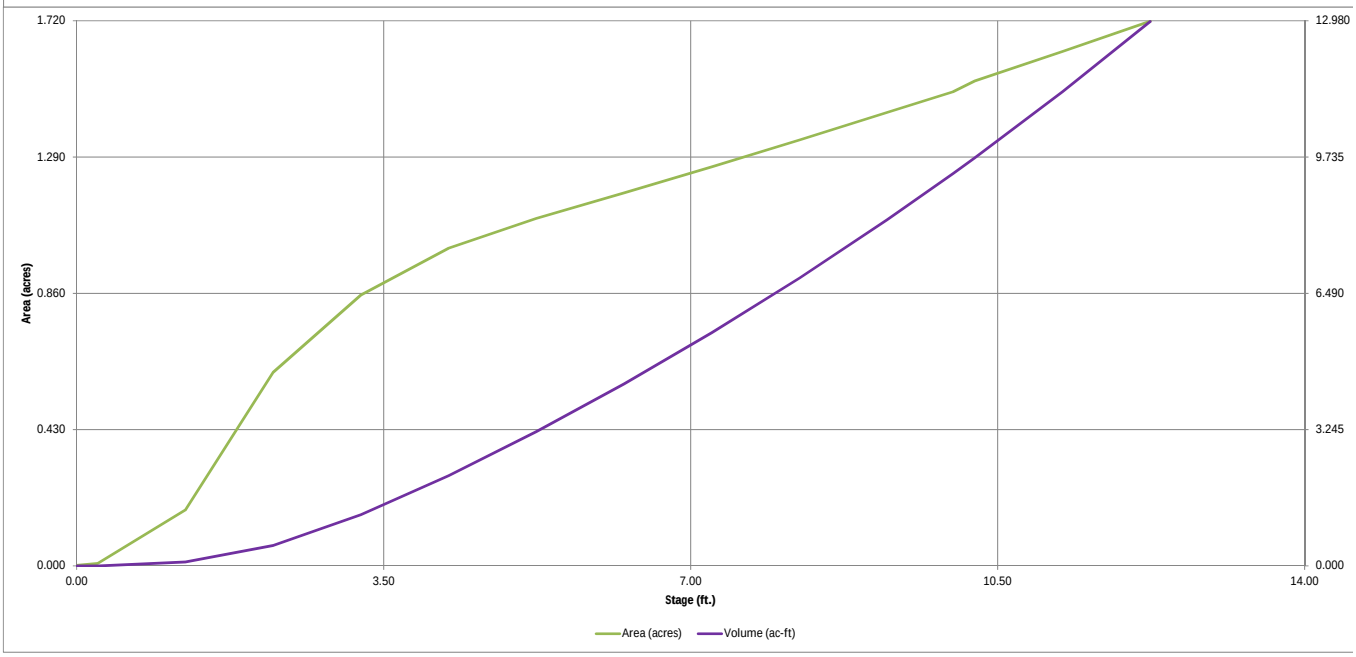
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)





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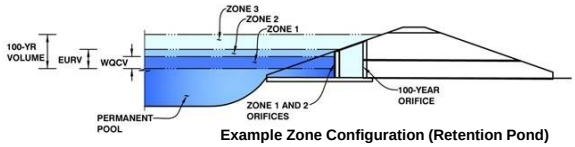
DETENTION BASIN OUTLET STRUCTURE DESIGN

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	0.893	Orifice Plate
Zone 3 (100-year)	9.35	6.218	Weir&Pipe (Restrict)
Total (all zones)		8.395	

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

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	3.257E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.27	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	4.69	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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)

	Not Selected	Not Selected				
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A feet
Vertical Orifice Diameter =	N/A	N/A	inches			

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	4.36	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	7.47	N/A feet
Overflow Weir Front Edge Length =	7.00	N/A	feet	Overflow Weir Slope Length =	12.80	N/A feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.64	N/A
Horiz. Length of Weir Sides =	12.42	N/A	feet	Overflow Grate Open Area w/o Debris =	70.89	N/A ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	17.72	N/A ft^2
Debris Clogging % =	75%	N/A	%			

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	6.29	0.00	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	12.57	ft^2
Outlet Pipe Diameter =	48.00		inches	Outlet Orifice Centroid =	2.00	feet
Restrictor Plate Height Above Pipe Invert =	48.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.99	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.74	feet
Spillway Crest Length =	123.00	feet	Stage at Top of Freeboard =	11.73	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.67	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	12.10	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	4.00
CUHP Runoff Volume (acre-ft) =	1.285	2.178	3.053	6.692	10.317	16.756	21.159	27.486	55.496
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.053	6.692	10.317	16.756	21.159	27.486	55.496
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	17.6	49.5	77.1	142.3	179.0	229.9	455.8
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	63.0	90.7	154.7	191.5	243.3	468.9
Peak Outflow Q (cfs) =	0.7	0.8	2.3	20.6	43.8	91.6	124.0	173.9	468.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.6	0.7	0.8	1.0
Structure Controlling Flow =	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	0.02	0.3	0.6	1.3	1.7	2.4	3.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	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	9.03	9.94	10.74
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	9.263	10.492

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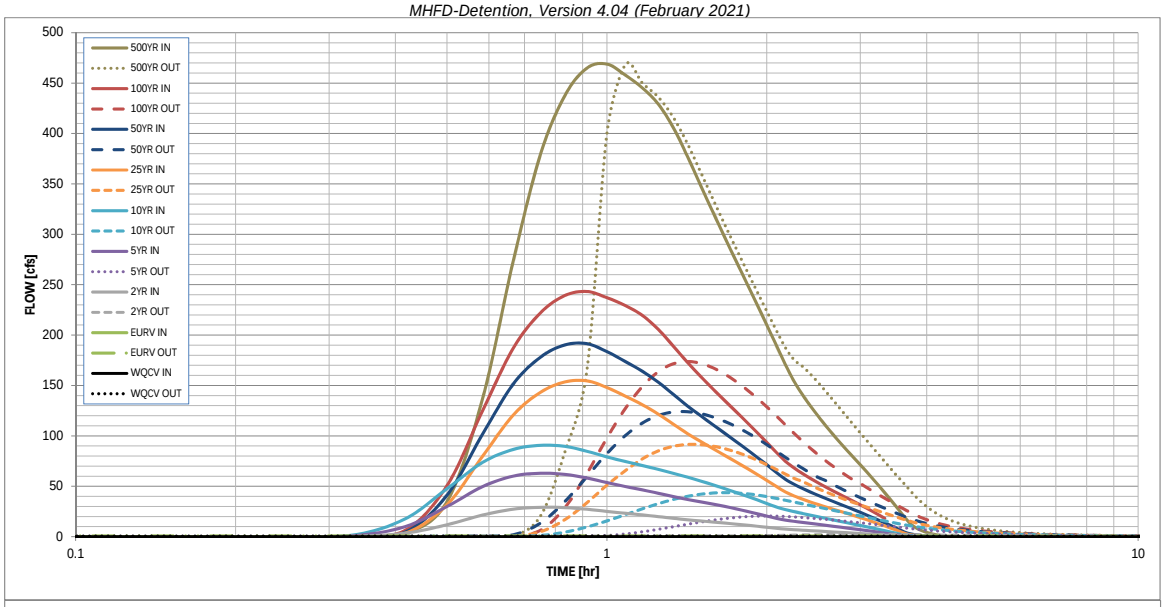
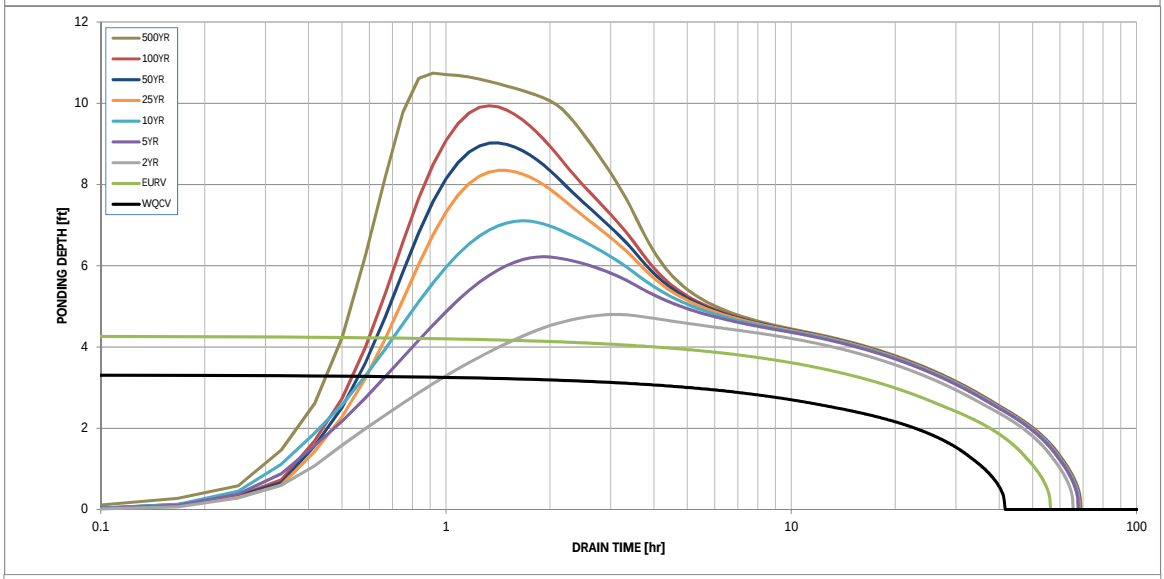
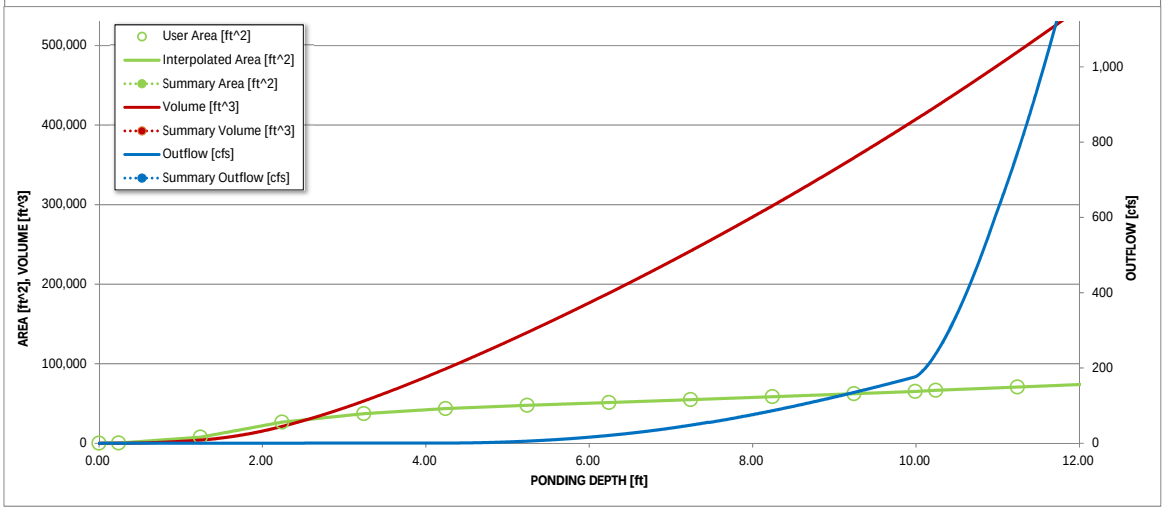
DETENTION BASIN OUTLET STRUCTURE DESIGN

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			

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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	1.76	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	34.89
	0:30:00	0.00	0.00	11.93	30.05	47.70	31.84	41.27	50.76	137.05
	0:35:00	0.00	0.00	21.52	49.77	73.77	79.91	101.82	125.07	274.25
	0:40:00	0.00	0.00	27.38	60.21	86.66	120.90	151.68	187.31	379.63
	0:45:00	0.00	0.00	29.25	62.97	90.71	143.35	178.22	222.24	437.70
	0:50:00	0.00	0.00	28.91	61.90	89.68	153.59	190.31	239.32	464.89
	0:55:00	0.00	0.00	27.31	58.30	84.82	154.66	191.55	243.32	468.91
	1:00:00	0.00	0.00	25.18	53.76	79.19	148.03	183.65	237.19	457.91
	1:05:00	0.00	0.00	23.30	49.83	74.64	139.46	173.83	229.28	445.18
	1:10:00	0.00	0.00	21.67	46.46	70.65	130.93	164.06	219.52	429.04
	1:15:00	0.00	0.00	20.00	43.13	66.78	121.63	153.18	205.57	405.88
	1:20:00	0.00	0.00	18.33	39.85	62.91	111.73	141.29	189.14	377.64
	1:25:00	0.00	0.00	16.88	37.05	59.17	102.48	129.95	173.20	348.86
	1:30:00	0.00	0.00	15.71	34.69	55.38	94.64	120.19	159.27	322.01
	1:35:00	0.00	0.00	14.62	32.42	51.52	87.44	111.12	146.60	296.95
	1:40:00	0.00	0.00	13.57	30.12	47.70	80.70	102.62	135.04	273.66
	1:45:00	0.00	0.00	12.54	27.73	43.94	74.26	94.48	124.17	251.60
	1:50:00	0.00	0.00	11.51	25.31	40.26	68.03	86.63	113.67	230.46
	1:55:00	0.00	0.00	10.47	22.89	36.63	61.90	78.92	103.46	209.97
	2:00:00	0.00	0.00	9.42	20.49	32.97	55.88	71.36	93.52	190.07
	2:05:00	0.00	0.00	8.40	18.24	29.54	49.93	63.87	83.80	170.98
	2:10:00	0.00	0.00	7.56	16.54	26.96	44.50	57.06	74.97	154.28
	2:15:00	0.00	0.00	6.99	15.33	24.95	40.53	52.07	68.29	141.01
	2:20:00	0.00	0.00	6.50	14.25	23.11	37.30	47.93	62.76	129.63
	2:25:00	0.00	0.00	6.05	13.24	21.40	34.51	44.31	57.85	119.36
	2:30:00	0.00	0.00	5.61	12.27	19.77	31.95	40.98	53.39	109.95
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	2:40:00	0.00	0.00	4.78	10.42	16.69	27.34	34.98	45.42	93.08
	2:45:00	0.00	0.00	4.38	9.53	15.23	25.17	32.17	41.82	85.46
	2:50:00	0.00	0.00	3.99	8.66	13.83	23.07	29.47	38.40	78.25
	2:55:00	0.00	0.00	3.60	7.80	12.48	20.99	26.81	35.02	71.23
	3:00:00	0.00	0.00	3.22	6.96	11.18	18.93	24.20	31.66	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	1.71	3.67	6.05	10.77	13.83	18.25	36.94
	3:25:00	0.00	0.00	1.34	2.86	4.79	8.74	11.25	14.92	30.15
	3:30:00	0.00	0.00	0.98	2.05	3.54	6.71	8.69	11.59	23.40
	3:35:00	0.00	0.00	0.62	1.28	2.37	4.71	6.15	8.30	16.93
	3:40:00	0.00	0.00	0.35	0.78	1.68	2.85	3.83	5.32	11.65
	3:45:00	0.00	0.00	0.24	0.58	1.32	1.82	2.56	3.56	8.30
	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

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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.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

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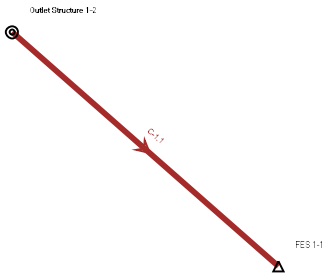
Scenario: 100 - Year



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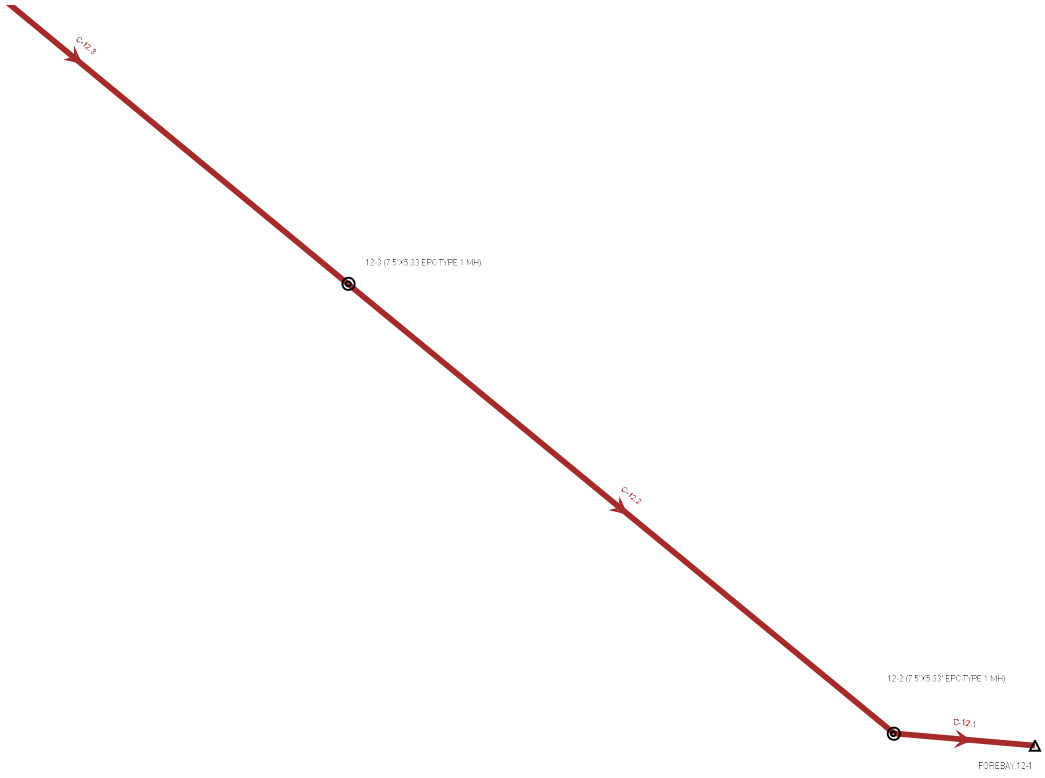

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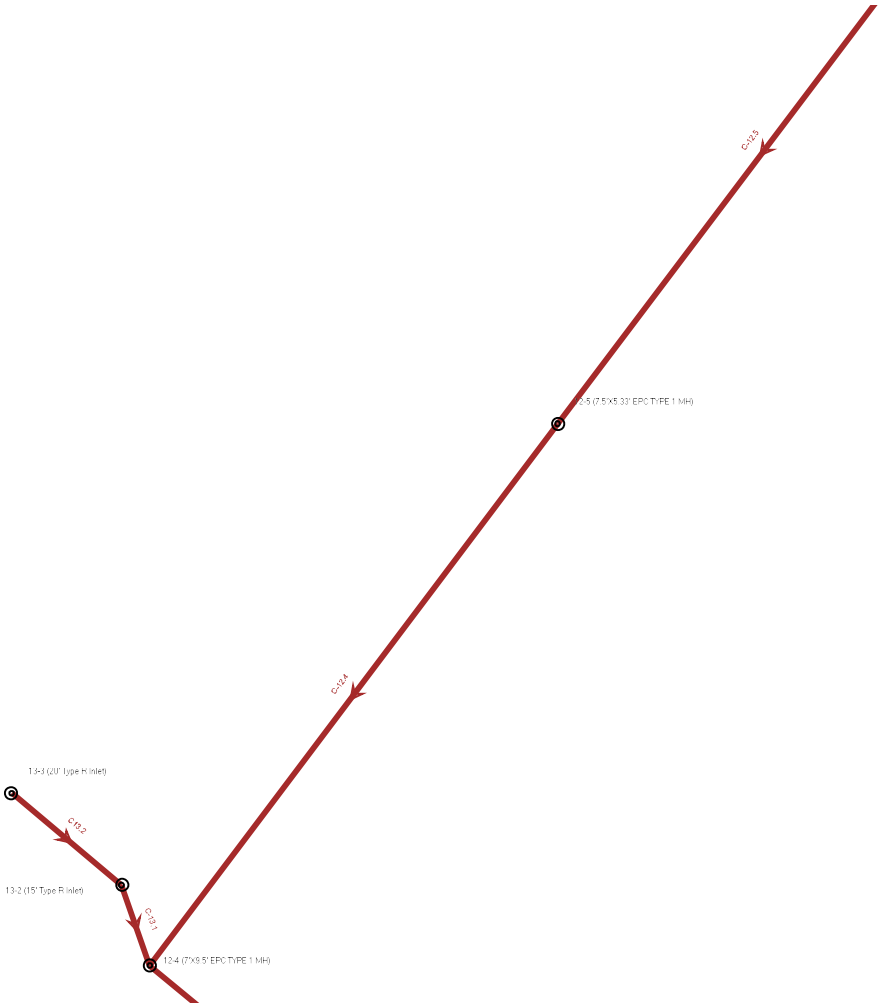

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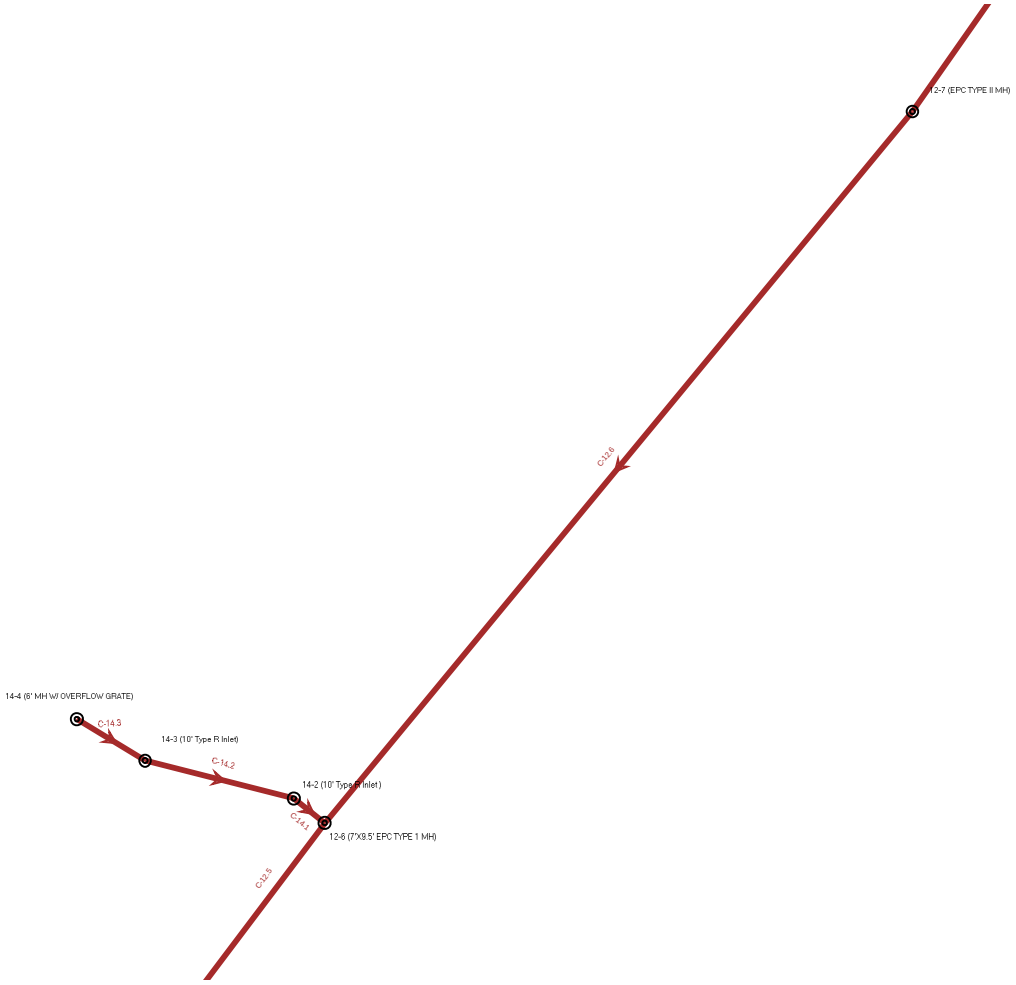

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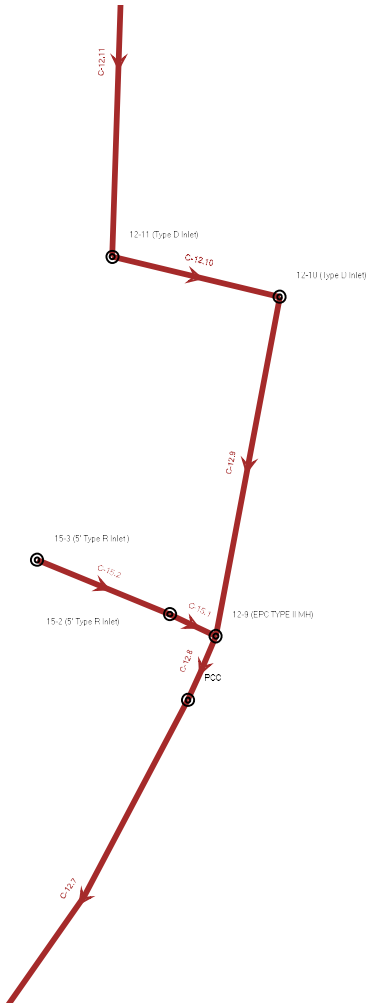
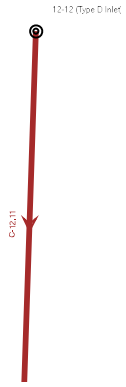


Scenario: 100 - Year



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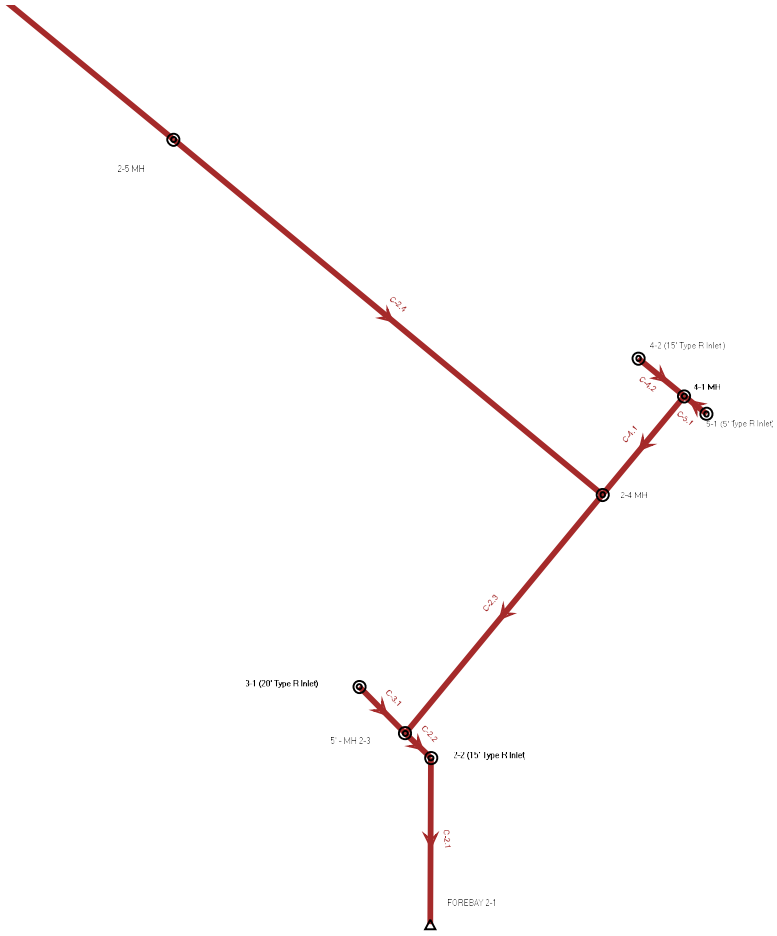
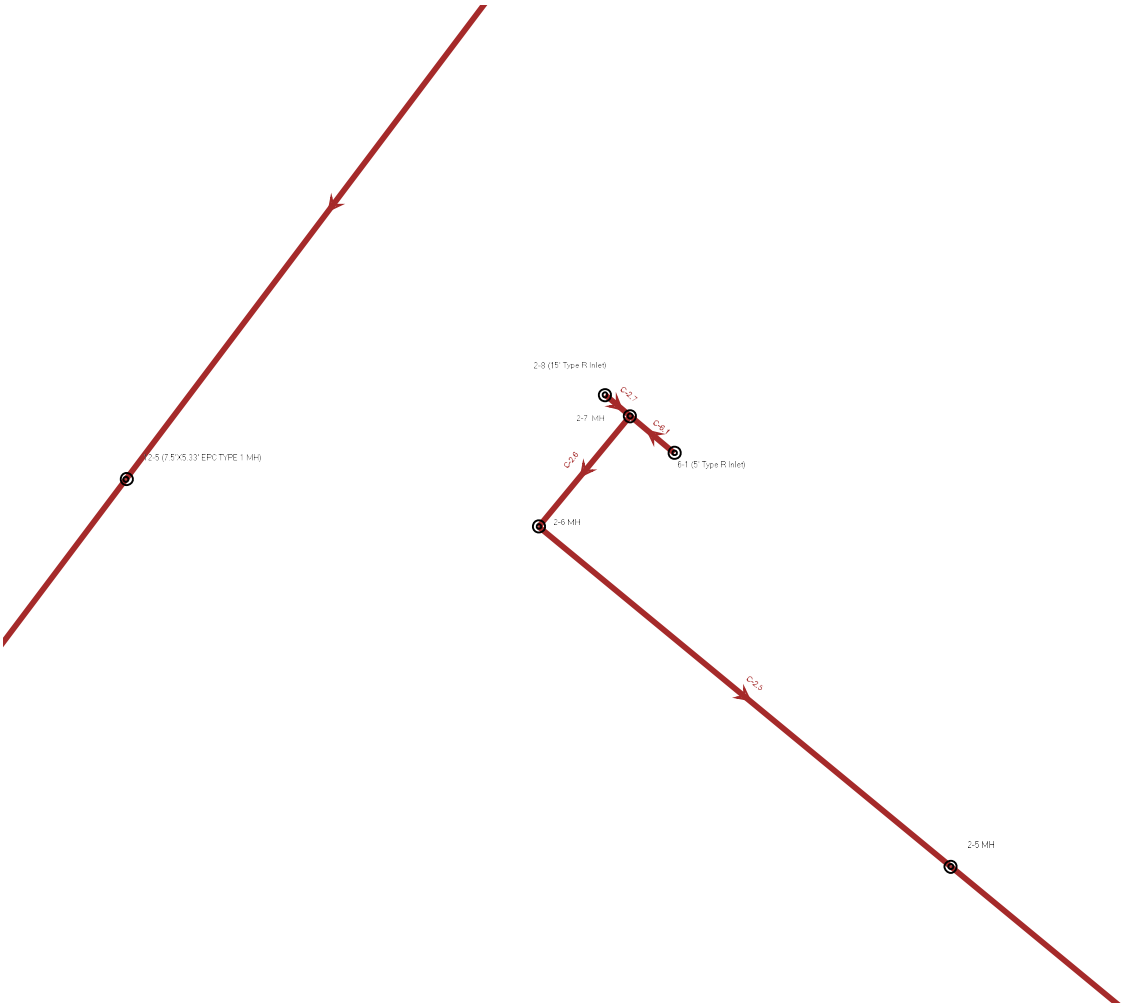


Scenario: 100 - Year



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

Label	Flow (cfs)	Diameter (in)	Manning's n	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Velocity (ft/s)	Length (User Defined) (ft)
C-1.1	170.10	48.0	0.013	0.015	7,101.47	7,098.92	7,105.20	7,102.19	15.80	173.3
C-2.1	65.00	36.0	0.013	0.044	7,112.83	7,108.95	7,117.55	7,116.72	9.20	87.9
C-2.2	55.30	36.0	0.013	0.019	7,116.61	7,116.46	7,119.02	7,118.59	13.70	7.8
C-2.3	17.80	24.0	0.013	0.019	7,120.76	7,117.81	7,122.28	7,120.97	10.34	152.1
C-2.4	11.70	18.0	0.013	0.022	7,127.26	7,121.26	7,128.56	7,123.42	9.67	272.8
C-2.5	11.70	18.0	0.013	0.025	7,133.90	7,127.36	7,135.20	7,128.29	10.18	261.8
C-2.6	11.70	18.0	0.013	0.026	7,135.85	7,134.00	7,137.15	7,136.26	10.40	70.1
C-2.7	10.70	18.0	0.013	0.089	7,136.57	7,135.95	7,138.44	7,138.37	6.05	6.9
C-3.1	18.10	24.0	0.013	0.012	7,118.19	7,117.81	7,121.17	7,120.97	5.76	30.8
C-4.1	12.90	18.0	0.013	0.025	7,122.82	7,121.26	7,124.37	7,123.42	7.30	62.7
C-4.2	11.50	18.0	0.013	0.029	7,123.71	7,122.92	7,125.96	7,125.63	6.51	27.5
C-5.1	1.90	18.0	0.013	0.076	7,123.50	7,122.92	7,125.63	7,125.63	1.08	7.6
C-6.1	1.50	18.0	0.013	0.018	7,136.44	7,135.95	7,138.38	7,138.37	0.85	26.9
C-12.1	220.30	60.0	0.013	0.010	7,109.50	7,108.72	7,117.28	7,116.72	11.22	78.1
C-12.10	11.60	24.0	0.013	0.010	7,170.03	7,169.21	7,171.65	7,171.51	7.26	81.6
C-12.11	6.00	24.0	0.013	0.009	7,171.83	7,170.13	7,172.70	7,172.02	5.89	185.9
C-12.2	220.30	60.0	0.013	0.014	7,119.72	7,115.00	7,123.94	7,118.19	17.00	340.1
C-12.3	220.30	60.0	0.013	0.015	7,124.93	7,119.81	7,129.14	7,125.15	17.53	341.3
C-12.4	205.30	60.0	0.013	0.015	7,129.91	7,125.03	7,134.00	7,131.32	17.21	327.8
C-12.5	205.30	60.0	0.013	0.014	7,136.86	7,132.30	7,140.94	7,135.36	16.64	333.5
C-12.6	19.20	24.0	0.013	0.028	7,153.36	7,143.31	7,154.94	7,144.32	12.09	359.1
C-12.7	19.20	24.0	0.013	0.039	7,163.47	7,153.56	7,165.05	7,155.34	13.74	251.3
C-12.8	19.20	24.0	0.013	0.028	7,166.91	7,163.67	7,168.49	7,165.45	12.03	117.3
C-12.9	17.70	24.0	0.013	0.012	7,169.01	7,167.11	7,170.53	7,169.22	8.52	161.0
C-13.1	15.50	24.0	0.013	0.020	7,128.78	7,128.03	7,131.50	7,131.32	4.93	37.3
C-14.1	195.00	48.0	0.013	0.007	7,138.22	7,137.96	7,144.98	7,144.28	15.52	38.4
C-14.2	192.50	48.0	0.013	0.010	7,139.07	7,138.32	7,148.20	7,146.85	15.32	74.9
C-14.3	190.90	48.0	0.013	0.005	7,139.38	7,139.16	7,149.17	7,148.38	15.19	44.5
C-15.1	2.20	18.0	0.013	0.020	7,167.60	7,167.41	7,169.22	7,169.22	1.24	9.5
C-15.2	1.10	18.0	0.013	0.020	7,169.18	7,167.80	7,169.57	7,169.23	4.92	68.9
C13.2	14.30	24.0	0.013	0.017	7,130.00	7,128.88	7,131.99	7,131.72	9.23	67.5

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

Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)
2-2 (15' Type R Inlet)	65.50	7,124.33	7,112.83	65.50	7,118.26	7,117.57	7,119.90	7,118.90	0.520
2-4 MH	17.80	7,126.50	7,120.77	17.80	7,123.42	7,122.28	7,124.25	7,123.03	1.520
2-5 MH	11.70	7,133.20	7,127.27	11.70	7,128.60	7,128.56	7,130.21	7,129.36	0.050
2-6 MH	11.70	7,139.45	7,133.71	11.70	7,136.26	7,135.20	7,136.94	7,136.00	1.320
2-7 MH	11.70	7,140.85	7,135.85	11.70	7,138.37	7,137.15	7,138.94	7,137.95	1.520
2-8 (15' Type R Inlet)	10.70	7,141.17	7,136.57	10.70	7,138.47	7,138.44	7,139.04	7,139.01	0.050
3-1 (15' Type R Inlet)	18.10	7,124.33	7,118.19	18.10	7,121.19	7,121.17	7,121.71	7,121.68	0.050
4-1 MH	12.90	7,127.76	7,122.81	12.90	7,125.63	7,124.37	7,125.64	7,125.19	1.520
4-2 (15' Type R Inlet)	11.50	7,128.01	7,123.71	11.50	7,125.99	7,125.96	7,126.65	7,126.61	0.050
5' - MH 2-3	55.30	7,124.02	7,116.61	55.30	7,120.97	7,119.02	7,121.48	7,120.30	1.520
5-1 (5' Type R Inlet)	1.90	7,128.02	7,123.51	1.90	7,125.63	7,125.63	7,125.65	7,125.65	0.050
6-1 (5' Type R Inlet)	1.50	7,141.19	7,136.45	1.50	7,138.38	7,138.38	7,138.39	7,138.39	0.050
12-10 (Type D Inlet)	17.70	7,175.38	7,169.01	17.70	7,171.51	7,170.53	7,171.72	7,171.27	1.320
12-11 (Type D Inlet)	11.60	7,175.68	7,170.03	11.60	7,172.02	7,171.65	7,172.08	7,171.93	1.320
12-12 (Type D Inlet)	6.00	7,175.00	7,171.83	6.00	7,172.71	7,172.70	7,173.04	7,173.03	0.050
12-2 (7.5'X5.33' EPC TYPE 1 MH)	220.30	7,123.42	7,109.50	220.30	7,118.45	7,117.28	7,122.78	7,119.23	0.600
12-3 (7.5'X5.33 EPC TYPE 1 MH)	220.30	7,130.74	7,119.72	220.30	7,125.15	7,123.94	7,127.10	7,126.36	0.500
12-4 (7'X9.5' EPC TYPE 1 MH)	220.30	7,135.21	7,124.95	220.30	7,131.32	7,129.14	7,133.02	7,131.56	0.900
12-5 (7.5'X5.33' EPC TYPE 1 MH)	205.30	7,141.42	7,129.91	205.30	7,135.11	7,134.00	7,139.25	7,136.22	0.500
12-6 (7'X9.5' EPC TYPE 1 MH)	205.30	7,149.67	7,136.86	205.30	7,144.28	7,140.94	7,148.02	7,143.17	1.500
12-7 (EPC TYPE II MH)	19.20	7,160.24	7,153.36	19.20	7,155.34	7,154.94	7,156.00	7,155.75	0.500
12-8 (EPC TYPE II MH)	19.20	7,170.00	7,163.47	19.20	7,165.45	7,165.05	7,166.11	7,165.86	0.500
12-9 (EPC TYPE II MH)	19.20	7,173.28	7,166.91	19.20	7,169.22	7,168.49	7,169.71	7,169.30	0.900
13-2 (15' Type R Inlet)	15.50	7,137.16	7,128.53	15.50	7,131.72	7,131.50	7,132.04	7,131.87	0.600
13-3 (15' Type R Inlet)	14.30	7,137.03	7,130.00	14.30	7,132.15	7,131.99	7,132.48	7,132.31	0.500
14-2 (10' Type R Inlet)	195.00	7,151.40	7,138.22	195.00	7,146.85	7,144.98	7,150.50	7,148.73	0.500
14-3 (10' Type R Inlet)	192.50	7,150.61	7,139.07	192.50	7,148.38	7,148.20	7,151.97	7,151.85	0.050
14-4 (6' MH W/ OVERFLOW GRATE)	190.90	7,145.00	7,139.38	190.90	7,145.00	7,145.00	7,148.59	7,148.59	0.000
15-2 (5' Type R Inlet)	2.20	7,173.68	7,167.60	2.20	7,169.23	7,169.22	7,169.24	7,169.25	0.500
15-3 (5' Type R Inlet)	1.10	7,173.73	7,169.18	1.10	7,169.64	7,169.57	7,169.78	7,169.71	0.500
Outlet Structure 1-2	170.10	7,111.12	7,100.49	170.10	7,106.71	7,105.20	7,109.73	7,108.22	0.500

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

Label	Flow (cfs)	Diameter (in)	Manning's n	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Velocity (ft/s)	Length (User Defined) (ft)
C-1.1	20.60	48.0	0.013	0.015	7,101.47	7,098.92	7,102.81	7,099.85	9.31	173.3
C-2.1	30.70	36.0	0.013	0.044	7,112.83	7,108.95	7,114.63	7,112.98	15.88	87.9
C-2.2	26.20	36.0	0.013	0.019	7,116.61	7,116.46	7,118.26	7,117.86	11.29	7.8
C-2.3	9.20	24.0	0.013	0.019	7,120.76	7,117.81	7,121.84	7,119.28	8.70	152.1
C-2.4	4.80	18.0	0.013	0.022	7,127.26	7,121.26	7,128.10	7,122.51	7.76	272.8
C-2.5	4.80	18.0	0.013	0.025	7,133.90	7,127.36	7,134.74	7,127.91	8.13	261.8
C-2.6	4.80	18.0	0.013	0.026	7,135.85	7,134.00	7,136.69	7,135.20	8.29	70.1
C-2.7	5.90	18.0	0.013	0.089	7,136.57	7,135.95	7,137.51	7,137.21	13.64	6.9
C-3.1	18.90	24.0	0.013	0.012	7,118.19	7,117.81	7,119.75	7,119.16	8.79	30.8
C-4.1	7.90	18.0	0.013	0.025	7,122.82	7,121.26	7,123.91	7,122.51	9.27	62.7
C-4.2	7.00	18.0	0.013	0.029	7,123.71	7,122.92	7,124.73	7,124.69	9.46	27.5
C-5.1	1.20	18.0	0.013	0.076	7,123.50	7,122.92	7,124.69	7,124.69	8.08	7.6
C-6.1	0.80	18.0	0.013	0.018	7,136.44	7,135.95	7,137.21	7,137.21	4.33	26.9
C-12.1	35.80	60.0	0.013	0.010	7,109.50	7,108.72	7,112.97	7,112.98	9.30	78.1
C-12.10	3.20	24.0	0.013	0.010	7,170.03	7,169.21	7,170.65	7,170.27	5.10	81.6
C-12.11	0.80	24.0	0.013	0.009	7,171.83	7,170.13	7,172.14	7,170.95	3.28	185.9
C-12.2	35.80	60.0	0.013	0.014	7,119.72	7,115.00	7,121.39	7,116.15	10.45	340.1
C-12.3	35.80	60.0	0.013	0.015	7,124.93	7,119.81	7,126.60	7,121.69	10.74	341.3
C-12.4	32.60	60.0	0.013	0.015	7,129.91	7,125.03	7,131.50	7,127.14	10.43	327.8
C-12.5	32.60	60.0	0.013	0.014	7,136.86	7,132.30	7,138.45	7,133.40	10.12	333.5
C-12.6	6.40	24.0	0.013	0.028	7,153.36	7,143.31	7,154.26	7,143.87	8.97	359.1
C-12.7	6.40	24.0	0.013	0.039	7,163.47	7,153.56	7,164.37	7,154.07	10.13	251.3
C-12.8	6.40	24.0	0.013	0.028	7,166.91	7,163.67	7,167.81	7,164.23	8.92	117.3
C-12.9	5.70	24.0	0.013	0.012	7,169.01	7,167.11	7,169.85	7,168.11	6.37	161.0
C-13.1	3.20	24.0	0.013	0.020	7,128.78	7,128.03	7,129.40	7,128.46	6.53	37.3
C-14.1	29.20	48.0	0.013	0.007	7,138.22	7,137.96	7,139.82	7,139.36	7.79	38.4
C-14.2	28.10	48.0	0.013	0.010	7,139.07	7,138.32	7,140.64	7,140.12	8.87	74.9
C-14.3	27.10	48.0	0.013	0.005	7,139.38	7,139.16	7,140.92	7,140.58	6.82	44.5
C-15.1	1.10	18.0	0.013	0.020	7,167.60	7,167.41	7,168.07	7,168.11	4.93	9.5
C-15.2	0.50	18.0	0.013	0.020	7,169.18	7,167.80	7,169.44	7,168.11	3.90	68.9
C13.2	2.50	24.0	0.013	0.017	7,130.00	7,128.88	7,130.55	7,129.54	5.67	67.5

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

Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)
2-2 (15' Type R Inlet)	30.90	7,124.33	7,112.83	30.90	7,115.02	7,114.63	7,116.05	7,115.39	0.520
2-4 MH	9.20	7,126.50	7,120.77	9.20	7,122.51	7,121.84	7,122.90	7,122.28	1.520
2-5 MH	4.80	7,133.20	7,127.27	4.80	7,128.12	7,128.10	7,129.15	7,128.45	0.050
2-6 MH	4.80	7,139.45	7,133.71	4.80	7,135.20	7,134.74	7,135.35	7,135.09	1.320
2-7 MH	4.80	7,140.85	7,135.85	4.80	7,137.21	7,136.69	7,137.43	7,137.04	1.520
2-8 (15' Type R Inlet)	5.90	7,141.17	7,136.57	5.90	7,137.53	7,137.51	7,137.93	7,137.91	0.050
3-1 (15' Type R Inlet)	18.90	7,124.33	7,118.19	18.90	7,119.79	7,119.75	7,120.59	7,120.55	0.050
4-1 MH	7.90	7,127.76	7,122.81	7.90	7,124.69	7,123.91	7,124.70	7,124.42	1.520
4-2 (15' Type R Inlet)	7.00	7,128.01	7,123.71	7.00	7,124.76	7,124.73	7,125.22	7,125.19	0.050
5' - MH 2-3	26.20	7,124.02	7,116.61	26.20	7,119.28	7,118.26	7,120.37	7,118.93	1.520
5-1 (5' Type R Inlet)	1.20	7,128.02	7,123.51	1.20	7,124.69	7,124.69	7,124.70	7,124.70	0.050
6-1 (5' Type R Inlet)	0.80	7,141.19	7,136.45	0.80	7,137.21	7,137.21	7,137.22	7,137.22	0.050
12-10 (Type D Inlet)	5.70	7,175.38	7,169.01	5.70	7,170.27	7,169.85	7,170.33	7,170.17	1.320
12-11 (Type D Inlet)	3.20	7,175.68	7,170.03	3.20	7,170.95	7,170.65	7,170.96	7,170.88	1.320
12-12 (Type D Inlet)	0.80	7,175.00	7,171.83	0.80	7,172.14	7,172.14	7,172.25	7,172.24	0.050
12-2 (7.5'X5.33' EPC TYPE 1 MH)	35.80	7,123.42	7,109.50	35.80	7,113.02	7,112.97	7,114.72	7,113.06	0.600
12-3 (7.5'X5.33 EPC TYPE 1 MH)	35.80	7,130.74	7,119.72	35.80	7,121.69	7,121.39	7,122.13	7,122.00	0.500
12-4 (7'X9.5' EPC TYPE 1 MH)	35.80	7,135.21	7,124.95	35.80	7,127.14	7,126.60	7,127.41	7,127.20	0.900
12-5 (7.5'X5.33' EPC TYPE 1 MH)	32.60	7,141.42	7,129.91	32.60	7,131.79	7,131.50	7,133.38	7,132.07	0.500
12-6 (7'X9.5' EPC TYPE 1 MH)	32.60	7,149.67	7,136.86	32.60	7,139.31	7,138.45	7,140.17	7,139.02	1.500
12-7 (EPC TYPE II MH)	6.40	7,160.24	7,153.36	6.40	7,154.43	7,154.26	7,156.02	7,154.60	0.500
12-8 (EPC TYPE II MH)	6.40	7,170.00	7,163.47	6.40	7,164.54	7,164.37	7,165.77	7,164.71	0.500
12-9 (EPC TYPE II MH)	6.40	7,173.28	7,166.91	6.40	7,168.11	7,167.81	7,168.32	7,168.15	0.900
13-2 (15' Type R Inlet)	3.20	7,137.16	7,128.53	3.20	7,129.54	7,129.40	7,129.66	7,129.63	0.600
13-3 (15' Type R Inlet)	2.50	7,137.03	7,130.00	2.50	7,130.65	7,130.55	7,130.85	7,130.75	0.500
14-2 (10' Type R Inlet)	29.20	7,151.40	7,138.22	29.20	7,140.12	7,139.82	7,140.53	7,140.42	0.500
14-3 (10' Type R Inlet)	28.10	7,150.61	7,139.07	28.10	7,140.67	7,140.64	7,141.38	7,141.23	0.050
14-4 (6' MH W/ OVERFLOW GRATE)	27.10	7,145.00	7,139.38	27.10	7,140.92	7,140.92	7,141.49	7,141.49	0.000
15-2 (5' Type R Inlet)	1.10	7,173.68	7,167.60	1.10	7,168.11	7,168.07	7,168.17	7,168.15	0.500
15-3 (5' Type R Inlet)	0.50	7,173.73	7,169.18	0.50	7,169.49	7,169.44	7,169.58	7,169.53	0.500
Outlet Structure 1-2	20.60	7,111.12	7,100.49	20.60	7,103.05	7,102.81	7,103.54	7,103.29	0.500

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: ARJ
Company: JR ENGINEERING
Date: June 15, 2022
Project: STERLING RANCH HOMESTEAD FIL. 1- 60" FOREBAY
Location: EL PASO COUNTY

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 4.4 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.044

C) Contributing Watershed Area — Area = 201.220 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.43 in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)
V_{DESIGN} = ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$)
$V_{DESIGN\ OTHER}$ = ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)
$V_{DESIGN\ USER}$ = 0.457 ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
$EURV_{DESIGN}$ = ac-f t

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

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)
L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)
Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)
V_{FMIN} = 0.014 ac-ft

B) Actual Forebay Volume
V_F = 0.019 ac-ft

C) Forebay Depth (D_F = 18 inch maximum)
D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge
Q_{100} = 173.80 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)
Q_F = 3.48 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches)
Calculated D_P = in

G) Rectangular Notch Width
Calculated W_N = 10.4 in

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: ARJ
Company: JR ENGINEERING
Date: September 9, 2022
Project: STERLING RANCH HOMESTEAD FIL. 1 - 36" Forebay
Location: EL PASO COUNTY

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 61.8 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.618

C) Contributing Watershed Area — Area = 23.230 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.43 in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- (●) Water Quality Capture Volume (WQCV)
- ( ) Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)
V_{DESIGN} = ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$
$V_{DESIGN\ OTHER}$ = 0.469 ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)
$V_{DESIGN\ USER}$ = ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
i) Percentage of Watershed consisting of Type A Soils — HSG_A = %
ii) Percentage of Watershed consisting of Type B Soils — HSG_B = %
iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
$EURV_{DESIGN}$ = ac-f t

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

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)
L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)
Z = 4.00 ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)
V_{FMIN} = 0.014 ac-ft

B) Actual Forebay Volume
V_F = 0.019 ac-ft

C) Forebay Depth (D_F = 18 inch maximum)
D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge
Q_{100} = 65.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)
Q_F = 1.30 cfs

E) Forebay Discharge Design

Choose One
- ( ) Berm With Pipe
- (●) Wall with Rect. Notch
- ( ) Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches)
Calculated D_P = in

G) Rectangular Notch Width
Calculated W_N = 6.2 in

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Homestead North Fil. 1
Location: El Paso County

Project Name: Homestead North-Filing 1
Project No.: 25188.00
Calculated By: ARJ
Checked By:
Date: 6/15/22

	STORM DRAIN SYSTEM			
	Pond C Outfall	DESIGN POINT	DESIGN POINT	Notes
Q_{100} (cfs):	173.8			Flows are the greater of proposed vs. future
Conduit	Pipe			
D_c, Pipe Diameter (in):	48			
W, Box Width (ft):	N/A			
H, Box Height (ft):	N/A			
Y_t, Tailwater Depth (ft):	1.00			If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	0.25			
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	5.43			
Supercritical?	No			
Y_n, Normal Depth (ft) [Supercritical]:	1.00			
D_a, H_a (in) [Supercritical]:	N/A			$D_a=(D_c+Y_n)/2$
Riprap d_{50} (in) [Supercritical]:	N/A			
Riprap d_{50} (in) [Subcritical]:	31.65			
Required Riprap Size:	VH			Fig. 9-38 or Fig. 9-36
d_{50} (in):	18			
Expansion Factor, $1/(2\tan\theta)$:	6.00			Read from Fig. 9-35 or 9-36
θ:	0.08			
Erosive Soils?	No			
Area of Flow, A_t (ft^2):	24.83			$A_t=Q/V$
Length of Protection, L_p (ft):	125.0			L=(1/(2 tan θ))(At/Yt - D)
Min Length (ft)	12.0			Min L=3D or 3H
Max Length (ft)	40.0			Max L=10D or 10H
Min Bottom Width, T (ft):	24.8			$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	40.0			
Design Width (ft)	24.8			
Riprap Depth (in)	36			Depth=2(d_{50})
Type II Bedding Depth (in)*	8			*Not used if Soil Riprap
Cutoff Wall	Yes			
Cutoff Wall Depth (ft)	44.0			Depth of Riprap and Base
Cutoff Wall Width (ft)	8.3			

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).

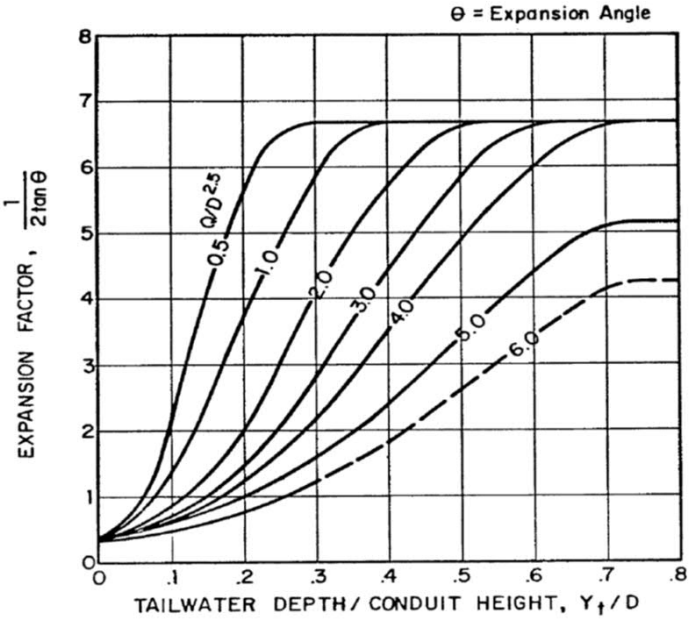


Figure 9-35. Expansion factor for circular conduits

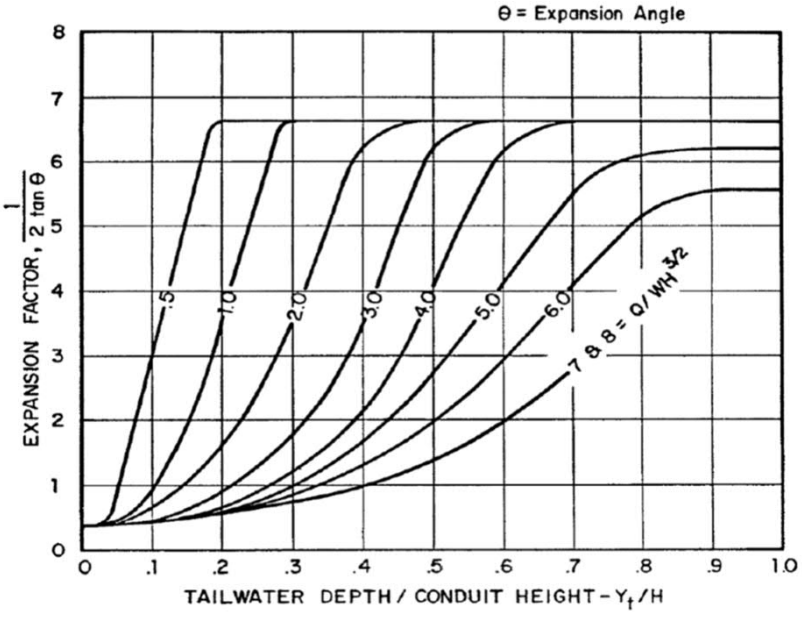
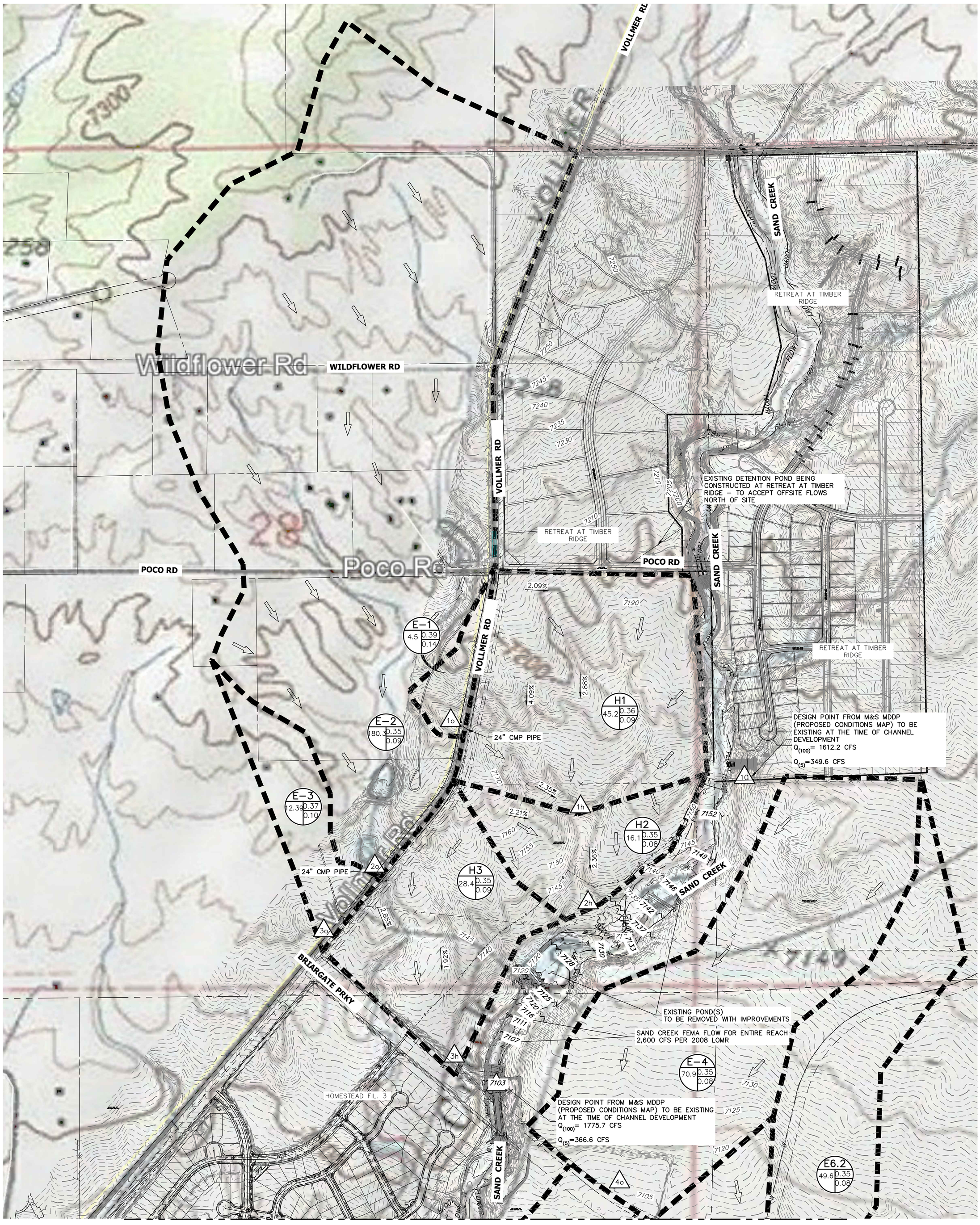


Figure 9-36. Expansion factor for rectangular conduits

Appendix D
Drainage Maps

EXISTING DRAINAGE MAP
HOMESTEAD NORTH



SEE SHEET 2

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (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	70.90	2%	0.08	0.35	49.0	9.9	72.7
E-5	18.80	2%	0.08	0.35	34.9	3.4	24.9
E6.1	117.40	2%	0.08	0.35	48.1	16.6	122.2
E6.2	49.61	2%	0.08	0.35	44.2	7.5	55.4
H1	45.20	3%	0.09	0.36	34.7	8.9	61.0
H2	16.10	2%	0.08	0.35	25.1	3.5	26.0
H3	28.40	3%	0.09	0.35	31.3	5.9	40.8

DESIGN POINT

DP	Q5 Total	Q100 Total
1h	8.0	52.4
2h	10.2	69.0
3h	32.5	223.2
1o	1.1	5.2
2o	28.1	192.9
3o	2.2	13.7
4o	9.9	72.7
5o	12.5	92.0
6.2o	7.5	55.4
6.1o	35.9	263.2

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

6100

N

300 150 0 300 600

ORIGINAL SCALE: 1" = 300'

EX DRAINAGE MAP
HOMESTEAD NORTH
JOB NO. 25188.00
1–4–2022
SHEET 1 OF 2

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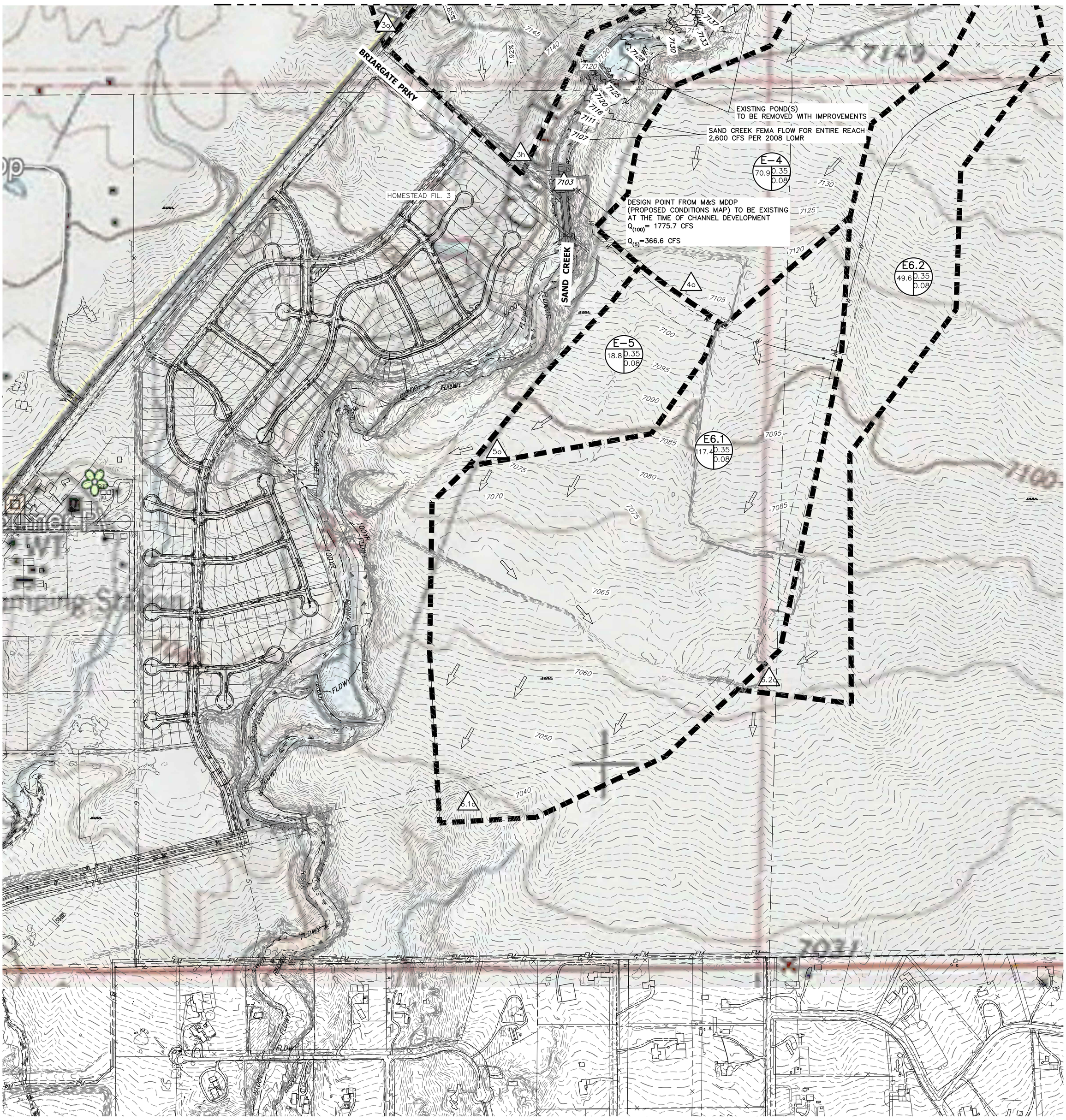
EXISTING DRAINAGE MAP
HOMESTEAD NORTH

SEE SHEET 1



BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (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	70.90	2%	0.08	0.35	49.0	9.9	72.7
E-5	18.80	2%	0.08	0.35	34.9	3.4	24.9
E6.1	117.40	2%	0.08	0.35	48.1	16.6	122.2
E6.2	49.61	2%	0.08	0.35	44.2	7.5	55.4
H1	45.20	3%	0.09	0.36	34.7	8.9	61.0
H2	16.10	2%	0.08	0.35	25.1	3.5	26.0
H3	28.40	3%	0.09	0.35	31.3	5.9	40.8

DESIGN POINT		
DP	Q5 Total	Q100 Total
1h	8.0	52.4
2h	10.2	69.0
3h	32.5	223.2
1o	1.1	5.2
2o	28.1	192.9
3o	2.2	13.7
4o	9.9	72.7
5o	12.5	92.0
6.2o	7.5	55.4
6.1o	35.9	263.2

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

6100

300 150 0 300 600

ORIGINAL SCALE: 1" = 300'

EX DRAINAGE MAP
HOMESTEAD NORTH
JOB NO. 25188.00
3–23–2022
SHEET 2 OF 2

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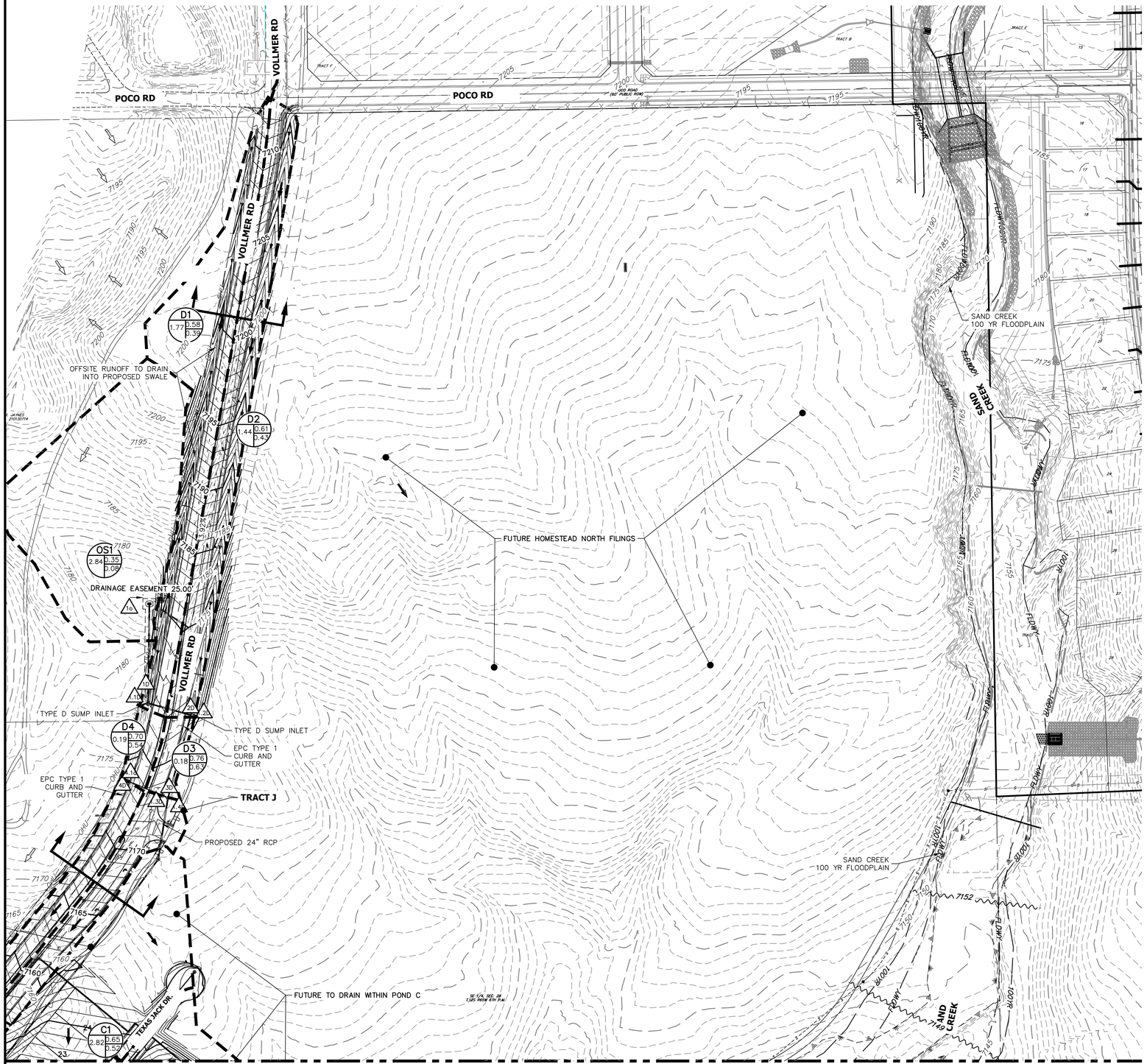
DRAINAGE MAP



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 6100

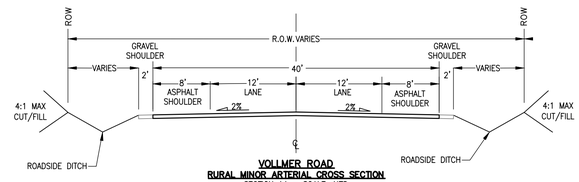
PROPOSED 6100

BASIN SUMMARY TABLE

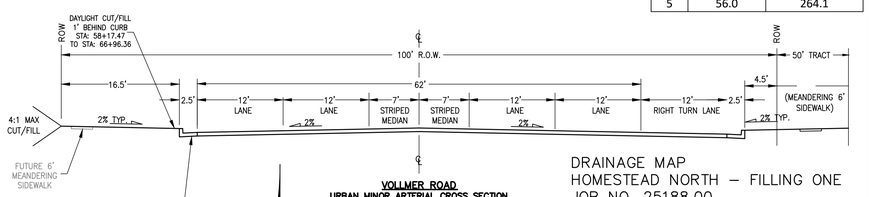
Tributary Sub-basin	Area (acres)	Percent Impervious	C5	C100	tc (min)	Q5 (cfs)	Q100 (cfs)
C1	2.82	69%	0.52	0.65	13.1	5.4	11.4
C2.1	0.20	91%	0.82	0.90	5.0	0.8	1.6
C2.2	4.69	73%	0.56	0.68	12.8	9.9	20.3
C2.3	0.83	67%	0.54	0.68	10.1	1.9	3.9
C3.1	0.35	73%	0.68	0.79	5.0	1.2	2.4
C3.2	1.66	63%	0.49	0.60	9.1	3.5	7.2
C4.1	6.34	65%	0.49	0.63	12.0	12.1	25.9
C4.2	3.59	57%	0.44	0.58	12.9	5.9	13.1
C5	0.16	81%	0.74	0.84	6.4	0.6	1.0
C6	2.59	20%	0.21	0.43	6.8	2.5	8.8
D1	1.77	40%	0.40	0.60	16.5	2.4	6.0
D2	1.44	56%	0.55	0.78	15.0	2.8	6.6
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	0.75	79%	0.72	0.82	5.0	2.8	5.3
D8	0.72	69%	0.64	0.74	5.0	2.4	4.6
OS1	2.84	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	11.98	2%	0.08	0.35	47.6	1.7	12.6

DESIGN POINT SUMMARY TABLE

DP	Q5 Total	Q100 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	13.1
4.2i	5.9	10.5
4C	18.8	41.8
3.1	4.7	11.6
3.1c	1.2	2.4
3.1i	1.2	1.9
3.2	7.9	12.9
3.3	9.1	17.6
3.4	26.0	54.9
3.2c	3.5	7.6
5C	4.0	8.5
6C	2.5	8.8
3.5	30.7	65.0
o1	0.8	6.0
1d	2.4	6.0
1.1d	3.2	11.7
2d	2.8	6.6
1.2d	5.8	18.0
3d	0.6	1.2
4d	0.5	1.1
4.1d	0.5	1.1
1.3d	1.0	2.2
1.4d	6.6	19.6
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	32.7	205.4
1.7d	36.1	221.0
3o	1.7	12.6
8d	2.5	14.3
2.1d	2.5	13.2
7d	2.4	5.3
2.2d	3.5	16.0
1.7d	36.1	221.0
5	56.0	264.1



VOLLMER ROAD
RURAL MINOR ARTERIAL CROSS SECTION
SECTION AA – SCALE: NTS



VOLLMER ROAD
URBAN MINOR ARTERIAL CROSS SECTION
SECTION BB – SCALE: NTS

N

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

DRAINAGE MAP
HOMESTEAD NORTH – FILLING ONE
JOB NO. 25188.00
9/9/22
SHEET 1 OF 2

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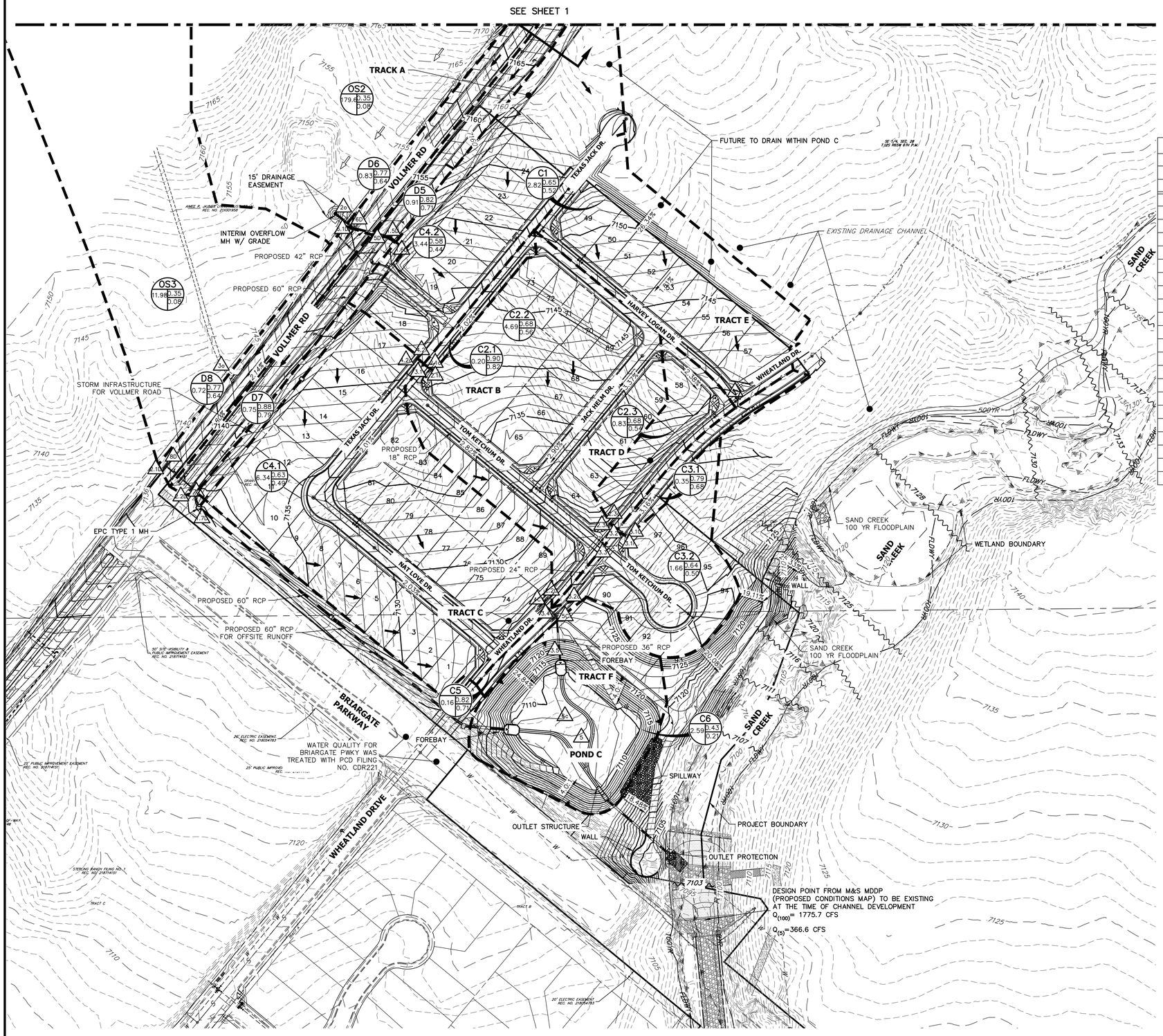
DRAINAGE MAP



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 6100

PROPOSED 6100

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C5	C100	tc (min)	Q5 (cfs)	Q100 (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	1.66	63%	0.49	0.60	9.1	3.5	7.2
C4.1	6.34	65%	0.49	0.63	12.0	12.1	25.9
C4.2	3.59	57%	0.44	0.58	12.9	5.9	13.1
C5	0.16	81%	0.74	0.84	6.4	0.6	1.0
C6	2.59	20%	0.21	0.43	6.8	2.5	8.8
D1	1.77	40%	0.40	0.60	16.5	2.4	6.0
D2	1.44	56%	0.55	0.78	15.0	2.8	6.6
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	0.75	79%	0.72	0.82	5.0	2.8	5.3
D8	0.72	69%	0.64	0.74	5.0	2.4	4.6
OS1	2.84	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	11.98	2%	0.08	0.35	47.6	1.7	12.6

DESIGN POINT SUMMARY TABLE

DP	Q5 Total	Q100 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	13.1
4.2i	5.9	10.5
4C	18.8	41.8
3.1	4.7	11.6
3.1c	1.2	2.4
3.1i	1.2	1.9
3.2	7.9	12.9
3.3	9.1	17.6
3.4	26.0	54.9
3.2c	3.5	7.6
5C	4.0	8.5
6C	2.5	8.8
3.5	30.7	65.0
o1	0.8	6.0
1d	2.4	6.0
1.1d	3.2	11.7
2d	2.8	6.6
1.2d	5.8	18.0
3d	0.6	1.2
4d	0.5	1.1
4.1d	0.5	1.1
1.3d	1.0	2.2
1.4d	6.6	19.6
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	32.7	205.4
1.7d	36.1	221.0
3o	1.7	12.6
8d	2.5	14.3
2.1d	2.5	13.2
7d	2.4	5.3
2.2d	3.5	16.0
1.7d	36.1	221.0
5	56.0	264.1

Design Point	Inlet Size
Inlet DP 2.3C	15' Type R
Inlet DP 2.1C	5' Type R
Inlet DP 4.2C	15' Type R
Inlet DP 3.1C	5' Type R
Inlet DP 4C	20' Type R (15' Type R + 5' Type R)
Inlet DP 5C	15' Type R
Inlet DP 3D	5' Type R
Inlet DP 4D	5' Type R
Inlet DP 5D	10' Type R
Inlet DP 6D	10' Type R
Inlet DP 7D	10' Type R
Inlet DP 8D	15' Type R
Inlet DP 1D	Type D Inlet
Inlet DP 2D	Type D Inlet

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

DRAINAGE MAP
HOMESTEAD NORTH FILLING NO. 1
JOB NO. 25188.00
9/9/22
SHEET 2 OF 2

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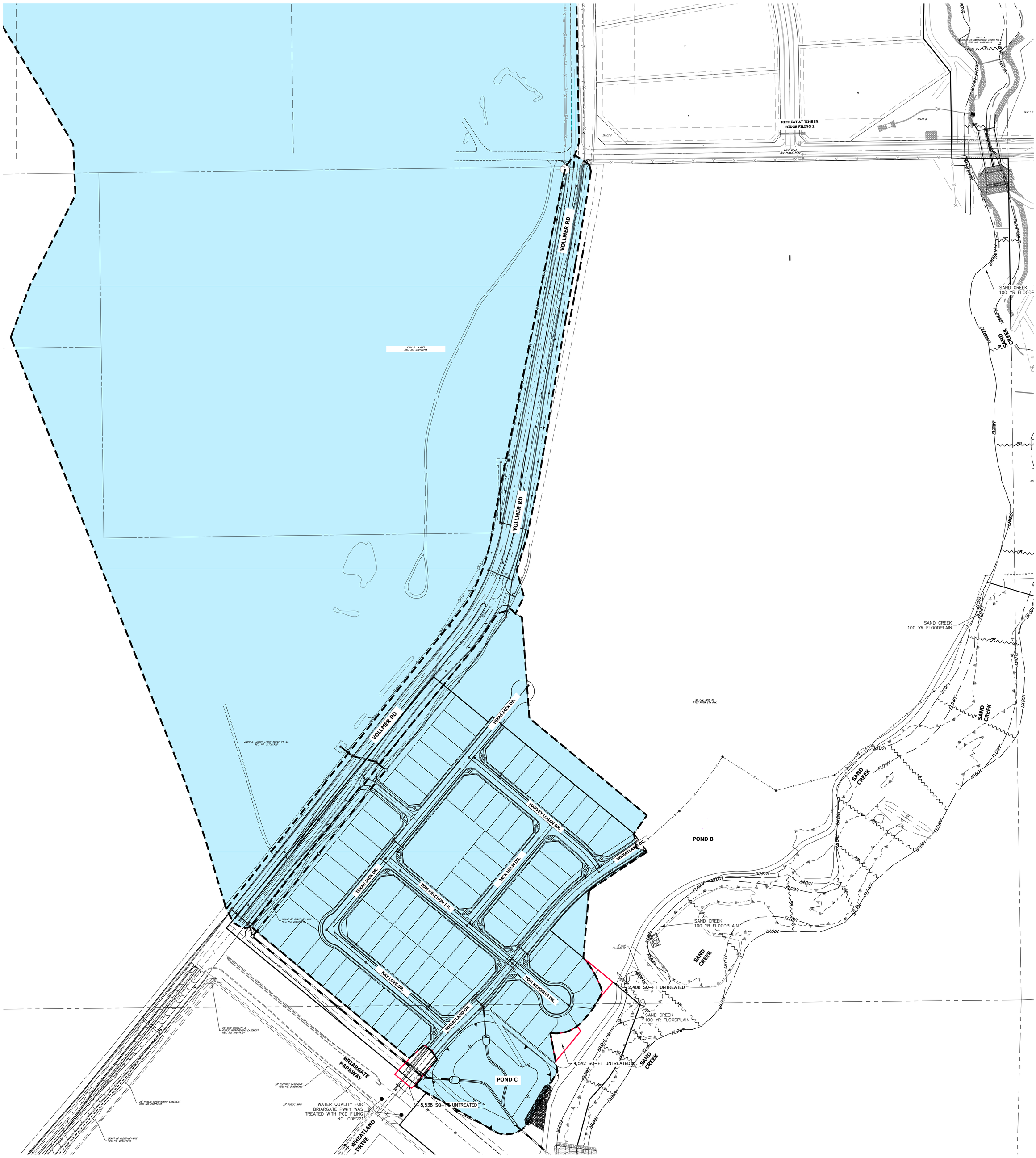
WATER QUALITY CAPTURE PLAN

HOMESTEAD NORTH



NOTE:

1. **A SEPARATE PLAN FOR STERLING RANCH ROAD AND BRIARGATE PKWY WILL BE PROVIDED IN A THE SEPARATE FDR REQUIRED FOR CONSTRUCTION OF THESE ROADWAYS.**
2. **A TOTAL OF 15,488 SQ-FT ON SITE IS LEFT UNTREATED.**
3. **POND C TREATS THE IMPROVEMENTS TO VOLLMER ROAD AND THE OFFSITE TRIBUTARY AREA**

POND C 224.4 ACRES, 10.3% IMPERVIOUS

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

WQ – POND C
HOMESTEAD NORTH – FILING ONE
JOB NO. 25188.00
9/9/22
SHEET 1 OF 1

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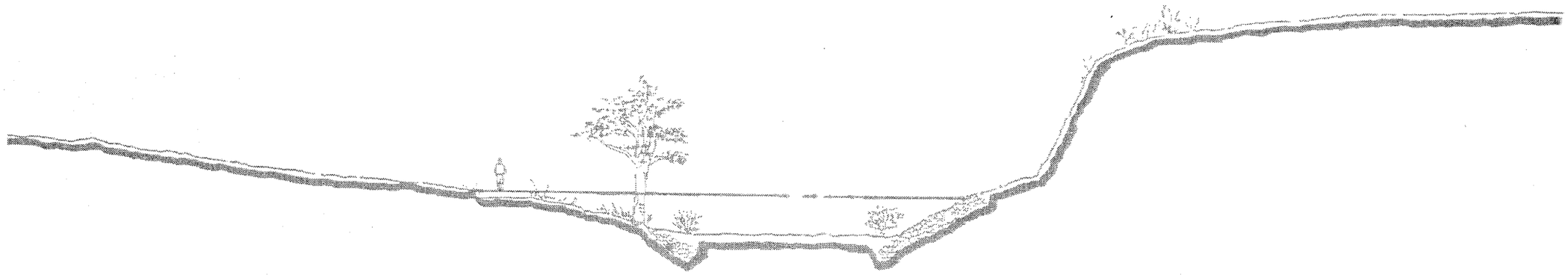
Appendix E
Reference Material

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN REPORT

CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO



PREPARED FOR:

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

PREPARED BY:

Kiowa Engineering Corporation
1011 North Weber
Colorado Springs, CO 80903

II. STUDY AREA DESCRIPTION

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

Basin Description

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

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

Climate

This area of El Paso County can be described, in general as high plains, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry. Precipitation ranges from 14 to 16 inches per year, with the majority of this precipitation occurring in spring and summer in the form of rainfall. Thunderstorms are common during the summer months, and are typified by quick-moving low pressure cells which draw moisture from the Gulf of Mexico into the region. Average temperatures range from about 30^{O}F in the winter to 75^{O} in the summer. The relative humidity ranges from about 25 percent in the summer to 45 percent in the winter.

Soils and Geology

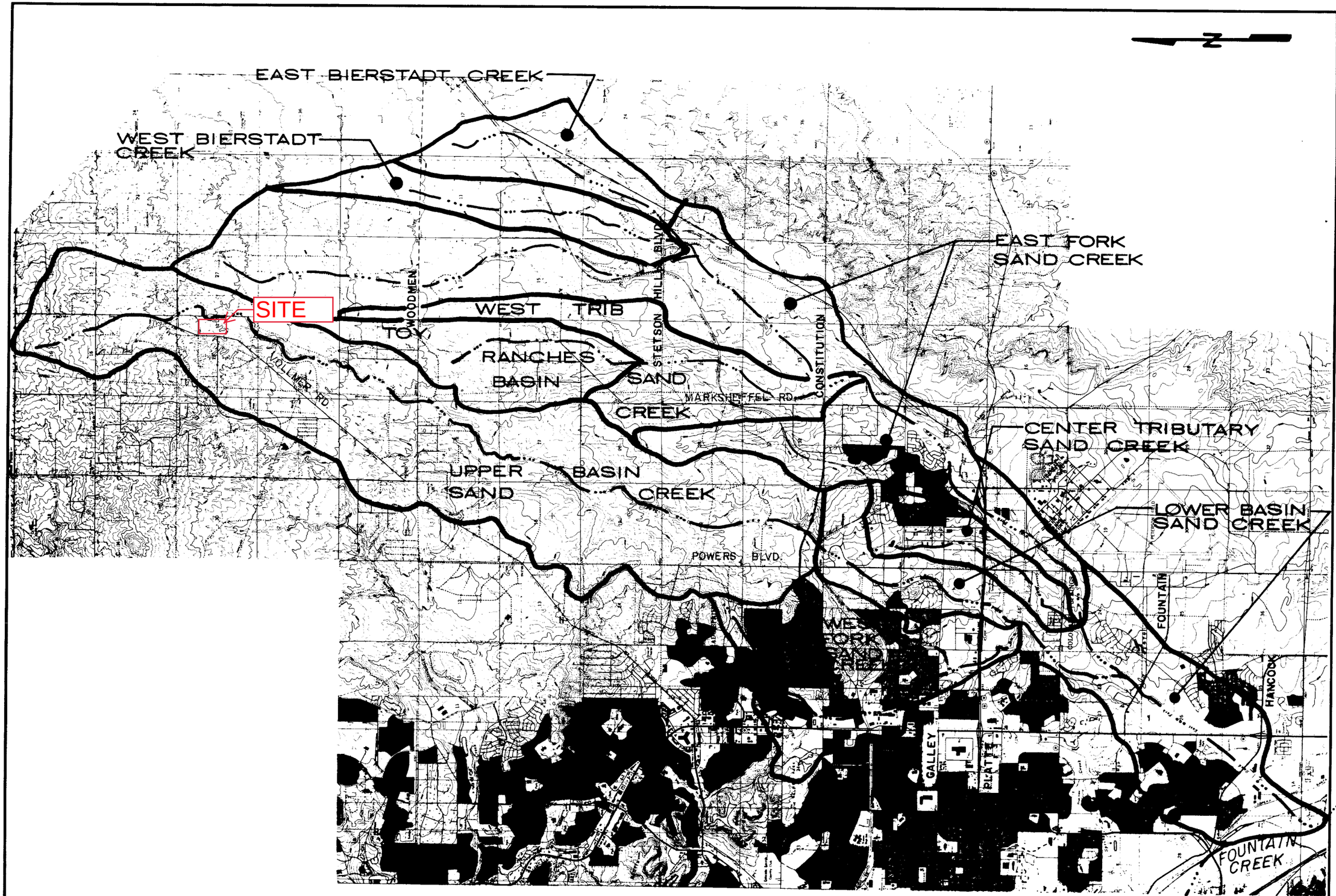
Soils within the Sand Creek basin vary between soil types A through D, as identified by the U. S. Department of Agriculture, Soil Conservation Service. The predominant soil groupings are in the Truckton and Bresser soil associations. The soils consist of deep, well drained soils that formed in alluvium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

Property Ownership and Impervious Land Densities

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

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

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



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

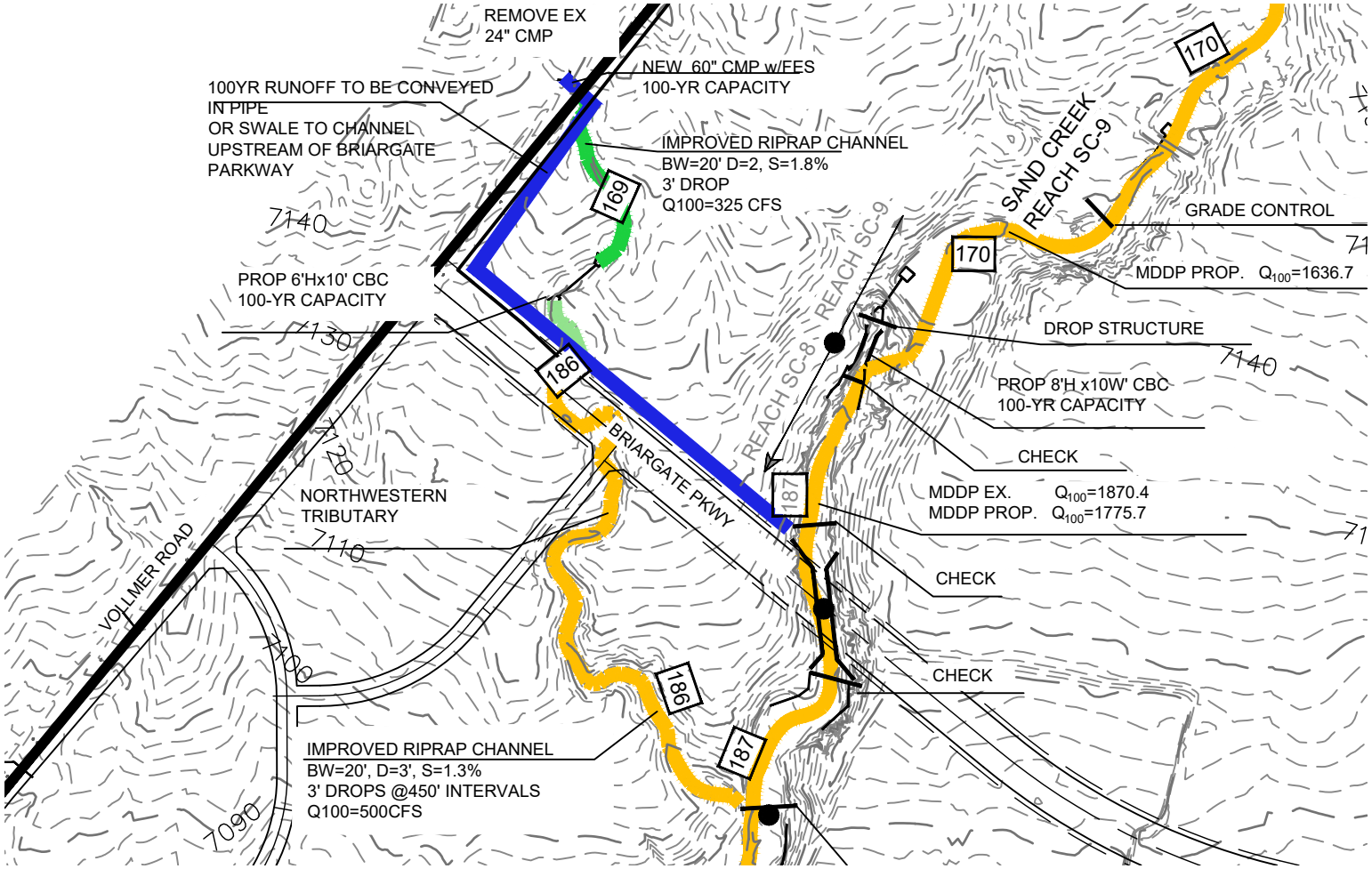
SAND CREEK DRAINAGE BASIN PLANNING STUDY

REGIONAL SUB-BASINS

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

11

FIG. III-1



NORTHWESTERN TRIBUTARY
SHEET 1 OF 5

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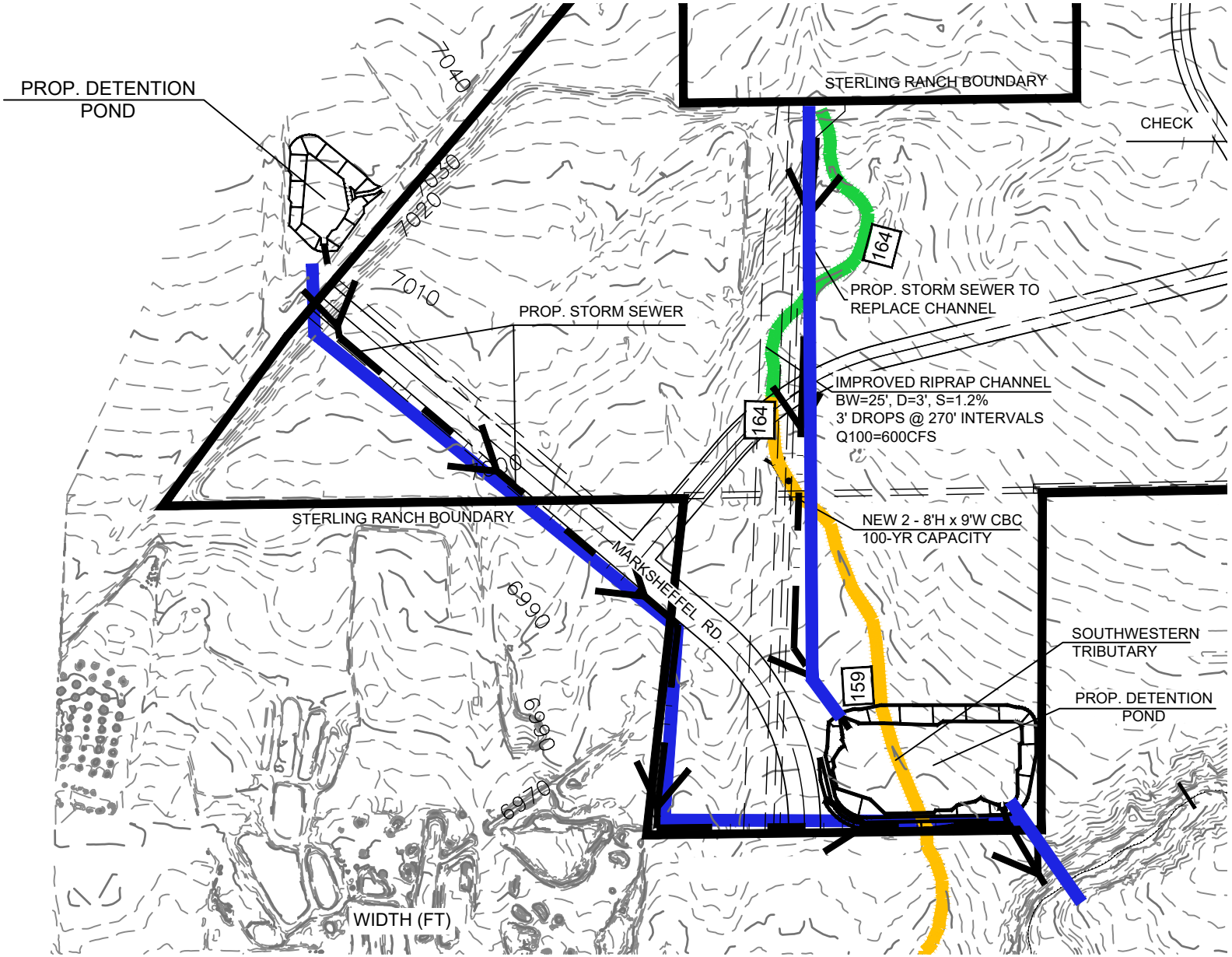

SOUTHWEST TRIBUTARY
SHEET 3 OF 5

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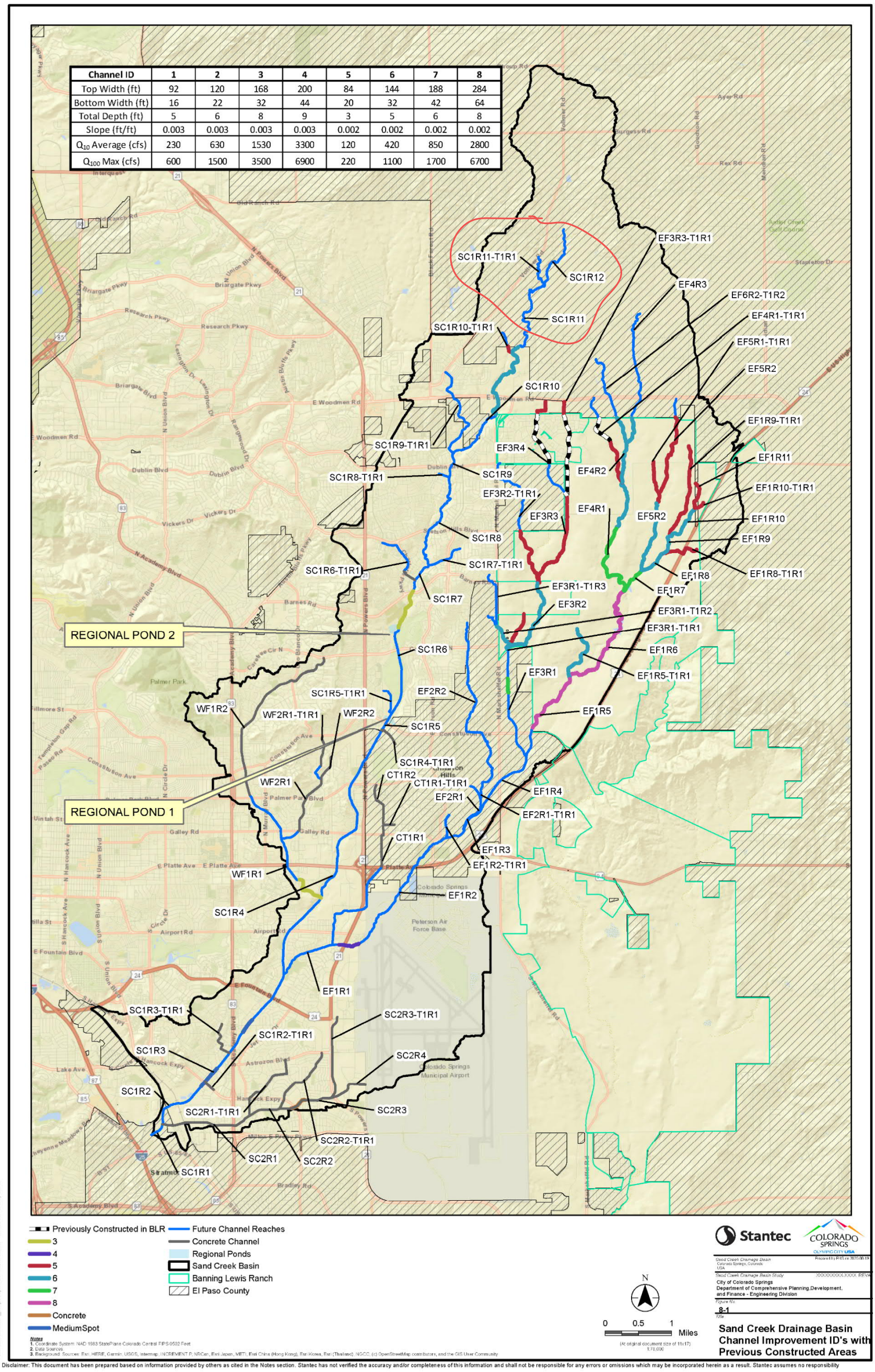
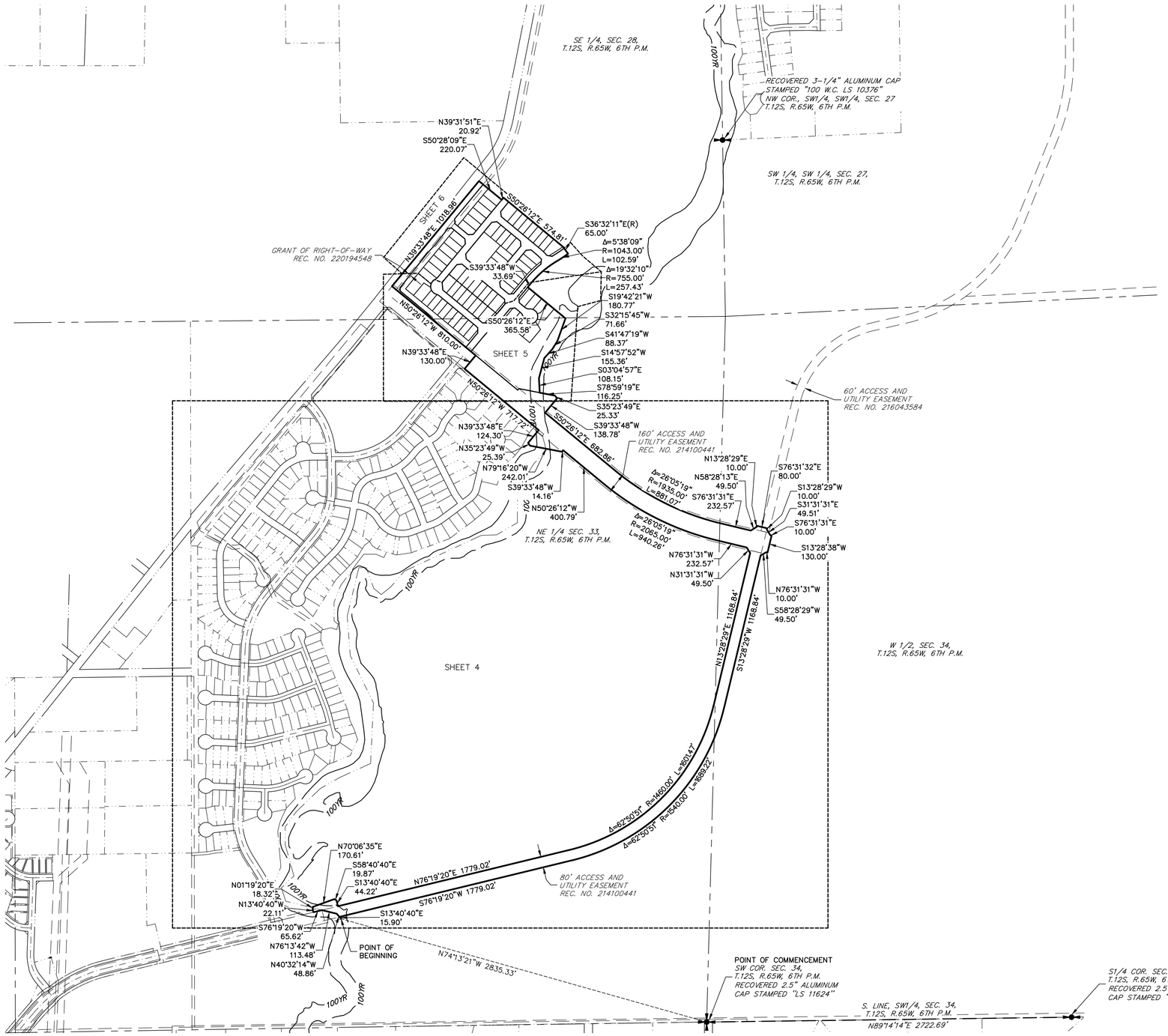


Figure 8-1. Sand Creek Drainage Basin Chanel Improvement IDs with Previous Constructed Areas

HOMESTEAD NORTH AT STERLING RANCH FILING NO. 1

A PORTION OF THE SW1/4 OF THE SW1/4 OF SECTION 27, THE SE1/4 OF SECTION 28, SECTION 33 AND THE W1/2 OF SECTION 34, ALL IN TOWNSHIP 12 SOUTH, RANGE 65 WEST OF THE 6TH PRINCIPAL MERIDIAN COUNTY OF EL PASO, STATE OF COLORADO



LEGEND

▲	RECOVERED 1-1/4" YELLOW PLASTIC CAP STAMPED "LS 10376" AT GRADE
○	SET 18" #5 REBAR W/ 1-1/2" ALUMINUM CAP STAMPED "JR ENG LS 38252" AT GRADE
S.F.	SQUARE FEET
####	ADDRESS
(R) RB	RADIAL BEARING
✳	NOT A PART OF THIS SUBDIVISION
	PROPOSED SUBDIVISION BOUNDARY
	PROPOSED LOT LINE
	PROPOSED RIGHT-OF-WAY LINE
	PROPOSED CENTERLINE
	EXISTING PROPERTY LINE
	EXISTING RIGHT-OF-WAY LINE
	EXISTING CENTERLINE

N

400 200 0 400

ORIGINAL SCALE: 1" = 400'

JOB NO. 25188.00
AUGUST 23, 2022
SHEET 3 OF 6

FILE NO. SF-2213

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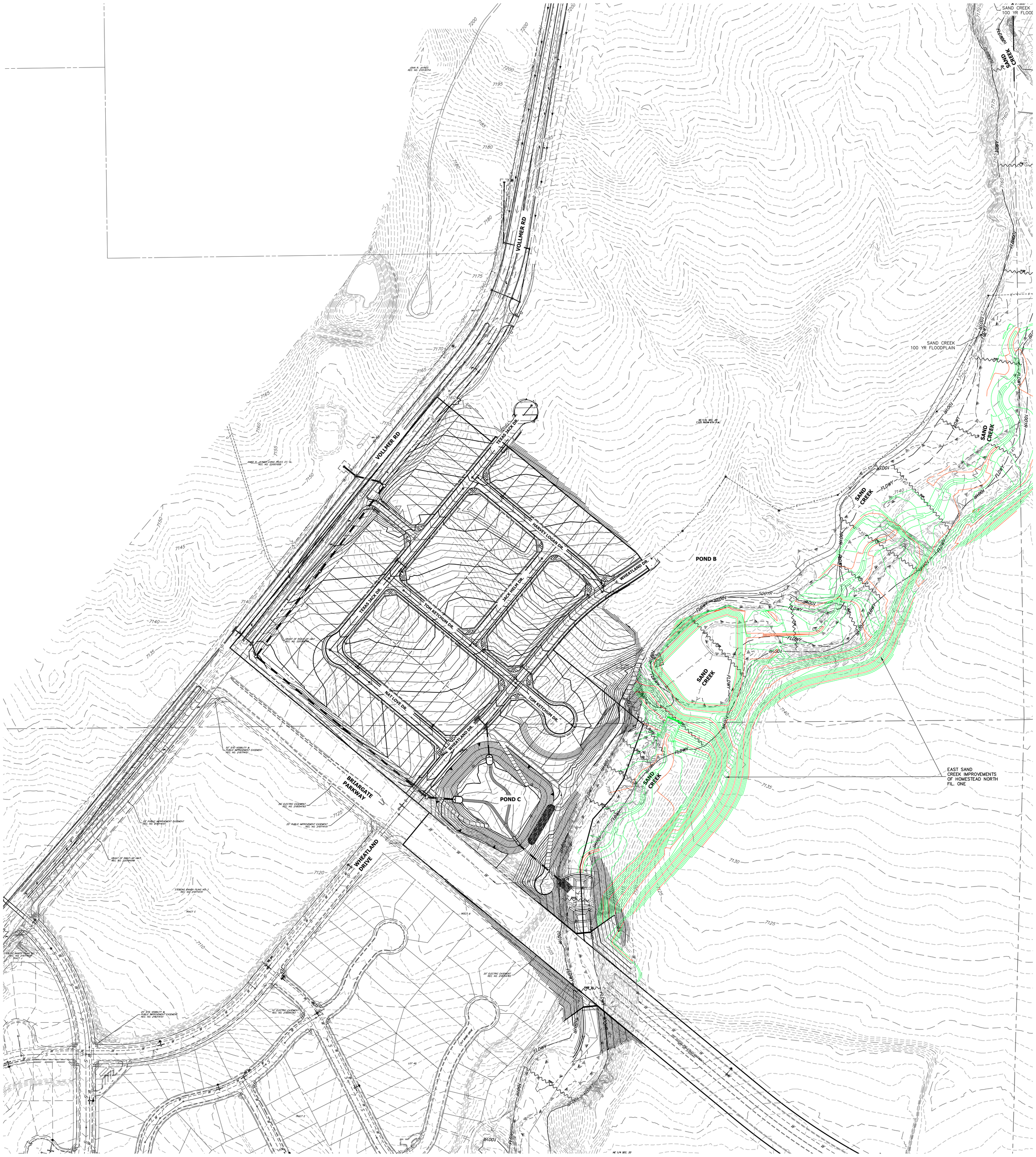
SAND CREEK IMPROVEMENTS

HOMESTEAD NORTH



100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SAND CREEK IMPROVEMENTS
HOMESTEAD NORTH – FILING ONE
JOB NO. 25188.00
06–13–2022
SHEET 1 OF 1

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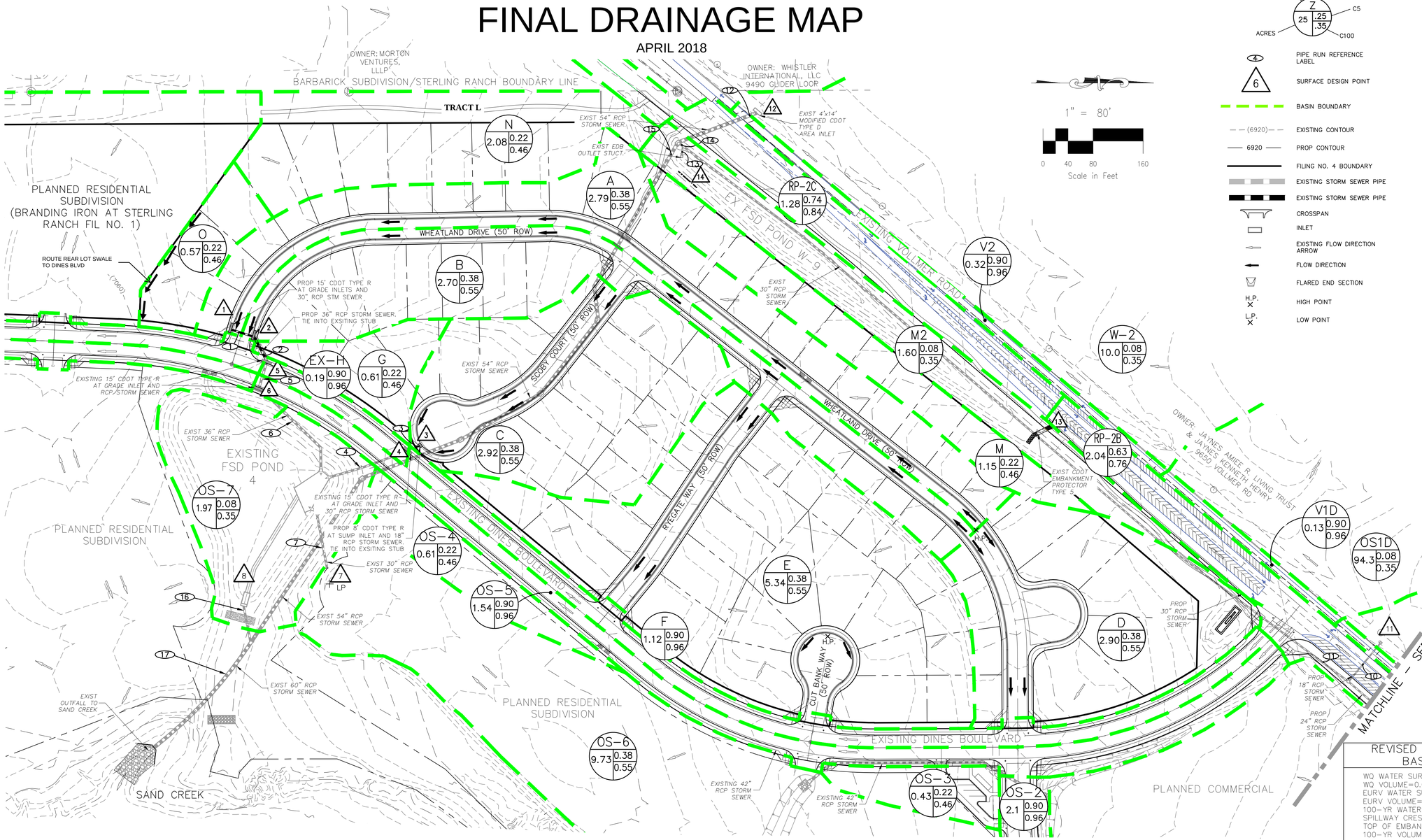
HOMESTEAD AT STERLING RANCH FILING NO. 1

COUNTY OF EL PASO, STATE OF COLORADO

FINAL DRAINAGE MAP

APRIL 2018



LEGEND

- BASIN DESIGNATION (Z; 25 ACRES; .25 / .35; C5; C100)
- PIPE RUN REFERENCE LABEL (4)
- SURFACE DESIGN POINT (6)
- BASIN BOUNDARY
- (6920) EXISTING CONTOUR
- 6920 PROP CONTOUR
- FILING NO. 4 BOUNDARY
- EXISTING STORM SEWER PIPE
- EXISTING STORM SEWER PIPE
- CROSSPAN
- INLET
- EXISTING FLOW DIRECTION ARROW
- FLOW DIRECTION
- FLARED END SECTION
- H.P. HIGH POINT
- L.P. LOW POINT

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
OS2	2.10	8.9	15.9
OS3	0.43	0.4	1.3
OS4	0.61	0.5	1.9
OS5	1.54	5.6	10.0
OS6	9.73	12.5	30.4
OS7	1.97	0.7	5.3
A	2.79	3.6	8.7
B	2.70	3.6	8.6
C	2.92	4.2	10.1
D	2.90	4.3	10.4
E	5.34	8.2	19.9
F	1.12	4.3	7.7
G	0.61	0.5	1.9
EX-H	0.19	0.9	1.6
M	1.15	1.0	3.6
M2	1.60	0.4	3.2
N	2.08	1.6	5.7
O	0.57	0.5	1.8
W-2	10.00	2.7	19.7
OS1 HISTORIC	111.70	18.9	136.8
SUB-BASIN OS1A	2.70	0.7	5.3
SUB-BASIN OS1B	9.09	2.4	17.8
SUB-BASIN OS1C	5.64	1.5	11.1
SUB-BASIN OS1D	94.3	16.3	119.5
V1A	0.31	1.4	2.6
V1B	0.26	1.2	2.2
V1C	0.21	1.0	1.7
V1D	0.13	0.6	1.1
V2	0.32	1.5	2.7
RP-2B	2.04	4.9	9.9
RP-2C	1.28	4.3	8.2

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	3.6	8.7	A	15' AT-GRADE INLET
2	3.6	8.6	B	15' AT-GRADE INLET
3	4.2	10.1	C	8' SUMP INLET
4	16.1	36.7	D, E, F	15' AT-GRADE INLET
5	4.2	19.7	G, EX-H, FLOWBY DP4	EX 15' AT-GRADE INLET
6	14.1	26.7	OS2, OS3, OS4, OS5	EX 15' AT-GRADE INLET
7	12.6	30.5	OS6	EX 18' RCP
8	49.2	105.3	OS7, PR4, PR6, PR7	EX FDS POND 4
9	1.6	7.0	OS1A, V1A	EX 12" CMP CULVERT
10	4.8	26.3	OS1B, V1B, DP6	EX 2.9'x5.7' CDOT TYPE D INLET
11	2.2	12.3	OS1C, V1C,	EX 2.9'x2.9' CDOT TYPE C INLET
12	18.9	133.7	OS1D, V1D, W-2, V2	EX 4'x14' MOD CDOT TYPE D INLET
13	2.8	5.6	RP-2B	EX CDOT EMBANKMENT PROTECTOR TYPE 5
14	8.9	21.2	M, M2, RP2C, DP13	EX FSD POND W-9

STORM SEWER SUMMARY				
PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DP'S
1	3.6	8.7	30" RCP	DP1
2	7.1	17.2	36" RCP	DP2, PR1
3	4.2	10.1	18" RCP	DP3
4	16.8	29.4	30" RCP	DP4, PR3
5	10.8	30.0	36" RCP	DP5, PR2
6	21.0	44.6	36" RCP	DP6, PR5
7	12.6	30.5	24" RCP	DP7
8	1.6	7.0	12" CMP	DP9
9	4.8	26.3	24" RCP	DP10
10	2.2	12.3	18" RCP	DP11
11	7.0	38.6	30" RCP	PR5, PR6
12	18.9	133.7	54" RCP	DP12
13	0.6	8.7	18" RCP	OUTFLOW EDB POND W-9
14	7.6	47.2	30" RCP	PR7, PR9
15	23.8	164.1	54" RCP	PR8, PR10
16	2.7	36.2	30" RCP	OUTFLOW EDB POND 4
17	26.5	200.3	60" RCP	PR11, PR12

REVISED POND 4 FSD BASIN DATA	REVISED POND W-9 FSD BASIN DATA
WQ WATER SURFACE EL = 7056.39	WQ WATER SURFACE EL = 7086.59
WQ VOLUME=0.046 AC-FT	WQ VOLUME=0.092 AC-FT
EURV WATER SURFACE EL = 7058.46	EURV WATER SURFACE EL = 7087.99
EURV VOLUME=1.510 AC-FT	EURV VOLUME=0.390 AC-FT
100-YR WATER SURFACE EL=7059.98	100-YR WATER SURFACE EL=7088.84
SPILLWAY CREST EL=7060.0	SPILLWAY CREST EL=7088.84
TOP OF EMBANKMENT EL=7063.0	TOP OF EMBANKMENT EL=7090.5
100-YR VOLUME=2.915 AC-FT	100-YR VOLUME=0.638 AC-FT
100-YR INFLOW = 105.3 CFS	100-YR INFLOW = 21.2 CFS
100-YR RELEASE = 36.8 CFS	100-YR RELEASE = 8.7 CFS

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20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

HOMESTEAD AT STERLING RANCH FIL NO. 1			
FINAL DRAINAGE MAP			
PROJECT NO. 09-005	SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A	DATE: 4/12/2018	
DESIGNED BY: CMN		SHEET 1 OF 1	FDM01
DRAWN BY: CMN			
CHECKED BY: VAS			

File: C:\Users\emoffett\VpsData\Local\Temp\Proposed Drainage Map_1_1_5096.dwg Plotstamp: 4/24/2018 10:06 AM