FINAL DRAINAGE REPORT
FOR
SADDLEHORN RANCH – FILING 1

Prepared For:
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April 29, 2019
Project No. 25142.02

Prepared By:
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El Paso County PCD File No.

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 Date
For and On Behalf of JR Engineering, LLC

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

Business Name: ROI Property Group, LLC

By: _____

Title: _____
Address: 2495 Rigdon Street
Napa, CA 94558

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

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

Conditions:

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PURPOSE

This document is the Final Drainage report for Filing 1 of Saddlehorn Ranch. The purpose of this report is to:

1. Identify on-site and off-site drainage patterns.
2. Recommend storm water facilities to collect and convey storm runoff from the proposed development to appropriate discharge and/or detention locations.
3. Recommend water quality and detention facilities to control discharge release rates to below historic.
4. Demonstrate compliance with surrounding major drainage basin planning studies, master development drainage plans and flood insurance studies.

GENERAL LOCATION AND DESCRIPTION

Location

The proposed Saddlehorn Ranch Filing 1, known as "Filing 1" from herein, is a parcel of land located in Section 3 and 10, Township 13 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. Saddlehorn Ranch is an 824 acre, rural, single family-development. Filing 1 is 174 acres and is comprised of 55 lots of the overall Saddlehorn Ranch development. Saddlehorn Ranch is bound by Judge Orr Road to the North and Curtis Road to the West. To the East, Saddlehorn Ranch is bound by undeveloped land owned by Brent Houser Enterprises, LLC. To the south, Saddlehorn Ranch is bound by undeveloped properties owned by Carolyn Gudzunas and Faye Reyonlds. Filing 1 is bound by future filings to the North and East while it is bound by Curtis Road to the West and to the South by undeveloped properties owned by Carolyn Gudzunas and Faye Reyonlds. A vicinity map is presented in Appendix A.

Currently, is one major Drainageway that bisects Filing 1: Haegler Ranch Tributary 6 (T-6). This Drainageway was analyzed, both hydrologically and hydraulically, in the following reports:

- Haegler Ranch Basin Drainage Basin Planning Study (DBPS), May 2009.
- Santa Fe Springs – Haegler Ranch Drainage Basin Letter of Map Revision, June 2004.
- Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch, April 2019.

The impact of this Drainageway and planning studies on the proposed development will be discussed later in the report.

Description of Property

Filing 1 is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. In general, Filing 1 slopes from northwest to southeast and the existing Drainageway follows this topography.

Per a NRCS web soil survey of the area, Filing 1 is made up of Type A and B soils. Type A soils cover roughly 91% of Filing 1 while Type B soils cover 9% of Filing 1. Group A soils have a high infiltration rate when thoroughly wet. Type B soils have a moderate infiltration when thoroughly wet. A NRCS soil survey map has been presented in Appendix A.

There are two existing wells in the south west corner of Filing 1.

Floodplain Statement

Based on the FEMA FIRM Map number 08041C0558G, dated December 7, 2018, Filing 1 lies within Zone AE and Zone X. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. All proposed residential development within Filing 1 will occur in Zone X. The FIRM Map has been presented in Appendix A.

DRAINAGE BASINS AND SUBBASINS

Existing Major Basin Descriptions

Filing 1 lies within Haegler Ranch Drainage Basin based on the "*Haegler Ranch Drainage Basin Planning Study*" prepared by URS Corporation in May 2009.

The Haegler Ranch Drainage Basin covers approximately 16.6 square miles in unincorporated El Paso County, CO. The Haegler Ranch Drainage Basin is tributary to Black Squirrel Creek. In its existing condition, the basin is comprised of rolling rangeland with poor vegetative cover associated with Colorado's semi-arid climate. The natural Drainageways within the basin are typically shallow and wide with poorly defined flow paths in most areas. Anticipated land use for the basin includes residential and commercial development. Residential developments will range from 0.125 – 5 acre lots with a mix of low, medium and high density developments.

As part of its drainage research, JR Engineering reviewed the following drainage studies, reports and LOMRs:

- Haegler Ranch Drainage Basin Planning Study prepared by URS Corporation in May 2009
- Santa Fe Springs – Haegler Ranch Drainage Basin Letter of Map Revision prepared by Tri-Core Engineering in June 2004.

- Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch, prepared by JR Engineering, April 2019.

The *Haegler Ranch Drainage Basin Planning Study* was used to establish a stormwater management plan for the existing and future stormwater infrastructure needs within the Haegler Ranch Drainage Basin. Based on provided drainage maps and analysis, in its existing condition Haegler Ranch contributes a 100-year flow of 120 cfs onto Filing 1. The offsite drainage crosses Curtis Road in an existing 36" CMP onto Filing 1. Major Drainageway T-6 conveys the stormwater through Filing 1 and to its off-site confluence with Major Drainageway MS-05. The existing 36" CMP culvert is undersized for existing flows.

The *Haegler Ranch DBPS* evaluated two detention alternatives for the drainage basin: region and sub regional. In the regional approach, it is recommended the existing 36" CMP be upsized to a 60" RCP. In the sub-regional approach, this culvert is recommended to be left in its existing condition.

The existing 36" CMP culvert will not be upsized within the context of this report and development. The culvert is owned by El Paso County and timing of improvements, if any, will be controlled by the County.

Furthermore, the *Haegler Ranch DBPS* recommends channel improvements within Drainageway T-6. Per the *Haegler Ranch DBPS*, Drainageway T-6 should be improved to a trapezoidal channel with an 8' bottom width, 4:1 side slopes and design depth of five feet. The DBPS also recommends a total of seven (7) four-foot drops within the on-site portion of T-6 to limit erosive velocities. The recommended drop structures will not be constructed with Saddlehorn Ranch Filing 1. Proposed channel improvements will limit erosive velocities without the use of drop structures. See recommended channel improvement sheets from the *Haegler Ranch DBPS* presented in Appendix E.

Based on flood impacts, stream stability and cost effectiveness, this study recommended a sub-regional detention approach. This allows future development anywhere in the basin with the construction of an associated sub-regional pond. However, based on the *Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch*, Filing 1 will utilize on-site full spectrum water quality and detention ponds instead. These full spectrum detention ponds will limit developed discharge into the Drainageways to less than historic rates.

The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR was executed on Haegler Ranch Tributary 2, 3, and 4. The LOMR revised the onsite effective flood zone from Zone A to Zone AE. See FIRM Map Panel 08041C0558G for limits of LOMR study and revised flood zones, presented in Appendix E.

Of the three drainageways that were evaluated in the LOMR, Haegler Ranch Tributary 4 passes through Filing 1. Within the boundary of the proposed development, Haegler Ranch Tributary 4 is synonymous with T-6 from the *Haegler Ranch DBPS*. The purpose of the LOMR was to revise the

flood hazard depicted in the current Flood Insurance Study. Per the LOMR, an existing 100-year flow of 130 cfs crosses onto Filing 1 in Haegler Ranch Tributary 4. The off-site flow of 130 cfs carried within Tributary 4 was used to design the 84" CMP culvert and associated channel improvements outline in this report. Plan and profiles of the culvert and Drainageway T-6 improvements has been presented in Appendix F.

See Table 2 for comparison of Drainageway identification and the naming convention used within the context of this report. See Table 3 for a comparison of 100-year flows as calculated in the aforementioned DBPS and LOMR. An existing conditions drainage map is presented in Appendix F.

Table 1: Major Drainageway Naming Convention

Saddlehorn Ranch Filing 1 Final Drainage Report	Per *Haegler Ranch DBPS*:	Per *Sante Fe Springs LOMR*:
T-6	Tributary 6 (T-6)	Haegler Ranch Tributary 4

Table 2: Major Drainageway – Ex. 100-Year Flow Comparison

Drainageway Name	Q_{100} Per *Haegler Ranch DBPS*:	Q_{100} Per Sante Fe Springs LOMR:
T-6	120 cfs	130 cfs

The *Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch* proposed the overall drainage facility design for Saddlehorn Ranch. Within the context of this report, onsite drainage basins and associated full spectrum water quality ponds were established. As it pertains to Filing 1, three full spectrum water quality ponds are recommended. Roadside ditches and local street culverts will be utilized to capture and convey Filing 1's runoff to the water quality ponds. Water quality ponds will discharge into Drainageway T-6 at less than historic rates.

In order to maintain the function of Drainageway T-6, the PDR/MDDP recommends an 84" corrugated metal pipe (CMP) culvert at the crossing of Del Cerro Trail and Drainageway T-6. This culvert has been designed to ensure a no-rise scenario in the floodplain is achieved.

Existing Sub-basin Drainage

On-site, existing sub-basin drainage patterns are generally from northwest to southeast by way of Drainageway T-6. On-site areas flow directly into this drainageway, which also bypasses off-site flow through Filing 1.

Proposed Sub-basin Drainage

Within the boundary of Filing 1, a 14.0 acre portion of Basin F is included which is comprised of Sub-basins F1-F4. The remaining area of Basin F is included within future Filings 2 and 3. In its existing condition, Basin F is rolling rangeland and runoff generally flows southeast towards Drainageway MS-06. In the proposed condition of Basin F within Filing 1, only four 2.5 acre lots will be developed and the remaining area will be undeveloped. During Filing 1, runoff from this basin will be captured in roadside ditches and conveyed to one of two temporary sediment basins. Sub-basins F1 and F2 will be routed to Sediment Basin F1 and Sub-basin F3 and F4 will be routed to Sediment Basin F2. During the construction of Filing 2, the rest of Basin F will be developed and the two sediment basins will be replaced with a single full spectrum water quality and detention pond, as shown in the MDDP.

Basin G consists of Sub-basins G1-G7, F-G1 & F-G2 combining for a total of 46.5 acres. In its existing condition, Basin G is rolling rangeland and runoff generally flows south and west to Drainageway T-6. In the proposed condition, Basin G will be rural 2.5 acre lots, paved roadway and will include Pond G. Basins F-G1 & F-G2 are Basin G area outside of Filing 1, however; these basins are tributary to Filing 1 and will be fully developed in future Filing 2. Therefore, F-G1 & F-G2 were analyzed as developed basins within the context of this report to adequately size ditches, culverts and water quality pond for the fully developed future condition. Runoff from this basin will be collected in road side ditches and conveyed south along El Raiceno Trail and west along Carranza Trail to Pond G. Pond G will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6.

Basin H consists of Sub-Basins H1-H4 combining for a total of 21.2 acres. In its existing condition, Basin H is rolling rangeland and runoff generally flows southeast towards Drainageway T6. In the proposed condition, Basin H will be rural 2.5 acre lots, paved roadway and will include Pond H. Runoff from this basin will be collected in road side ditches and conveyed along Rosalia Place to Pond H. Pond H will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6.

Basin I consists of Sub-basins I1-I7 combining for a total of 37.4 acres. In its existing condition, Basin I is rolling rangeland and runoff generally flows east across the basin towards Drainageway T-6. In the proposed condition, Basin I will be rural 2.5 acre lots, paved roadway and will include Pond I. Runoff from this basin will be collected in road side ditches and conveyed south down Carrizo Springs Trail and east down Zaragoza Trail to Pond I. Pond I will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6.

Basin UD1-UD6 combine for a total of 53.4 acres. In their existing condition, these basins are rolling rangeland. Runoff from basins UD1-UD3 generally flows south and east to Drainageway T-6, while basins UD4 & UD5 generally flow south and west to Drainageway T-6. Basin UD-6 flows directly south and off site. In the proposed condition, basins UD1-UD6 will be rural 2.5 acre lots, however; basin UD2 and UD3 contain approximately 440 linear feet of paved roadway. Consistent with the

Saddlehorn Ranch PDR/MDDP, these basins will follow existing drainage patterns and will not be captured by a full spectrum water quality and detention pond.

Basin OS1-OS3 combine for a total of 2.06 acres of offsite area. In their existing condition, these basins are paved roadway (Curtis Road) and undeveloped area. In the proposed condition, basin OS2 and OS3 will remain as is and the stretch of Curtis Road within basin OS1 will be improved with a deceleration lane for access to Filing 1. This will have a negligible impact on the runoff generated from this basin. Basin OS1-OS3 will follow existing drainage patterns and will flow on-site prior to capture in a roadside ditch and conveyed to Pond H. Pond H will be a full spectrum water quality and detention pond and will release at less than historic rates into Drainageway T-6.

A summary table of proposed basin parameters and flow rates has been presented in Appendix B.

Basins G, H and I runoff will be captured in roadside ditches and conveyed to a corresponding full spectrum water quality and detention pond. Each full spectrum pond will release treated flows at less than historic rates to minimize adverse impacts downstream. Ponds G, H and I will discharge into Major Drainageway T-6. Basin F flows will be captured in roadside ditches and conveyed to two temporary sediment basins. When Filing 2 development commences, these sediment basins will be replaced with a single full spectrum water quality pond (Pond F).

See Table 5 below for comparison of proposed Filing 1 pond parameters.

Table 3: Pond Summary

Tributary Sub-Basin	Pond Name	Tributary Acres	Comp. % Imperv.	WQ Volume (ac-ft)	Total Detention Volume (ac-ft)	Provided Volume (ac-ft)	Maximum 100-Year Discharge (cfs)
G	POND G	33.57	18.6	0.307	1.244	1.286	1.80
H	POND H	21.16	17.0	0.181	0.730	0.772	6.5
I	POND I	37.43	17.0	0.320	1.334	1.391	6.6

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the "*City of Colorado Spring/El Paso County Drainage Criteria Manual*" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "*Urban Storm Drainage Criteria Manual"* Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the "Colorado Springs Drainage Criteria Manual (CCSDCM), 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. Rational Method calculations were prepared, in accordance with Section 13.3.2.1. of the CCSDCM, for the sub-basins that directly impact the sizing of ditches and local street culverts. Rational method calculations are presented in Appendix B.

Urban Drainage and Flood Control District’s UD-Detention, Version 3.07 workbook was used for pond sizing. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. Pond sizing spreadsheets are presented in Appendix D.

Hydraulic Criteria

The Federal Highway Administration’s HY-8 program (Volume 7.50) was used to analyze the proposed box culvert within Drainageway T-6. Per Section 14.3.2 of the CCS/EPCDCM, a maximum headwater to rise ratio of 1.5 was used to size the 84” CMP culvert. The culvert was designed in conjunction with channel improvements to ensure a no rise scenario of the current floodplain elevations. A summary report of the 84” CMP culvert design is presented in Appendix C.

Autodesk Inc.’s Hydraflow Express Extension (Volume 10.5) was used for roadside ditch design. Ditches were checked for velocity and capacity per the CCS/EPCDCM Section 12.3.2.2. In order to check capacity, a cross section analysis was performed on the roadside ditch with the basin’s minimum ditch slope. In order to check velocity, a cross section analysis was performed on the roadside ditch with the basin’s maximum ditch slope. Ditch cross sections have been presented in Appendix C.

Autodesk Inc.’s Hydraflow Express Extension (Volume 10.5) was used for local road crossing culvert design. Culvert size was determined based on 100-year flows and hydraulic criteria from EPCDCM Chapter 9 –Culvert Design. All local road crossing culverts are 18” or 24” CMP. Culvert design reports are presented in Appendix C.

DRAINAGE FACILITY DESIGN

General Concept

The proposed stormwater conveyance system was designed to convey the developed Filing 1 runoff to full spectrum water quality and detention ponds (Pond G, H, I) via roadside ditches and local street culverts. Pond G, H, and I were designed to release at less than historic rates to minimize adverse impacts downstream.

An 84" CMP culvert is proposed within Drainageway T-6 to convey existing, off site flows underneath Del Cerro Trail and through Filing 1, to maintain T-6 drainage patterns presented with the *Haegler Ranch DBPS*.

A trapezoidal channel section, 50' bottom width w/ 10:1 daylights to existing, is proposed 1,200 feet downstream and 650 feet upstream of the 84" CMP culvert in order to maintain water surface elevations at or below the current floodplain's base flood elevations. A proposed drainage map is presented in Appendix F showing locations of channel and culvert improvements.

Specific Details

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, stabilizing drainageways, treating the water quality capture volume (WQCV), and consider the need for Industrial Commercial BMP's.

Step 1, Reducing Runoff Volumes: The development of the project site is proposed single family residential lots (2.5 ac. min.) with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roadways utilize soil riprap lined roadside ditches further disconnecting impervious areas. These practices will also allow for increased infiltration and reduce runoff volume.

Step 2, Stabilize Drainageways: Filing 1 utilizes roadside ditches with culvert crossings throughout. These roadside ditches direct the on-site development flows to the multiple detention ponds within the project that release at or below historic rates into Drainageway T-6. Drainageway T-6 is stabilized upstream and downstream of the Del Cerro Trail culvert crossing. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream Drainageway T-6 is anticipated.

Step 3, Provide WQCV: Runoff from this development is treated through capture and slow release of the WQCV in multiple full spectrum water quality and detention ponds that are designed per current El Paso County drainage criteria.

Step 4 Consider the need for Industrial and Commercial BMP's: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative are prepared in conjunction with this report. Site specific temporary source control BMPs as well as permanent BMP's are detailed in this plan and narrative to protect receiving waters.

Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention are provided for all developed basins. Outlet structure release rates are limited to less

than historic rates to minimize adverse impacts to downstream stormwater facilities. Complete pond and outlet structure designs are presented in Appendix D.

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 Filing 1 is submitted concurrently 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. All proposed drainage structures within the any platted County ROW will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts will be owned and maintained by the 824 Acre Metropolitan District (to be officially named and established prior to final platting). An Inspection & Maintenance Plan is submitted concurrently with this drainage report that details the required maintenance activities and intervals to ensure proper function of all stormwater infrastructure in the future.

Drainage and Bridge Fees

Drainage and Bridge Fees are due at time of final platting. An estimate of basin fees for the proposed development within Haegler Ranch drainage basin is provided in Table 6. Basin and bridge fees are presented in Table 6 below.

Table 4: Drainage Basin and Bridge Fees

El Paso County - Haegler Ranch Drainage Basin Fees						
Area (acre)	Composite % Impervious	Total Impervious Acreage	2018 Drainage Fee (per Impervious Acre)	2018 Bridge Fee (per Impervious Acre)	Filing 1 Drainage Fee	Filing 1 Bridge Fee
179.8	15.9%	28.59	$10,324	$1,524	$295,163.16	$43,571.16

Construction Cost Opinion

(For Information Only / Non-Reimbursable)
Cost opinion has been presented in Appendix A.

SUMMARY

The proposed development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements, including ditches, culverts, detention ponds and drainage channel improvements. The proposed development will not adversely affect the offsite major Drainageways or surrounding development. This report meets the latest El Paso County

Drainage Criteria requirements for this site and is in accordance with the PDR/MDDP for Saddlehorn Ranch.

REFERENCES:

1. City of Colorado Springs Drainage Criteria Manual Volume 1, City of Colorado Springs, CO, May 2014.

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. Preliminary Drainage Report/Master Development Drainage Plan for Saddlehorn Ranch, J.R. Enbgineering, April 2019.

4. Haegler Ranch Drainage Basin Planning Study, URS Corporation, May 2009.

5. The Santa Fe Springs – Haegler Ranch Drainage Basin LOMR, Federal Emergency Management Agency, October 20, 2004.

APPENDIX A

FIGURES AND EXHIBITS

VICINITY MAP
SADDLEHORN RANCH
25142.00
01/17/19
SHEET 1 OF 1

5000 2500 0 5000 10000

ORIGINAL SCALE: 1" = 5000'

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Hydrologic Soil Group—El Paso County Area, Colorado

Map Scale: 1:13,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

Streams and Canals

Transportation

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

Background

Aerial Photography

MAP INFORMATION

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

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 16, Sep 10, 2018

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

Date(s) aerial images were photographed: May 22, 2016—Aug 17, 2017

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	388.3	44.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	307.3	35.3%
29	Fluvaquentic Haplaquolls, nearly level	D	150.0	17.2%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	24.6	2.8%
95	Truckton loamy sand, 1 to 9 percent slopes	A	0.6	0.1%
Totals for Area of Interest			**870.8**	**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 64 WEST, AND TOWNSHIP 13 SOUTH, RANGE 64 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)
^{4275000m}N	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0558G

NATIONAL FLOOD INSURANCE PROGRAM

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

PANEL 558 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0558	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
08041C0558G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

2019 Financial Assurance Estimate Form

(Basic form)

Project Information	
Saddlehorn Ranch - Filing 1	3/5/2019
Project Name	Date

Section 1 - Grading and Erosion Control BMPs	Quantity	Units		Price			
Earthwork* (CIP)	61,992.00	CY	@	$ $5	=	$ 309,960.00	*
Permanent Seeding* (inc. noxious weed management)	4.60	AC	@	$ $582	=	$ 2,677.20	*
Mulching*	4.60	AC	@	$ $507	=	$ 2,332.20	*
Permanent Erosion Control Blanket*	10,120.00	SY	@	$ $6	=	$ 60,720.00	*
Temporary Erosion Control Blanket		SY	@	$ $3		$	
Vehicle Tracking Control	1.00	EA	@	$ $1,625	=	$ 1,625.00	
Safety Fence		LF	@	$ $3	=	$	
Silt Fence	11,840.00	LF	@	$ $4	=	$ 47,360.00	
Construction Markers	11,050.00	LF	@	$ $4	=	$ 44,200.00	
Temporary Seeding		AC	@	$ $485	=	$	
Temporary Mulch		AC	@	$ $507	=	$	
Erosion Bales		EA	@	$ $21	=	$	
Erosion Logs		LF	@	$ $6	=	$	
Rock Ditch Checks		EA	@	$ $98	=	$	
Inlet Protection	13.00	EA	@	$ $153	=	$ 1,989.00	
Outlet Protection	15.00	EA	@	$ $153	=	$ 2,295.00	
Sediment Basin	5.00	EA	@	$ $1,625	=	$ 8,125.00	
Concrete Washout Basin	1.00	EA	@	$ $776	=	$ 776.00	
			@	$	=	$	
specified items subject to defect warranty financial assurance							
				Section 1 Subtotal	=	$ 482,059.40	

Section 2 - Public Improvements**	Quantity	Units		Price		
- Roadway Improvements						
Construction Traffic Control	1.00	LS	@	$ 25,000	=	$ 25,000.00
Aggregate Base Course	15,559.00	Tons	@	$ $18	=	$ 280,062.00
Asphalt Pavement	16,315.00	Tons	@	$ $65	=	$ 1,060,475.00
Raised Median, Paved		SF	@	$ $7	=	$
Electrical Conduit, Size =		LF	@	$ $14	=	$
Traffic Signal, complete intersection		EA	@	$ $250,000	=	$
Regulatory Sign	6.00	EA	@	$ $100	=	$ 600.00
Advisory Sign		EA	@	$ $100	=	$
Guide/Street Name Sign	6.00	EA	@	$ $200		$ 1,200.00
Epoxy Pavement Marking	668.00	SF	@	$ $12	=	$ 8,016.00
Thermoplastic Pavement Marking		SF	@	$ $22	=	$
Barricade - Type 3	2.00	EA	@	$ $115	=	$ 230.00
Delineator (Type I)		EA	@	$ $21	=	$
Curb and Gutter, Type C (Ramp)		LF	@	$ $21	=	$
Curb and Gutter, Type A (6" Vertical)		LF	@	$ $16	=	$
Curb and Gutter, Type B (Median)		LF	@	$ $13	=	$
Pedestrian Ramp		SY	@	$ $108	=	$
Cross Pan		SY	@	$ $53	=	$
Sidewalk		LF	@	$ $23		$
Guardrail Type 3 (W-Beam)		LF	@	$ $18	=	$
Guardrail Type 7 (Concrete)		LF	@	$ $67	=	$
Guardrail End Anchorage		EA	@	$ $1,978	=	$
Guardrail Impact Attenuator		EA	@	$ $3,564	=	$
Sound Barrier Fence		LF	@	$ $100	=	$

- Storm Drain Improvements							
Concrete Box Culvert (M Standard), Size (W x H)			LF	@	$	=	$
Reinforced Concrete Pipe (RCP)	Size		LF	@	$	=	$
18" Reinforced Concrete Pipe			LF	@	$ $69	=	$
24" Reinforced Concrete Pipe			LF	@	$ $84	=	$
30" Reinforced Concrete Pipe			LF	@	$ $94	=	$
36" Reinforced Concrete Pipe			LF	@	$ $124	=	$
42" Reinforced Concrete Pipe			LF	@	$ $134	=	$
48" Reinforced Concrete Pipe			LF	@	$ $178	=	$
54" Reinforced Concrete Pipe			LF	@	$ $182	=	$
60" Reinforced Concrete Pipe		34.00	LF	@	$ $216	=	$ 7,344.00
66" Reinforced Concrete Pipe			LF	@	$ $263	=	$
72" Reinforced Concrete Pipe			LF	@	$ $283	=	$
Corrugated Steel Pipe (CSP)	Size		LF	@	$	=	$
18" Corrugated Steel Pipe		247.00	LF	@	$ $66	=	$ 16,302.00
24" Corrugated Steel Pipe		102.00	LF	@	$ $96	=	$ 9,792.00
30" Corrugated Steel Pipe			LF	@	$ $101	=	$
36" Corrugated Steel Pipe			LF	@	$ $136	=	$
42" Corrugated Steel Pipe			LF	@	$ $147	=	$
48" Corrugated Steel Pipe			LF	@	$ $169	=	$
54" Corrugated Steel Pipe			LF	@	$ $193	=	$
60" Corrugated Steel Pipe			LF	@	$ $227	=	$
66" Corrugated Steel Pipe			LF	@	$ $278	=	$
72" Corrugated Steel Pipe			LF	@	$ $330	=	$
78" Corrugated Steel Pipe			LF	@	$ $381	=	$
84" Corrugated Steel Pipe		109.00	LF	@	$ $432	=	$ 47,088.00
Flared End Section (FES) RCP	+		EA	@	$ 1,800	=	$
18" Flared End Section (FES) CSP	+	15.00	EA	@	$ 1,200	=	$ 18,000.00
24" Flared End Section (FES) CSP	+	4.00	EA	@	$ 1,500	=	$ 6,000.00
End Treatment- Headwall			EA	@	$ 5,000	=	$
End Treatment- Wingwall			EA	@	$ 9,000	=	$
End Treatment - Cutoff Wall			EA	@	$ 500	=	$
Curb Inlet (Type R) L=5', Depth < 5 feet			EA	@	$ $3,791	=	$
Curb Inlet (Type R) L=5', 5'-10' Depth			EA	@	$ $5,044		$
Curb Inlet (Type R) L =5' , 10'-15' Depth			EA	@	$ $6,027	=	$
Curb Inlet (Type R) L =10', Depth < 5 feet			EA	@	$ $5,528	=	$
Curb Inlet (Type R) L =10' , 5'-10' Depth			EA	@	$ $6,694	=	$
Curb Inlet (Type R) L =10' , 10'-15' Depth			EA	@	$ $7,500	=	$
Curb Inlet (Type R) L =15' , Depth < 5 feet			EA	@	$ $7,923	=	$
Curb Inlet (Type R) L =15' , 5'-10' Depth			EA	@	$ $8,000	=	$
Curb Inlet (Type R) L =15' , 10'-15' Depth			EA	@	$ $8,800	=	$
Curb Inlet (Type R) L =20' , Depth < 5 feet			EA	@	$ $8,000	=	$
Curb Inlet (Type R) L =20' , 5'-10' Depth			EA	@	$ $8,830	=	$
Curb Inlet (Type R) L =_____', __' - __' Depth			EA	@	$	=	$
Curb Inlet (Type R) L =_____', __' - __' Depth			EA	@	$	=	$
Grated Inlet (Type C), < 5' deep			EA	@	$ $3,270	=	$
Grated Inlet (Type D), < 5' deep			EA	@	$ $3,908	=	$
Storm Sewer Manhole, Box Base, Depth < 15 feet			EA	@	$ $8,592	=	$
Storm Sewer Manhole, Slab Base, Depth < 15 feet			EA	@	$ $4,575	=	$
Geotextile (Erosion Control)			SY	@	$ $5	=	$
Rip Rap, d50 Size from 6" to 24"			CY	@	$ $98	=	$

Rip Rap, Grouted		CY	@	$ $215	=	$
Drainage Channel Construction, Size (W' x H')		LF	@	$	=	$
Channel Lining, Concrete		CY	@	$ $450	=	$
Channel Lining, Rip Rap		CY	@	$ $98	=	$
Channel Lining, Grass		AC	@	$ $1,287	=	$
Channel Lining, Other Stabilization		SY	@	$ $3	=	$
Detention Outlet Structure		EA	@	$ 5,000	=	$
Detention Emergency Spillway		EA	@	$ 4,000	=	$
Permanent Water Quality Facility (Describe)		EA	@	$ 5,000	=	$
~150 SY footprint, ~ 4' depth						
**all items this section subject to defect warranty financial assurance. ┼ For flared end sections, multiply pipe LF cost by 6				**Section 2 Subtotal**	=	$ 1,480,109.00 **

Section 3 - Common Development Improvements (Private or District)***	Quantity	Units		Price		
- Roadway Improvements						
(Include any applicable items from above Public Improvements list, that are to be private and NOT maintained by El Paso County)			@	$	=	$
			@	$	=	$
			@	$	=	$
Epoxy Pavement Marking		SF	@	$ $12	=	$
Curb and Gutter, Type C (Ramp)		LF	@	$ $21	=	$
Curb and Gutter, Type A (6" Vertical)		LF	@	$ $16	=	$
Pedestrian Ramp		SY	@	$ $108	=	$
Concrete Sidewalk		SY	@	$ $38	=	$
- Storm Drain Improvements						
(Include any applicable items from above Public Improvements list, that are to be private and NOT maintained by El Paso County)			@	$	=	$
			@	$	=	$
			@	$	=	$
Corrugated Metal Pipe (CMP) Size - 18"	137.00	LF	@	$ 66	=	$ 9,042.00
Detention Outlet Structure	2.00	EA	@	$ 5,000	=	$ 10,000.00
Detention Emergency Spillway	3.00	EA	@	$ 4,000	=	$ 12,000.00
Flared End Section (FES) RCP ┼	3.00	EA	@	$ 390	=	$ 1,170.00
Permanent Water Quality Facility (Describe)	3.00	EA	@	$ 5,000	=	$ 15,000.00
~150 SY footprint, ~ 4' depth						
Gravel Pond Maintenance Access Road	1,500.00	SY	@	$ $45	=	$ 67,500.00
Channel Lining, Rip Rap	445.00	CY	@	$ $98	=	$ 43,610.00
Channel Lining, Grass	5.00	AC	@	$ $1,287	=	$ 6,435.00
- Water System Improvements						
Water Main Pipe (PVC), Size 8"	7,000.00	LF	@	$ $94	=	$ 658,000.00
Water Main Pipe (Ductile Iron), Size 8"		LF	@	$ $137	=	$
Gate Valves, 8"	63.00	EA	@	$ $1,852	=	$ 116,676.00
Water Main Pipe (PVC), Size 16"	3,200.00	LF	@	$ $130	=	$ 416,000.00
Gate Valves, 16"	11.00	EA	@	$ $4,200		$ 46,200.00
Fire Hydrant Assembly w/ all valves	13.00	EA	@	$ $6,430	=	$ 83,590.00
Water Service Line Installation, inc. tap & valves	55.00	EA	@	$ $1,253	=	$ 68,915.00
Water Treatment Plant	1.00	LS	@	$ $3,800,000	=	$ 3,800,000.00

- Sanitary Sewer Improvements						
Sewer Main Pipe (PVC), Size 8"		LF	@	$ $94	=	$
Sanitary Sewer Manhole, Depth < 15 feet		EA	@	$ $4,575	=	$
Sanitary Service Line Installation, complete		EA	@	$ 1,516	=	$
Sanitary Sewer Lift Station, complete		EA	@	$	=	$
- Landscaping (If Applicable)						
(List landscaping line items and cost - usually only in case of subdivision specific condition of approval, or PUD)		EA	@	$	=	$
		EA	@	$	=	$
		EA	@	$	=	$
		EA	@	$	=	$
		EA	@	$	=	$
***items in this section are not subject to defect warranty financial assurance				**Section 3 Subtotal**	=	$ 5,354,138.00

Financial Assurance Totals			
As-built drawings - **(FILL IN IF THERE ARE ANY PUBLICLY-MAINTAINED IMPROVEMENTS)**			$ 10,000.00
(Inc. survey to verify detention pond volumes.) **Construction Financial Assurance Total**		=	$ 7,326,306.40
(Sum of all Section Totals)			
Public Improvements Total* **			$ 1,855,798.40
Defect Warranty Financial Assurance Total		=	$ 371,159.68
(20%of Section 2 Subtotal and 20% of identified Grading and Erosion BMP items)			

Approvals

I hereby certify that this is an accurate and complete estimate of costs for the work as shown on the approved Construction Drawings associated with the Project.

Engineer Date

(P.E. Seal)

Approved by Owner / Applicant Date

Approved by El Paso Couny Engineer / ECM Administrator Date

APPENDIX B

HYDROLOGIC CALCULATIONS

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	17%	0.09	0.24	26.1	1.9	8.7
H2	10.40	17%	0.09	0.24	23.6	2.7	12.1
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.30	45%	0.32	0.49	16.0	1.4	3.7
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.64	45%	0.32	0.48	11.8	0.8	2.0
I4	15.30	14%	0.08	0.27	17.9	3.9	22.3
I5	0.95	45%	0.31	0.46	11.0	1.2	2.9
I6	17.00	15%	0.08	0.23	20.3	4.0	19.9
I7	1.50	2%	0.01	0.20	5.5	0.1	2.5
F-G1	12.40	16%	0.08	0.23	38.4	2.1	10.1
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	17%	0.09	0.24	30.5	2.9	13.2
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	29%	0.18	0.34	36.5	1.0	3.1
G5	11.80	16%	0.09	0.24	17.9	3.3	15.3
G6	4.00	11%	0.06	0.33	22.7	0.7	6.5
G7	0.46	45%	0.31	0.46	12.0	0.5	1.4
F1	11.30	13%	0.06	0.21	26.7	1.9	10.6
F2	0.40	45%	0.31	0.46	10.5	0.5	1.3
F3	2.00	8%	0.03	0.17	26.9	0.2	1.5
F4	0.30	45%	0.31	0.46	10.2	0.4	1.0
UD1	4.30	13%	0.06	0.21	8.8	1.2	6.6
UD2	13.00	14%	0.07	0.26	17.7	3.2	18.4
UD3	9.60	14%	0.08	0.30	14.1	2.8	17.6
UD4	16.50	13%	0.06	0.21	21.9	3.1	17.2
UD5	10.00	13%	0.08	0.32	24.1	2.1	15.0
UD6	6.80	13%	0.07	0.27	10.8	1.9	12.3
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY

Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	2.2	9.7
2	2.3	10.7
3	3.0	13.3
4	0.9	2.4
5	6.2	28.2
6	11.2	51.4
7	4.0	18.8
8	1.8	4.4
9	4.3	19.6
10	3.7	14.3
11	7.3	31.1
12	3.4	17.3
13	0.4	2.1

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Saddlehorn Ranch
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.02
Calculated By: NQJ
Checked By: TBD
Date: 2/18/19

Basin ID	Total Area (ac)	Paved Roads			2.5 Acre Rural Lots			Lawns			Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
H1	7.90	45%	1.00	5.7%	13.0%	6.90	11.4%	2%	0.00	0.0%	17.1%
H2	10.4	45%	1.35	5.8%	13.0%	9.05	11.3%	2%	0.00	0.0%	17.2%
H3	0.96	45%	0.96	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
H4	1.90	45%	0.00	0.0%	13.0%	0.00	0.0%	2%	1.90	2.0%	2.0%
I1	1.30	45%	1.30	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
I2	0.74	45%	0.74	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
I3	0.64	45%	0.64	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
I4	15.3	45%	0.70	2.1%	13.0%	14.60	12.4%	2%	0.00	0.0%	14.5%
I5	0.95	45%	0.95	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
I6	17.00	45%	1.05	2.8%	13.0%	15.95	12.2%	2%	0.00	0.0%	15.0%
I7	1.50	45%	0.00	0.0%	13.0%	0.00	0.0%	2%	1.50	2.0%	2.0%
F-G1	12.40	45%	0.99	3.6%	13.0%	11.41	12.0%	2%	0.00	0.0%	15.6%
F-G2	1.00	45%	1.00	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
G1	13.2	45%	1.61	5.5%	13.0%	11.59	11.4%	2%	0.00	0.0%	16.9%
G2	0.98	45%	0.98	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
G3	0.63	45%	0.63	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
G4	2.50	45%	1.28	23.0%	13.0%	1.22	6.3%	2%	0.00	0.0%	29.4%
G5	11.8	45%	1.25	4.8%	13.0%	10.55	11.6%	2%	0.00	0.0%	16.4%
G6	4.00	45%	0.00	0.0%	13.0%	3.10	10.1%	2%	0.90	0.5%	10.5%
G7	0.46	45%	0.46	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
F1	11.3	45%	0.36	1.4%	13.0%	9.75	11.2%	2%	1.19	0.2%	12.9%
F2	0.40	45%	0.00	0.0%	13.0%	0.00	0.0%	2%	0.40	2.0%	2.0%
F3	2.0	45%	0.26	5.9%	13.0%	0.00	0.0%	2%	1.74	1.7%	7.6%
F4	0.30	45%	0.30	45.0%	13.0%	0.00	0.0%	2%	0.00	0.0%	45.0%
UD1	4.30	45%	0.00	0.0%	13.0%	4.30	13.0%	2%	0.00	0.0%	13.0%
UD2	13.0	45%	0.38	1.3%	13.0%	12.62	12.6%	2%	0.00	0.0%	13.9%
UD3	9.60	45%	0.38	1.8%	13.0%	9.22	12.5%	2%	0.00	0.0%	14.3%
UD4	16.50	45%	0.00	0.0%	13.0%	16.50	13.0%	2%	0.00	0.0%	13.0%
UD5	10.0	45%	0.00	0.0%	13.0%	10.00	13.0%	2%	0.00	0.0%	13.0%
UD6	6.80	45%	0.00	0.0%	13.0%	6.80	13.0%	2%	0.00	0.0%	13.0%
OS1	1.00	45%	0.50	22.5%	13.0%	0.00	0.0%	2%	0.50	1.0%	23.5%
OS2	0.76	45%	0.28	16.6%	13.0%	0.00	0.0%	2%	0.48	1.3%	17.8%
OS3	0.30	45%	0.11	16.5%	13.0%	0.00	0.0%	2%	0.19	1.3%	17.8%
TOTAL	181.82										15.9%

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis - Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

2.5 Acre Rural Lots - Comp. % Impervious Calculation			
Total Area (ac)	Area - Roofs (90%)	Area - Drives (100%)	Area - Lawns (2%)
2.50	0.07	0.05	2.39
Comp % Imperviousness	0.13		

Roads w/ Roadside Ditches - Comp. % Impervious Calculation		
Area* (ac)	Area - Ditch (5%)	Area - Roads (100%)
0.2124	0.1320	0.0804
Comp % Imperviousness	0.39	

*Area based on 250 LF roadway from CL to outside edge of roadside ditch

the above rounded to 45% for conservative

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Saddlehorn Ranch
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.02
Calculated By: NQJ
Checked By: TBD
Date: 2/18/19

Basin ID	Total Area (ac)	Basins Total Weighted % Imp.	Hydrologic Soil Group			Hydrologic Soil Group			Minor Coefficients			Major Coefficients			Basins Total Weighted C_5	Basins Total Weighted C_{100}
			Area A (ac)	Area B (ac)	Area C/D (ac)	% A (ac)	% B (ac)	% C/D (ac)	$C_{5,A}$	$C_{5,B}$	$C_{5,C/D}$	$C_{100,A}$	$C_{100,B}$	$C_{100,C/D}$		
H1	7.90	17.1%	7.90	0.00	0.00	100%	0%	0%	0.09	0.13	0.17	0.24	0.51	0.55	0.09	0.24
H2	10.40	17.2%	10.40	0.00	0.00	100%	0%	0%	0.09	0.13	0.18	0.24	0.51	0.55	0.09	0.24
H3	0.96	45.0%	0.96	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
H4	1.90	2.0%	1.90	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
I1	1.30	45.0%	1.09	0.21	0.00	84%	16%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.32	0.49
I2	0.74	45.0%	0.63	0.11	0.00	85%	15%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.32	0.49
I3	0.64	45.0%	0.57	0.07	0.00	89%	11%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.32	0.48
I4	15.30	14.5%	12.85	2.45	0.00	84%	16%	0%	0.07	0.10	0.15	0.22	0.49	0.54	0.08	0.27
I5	0.95	45.0%	0.95	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
I6	17.00	15.0%	17.00	0.00	0.00	100%	0%	0%	0.08	0.11	0.16	0.23	0.50	0.55	0.08	0.23
I7	1.50	2.0%	1.16	0.34	0.00	77%	23%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.20
F-G1	12.40	15.6%	12.40	0.00	0.00	100%	0%	0%	0.08	0.11	0.16	0.23	0.50	0.55	0.08	0.23
F-G2	1.00	45.0%	1.00	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
G1	13.20	16.9%	13.20	0.00	0.00	100%	0%	0%	0.09	0.12	0.17	0.24	0.50	0.55	0.09	0.24
G2	0.98	45.0%	0.98	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
G3	0.63	45.0%	0.63	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
G4	2.50	29.4%	2.50	0.00	0.00	100%	0%	0%	0.18	0.23	0.28	0.34	0.56	0.60	0.18	0.34
G5	11.80	16.4%	11.80	0.00	0.00	100%	0%	0%	0.09	0.12	0.17	0.24	0.50	0.55	0.09	0.24
G6	4.00	10.5%	2.00	2.00	0.00	50%	50%	0%	0.05	0.07	0.12	0.19	0.47	0.53	0.06	0.33
G7	0.46	45.0%	0.46	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
F1	11.30	12.9%	11.30	0.00	0.00	100%	0%	0%	0.06	0.09	0.14	0.21	0.49	0.54	0.06	0.21
F2	0.40	2.0%	0.40	0.00	0.00	100%	0%	0%	0.01	0.01	0.05	0.13	0.44	0.49	0.01	0.13
F3	2.00	7.6%	2.00	0.00	0.00	100%	0%	0%	0.03	0.05	0.10	0.17	0.46	0.51	0.03	0.17
F4	0.30	45.0%	0.30	0.00	0.00	100%	0%	0%	0.31	0.36	0.40	0.46	0.64	0.67	0.31	0.46
UD1	4.30	13.0%	4.30	0.00	0.00	100%	0%	0%	0.06	0.09	0.14	0.21	0.49	0.54	0.06	0.21
UD2	13.00	13.9%	11.17	1.83	0.00	86%	14%	0%	0.07	0.10	0.15	0.22	0.49	0.54	0.07	0.26
UD3	9.60	14.3%	6.74	2.86	0.00	70%	30%	0%	0.07	0.10	0.15	0.22	0.49	0.54	0.08	0.30

UD4	16.50	13.0%	16.50	0.00	0.00	100%	0%	0%	0.06	0.09	0.14	0.21	0.49	0.54	0.06	0.21
UD5	10.00	13.0%	6.09	3.91	0.00	61%	39%	0%	0.06	0.09	0.14	0.21	0.49	0.54	0.08	0.32
UD6	6.80	13.0%	5.37	1.43	0.00	79%	21%	0%	0.06	0.09	0.14	0.21	0.49	0.54	0.07	0.27
OS1	1.00	23.5%	1.00	0.00	0.00	100%	0%	0%	0.14	0.18	0.23	0.29	0.54	0.58	0.14	0.29
OS2	0.76	17.8%	0.76	0.00	0.00	100%	0%	0%	0.09	0.13	0.18	0.25	0.51	0.56	0.09	0.25
OS3	0.30	17.8%	0.30	0.00	0.00	100%	0%	0%	0.09	0.13	0.18	0.25	0.51	0.56	0.09	0.25
TOTAL	181.82	15.9%	166.61	15.21	0.00	92%	8%	0%	---	---	---	---	---	---	0.09	0.26

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.276}$	$C_A = 0.87i^{1.232}$	$C_A = 0.84i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B = 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$	$C_{C/D} = 0.32i+0.588$

Where:

i = % imperviousness (expressed as a decimal)

C_A = Runoff coefficient for Natural Resources Conservation Service (NRCS) HSG A soils

C_B = Runoff coefficient for NRCS HSG B soils

$C_{C/D}$ = Runoff coefficient for NRCS HSG C and D soils.

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Saddlehorn Ranch
Location: El Paso County

Project Name: Saddlehorn Ranch
Project No.: 25142.02
Calculated By: NQJ
Checked By: TBD
Date: 2/18/19

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)
H1	7.90	A	17%	0.09	0.24	200	4.9%	15.3	975	1.0%	15.0	1.5	10.8	26.1	1175.0	37.4	26.1
H2	10.40	A	17%	0.09	0.24	200	4.5%	15.7	961	1.8%	15.0	2.0	8.0	23.6	1161.0	33.6	23.6
H3	0.96	A	45%	0.31	0.46	28	2.0%	6.0	784	1.0%	15.0	1.5	8.7	14.7	812.0	26.9	14.7
H4	1.90	A	2%	0.01	0.13	20	3.4%	5.9	343	2.1%	20.0	2.9	2.0	7.9	363.0	29.9	7.9
I1	1.30	A	45%	0.32	0.49	28	2.0%	5.9	1482	2.7%	15.0	2.5	10.0	16.0	1510.0	28.2	16.0
I2	0.74	A	45%	0.32	0.49	28	2.0%	5.9	860	3.2%	15.0	2.7	5.3	11.3	888.0	23.6	11.3
I3	0.64	A	45%	0.32	0.48	28	2.0%	6.0	735	1.9%	15.0	2.1	5.9	11.8	763.0	24.1	11.8
I4	15.30	A	14%	0.08	0.27	200	5.5%	14.9	683	3.5%	20.0	3.7	3.0	17.9	883.0	29.1	17.9
I5	0.95	A	45%	0.31	0.46	28	2.0%	6.0	1062	5.5%	15.0	3.5	5.0	11.0	1090.0	23.3	11.0
I6	17.00	A	15%	0.08	0.23	200	5.3%	15.1	1332	4.5%	20.0	4.2	5.2	20.3	1532.0	32.9	20.3
I7	1.50	A	2%	0.01	0.20	5	3.3%	3.0	560	3.3%	20.0	3.6	2.6	5.5	565.0	31.2	5.5
F-G1	12.40	A	16%	0.08	0.23	200	1.6%	22.3	1622	1.3%	15.0	1.7	16.1	38.4	1822.0	45.0	38.4
F-G2	1.00	A	45%	0.31	0.46	28	2.0%	6.0	1117	1.7%	15.0	2.0	9.5	15.5	1145.0	27.7	15.5
G1	13.20	A	17%	0.09	0.24	200	1.9%	21.0	1100	1.7%	15.0	1.9	9.4	30.5	1300.0	35.6	30.5
G2	0.98	A	45%	0.31	0.46	28	2.0%	6.0	1150	1.7%	15.0	2.0	9.8	15.8	1178.0	28.0	15.8
G3	0.63	A	45%	0.31	0.46	28	2.0%	6.0	729	1.0%	15.0	1.5	7.9	13.9	757.0	26.1	13.9
G4	2.50	A	29%	0.18	0.34	200	1.3%	21.8	1387	1.1%	15.0	1.6	14.6	36.5	1587.0	37.7	36.5
G5	11.80	A	16%	0.09	0.24	120	3.3%	13.5	817	2.4%	20.0	3.1	4.4	17.9	937.0	31.0	17.9
G6	4.00	A	11%	0.06	0.33	200	2.7%	19.0	598	1.8%	20.0	2.7	3.7	22.7	798.0	31.3	22.7
G7	0.46	A	45%	0.31	0.46	28	2.0%	6.0	540	1.0%	15.0	1.5	6.0	12.0	568.0	24.2	12.0
F1	11.30	A	13%	0.06	0.21	200	2.0%	21.1	930	1.9%	20.0	2.7	5.7	26.7	1130.0	34.3	26.7
F2	0.40	A	2%	0.01	0.13	28	2.0%	8.3	417	1.1%	15.0	1.5	4.5	12.8	445.0	33.0	12.8
F3	2.00	D	8%	0.03	0.17	134	0.8%	24.5	315	1.3%	20.0	2.3	2.3	26.9	449.0	29.3	26.9
F4	0.30	A	45%	0.31	0.46	28	2.0%	6.0	378	1.0%	15.0	1.5	4.2	10.2	406.0	22.5	10.2
UD1	4.30	A	13%	0.06	0.21	60	6.7%	7.7	297	5.0%	20.0	4.5	1.1	8.8	357.0	25.8	8.8
UD2	13.00	A	14%	0.07	0.26	154	3.9%	14.7	707	3.7%	20.0	3.8	3.1	17.7	861.0	29.2	17.7
UD3	9.60	A	14%	0.08	0.30	167	6.6%	12.8	287	3.4%	20.0	3.7	1.3	14.1	454.0	26.0	14.1
UD4	16.50	A	13%	0.06	0.21	118	1.8%	16.8	819	1.8%	20.0	2.6	5.2	21.9	937.0	33.3	21.9
UD5	10.00	A	13%	0.08	0.32	180	2.2%	19.1	777	1.7%	20.0	2.6	5.0	24.1	957.0	33.1	24.1
UD6	6.80	A	13%	0.07	0.27	43	2.4%	9.1	232	1.3%	20.0	2.3	1.7	10.8	275.0	26.9	10.8
OS1	1.00	A	24%	0.14	0.29	15	2.0%	5.4	1436	0.3%	20.0	1.1	21.8	27.2	1451.0	57.6	27.2
OS2	0.76	A	18%	0.09	0.25	15	2.0%	5.6	1101	1.0%	20.0	2.0	9.2	14.8	1116.0	38.9	14.8
OS3	0.30	A	18%	0.09	0.25	15	2.0%	5.6	431	2.4%	20.0	3.1	2.3	7.9	446.0	27.0	7.9

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

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

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

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

Equation 6-4

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

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).

Equation 6-3

Equation 6-5

Table 6-2. NRCS Conveyance factors, K

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

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

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

Project Name: Saddlehorn Ranch
Project No.: 25142.02
Calculated By: NQJ
Checked By: TBD
Date: 2/18/19

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				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} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
		OS1	1.00	0.14	27.2	0.14	2.63	0.4															BASIN OS1 FLOW TO DP1 (ROUTED IN SF2)
	1	H1	7.90	0.09	26.1	0.71	2.69	1.9	27.2	0.85	2.63	2.2	2.2	0.85	1					840	2.0	7.0	BASIN H1 FLOW CAPTURED AT DP1, SWALE FLOW TO DP2
		OS2	0.76	0.09	14.8	0.07	3.54	0.2															
	2	H2	10.40	0.09	23.6	0.95	2.84	2.7	34.2	1.02	2.28	2.3				2.3	1.0	0.5	24	56	3.6	0.3	BASIN H1 & H2 FLOW COMBINED/CAPTURED, CULVERT FLOW TO DP3
		H3	0.96	0.31	14.7	0.30	3.55	1.1															BASIN H3 FLOW, SWALE FLOW TO DP3. (ROUTED IN SF2)
		H4	1.90	0.01	7.9	0.01	4.49	0.04															BASIN H4 FLOW
	3								34.5	1.33	2.27	3.0											BASIN H1-H4 FLOW, TOTAL FLOW ENTERING POND H
		I1	1.30	0.32	16.0	0.41	3.43	1.4															BASIN I1 FLOW, SWALE FLOW TO DP5 (ROUTED IN SF2)
	4	I2	0.74	0.32	11.3	0.24	3.95	0.9					0.9	0.2	1.9					790	2.8	4.8	BASIN I2 FLOW, CAPTURED AT DP4, SWALE FLOW TO DP6
		I3	0.64	0.32	11.8	0.20	3.88	0.8															BASIN I3 FLOW, CAPTURED AT DP6 (ROUTED IN SF2)
		I4	15.30	0.08	17.9	1.20	3.26	3.9															BASIN I4 FLOW, CAPTURED AT DP5 (ROUTED IN SF2)
		I5	0.95	0.31	11.0	0.29	3.98	1.2															BASIN I5 FLOW, CAPTURED AT DP5 (ROUTED IN SF2)
		I6	17.00	0.08	20.3	1.29	3.07	4.0															BASIN I5 FLOW, CAPTURED AT DP6 (ROUTED IN SF2)
		I7	1.50	0.01	5.5	0.01	5.01	0.1															BASIN I7 FLOW (POND BASIN)
	5								17.9	1.90	3.26	6.2				6.2	1.9	0.5	24	80	4.7	0.3	BASIN I1, I4, & I5 FLOW, CAPTURED AT DP5, PIPED TO DP6
	6								20.3	3.64	3.07	11.2											DP4, I3, I6, I7 FLOW, TOTAL FLOW ENTERING POND I

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

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

Project Name: Saddlehorn Ranch
Project No.: 25142.02
Calculated By: NQJ
Checked By: TBD
Date: 2/18/19

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				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} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
		F-G1	12.40	0.08	38.4	0.99	2.11	2.1					2.1	1.0	1.7					1135	2.6	7.3	F-G1 BASIN FLOW, SWALE FLOW TO DP7
		G1	13.20	0.09	30.5	1.17	2.46	2.9															BASIN G1 FLOW, SWALE FLOW TO DP7 (ROUTED IN SF2)
	7								45.7	2.16	1.85	4.0				4.0	2.2	0.5	24	56	4.2	0.2	BASIN F-G1 & G1 FLOW, CAPTURED AT DP7, PIPE TO DP9
		F-G2	1.00	0.31	15.5	0.31	3.47	1.1					1.1	0.31	1.7					1135	2.6	7.3	BASIN F-G2 FLOW, SWALE FLOW TO DP8
		G2	0.98	0.31	15.8	0.30	3.44	1.0															BASIN G2 FLOW, SWALE FLOW TO DP8 (ROUTED IN SF2)
	8								22.8	0.61	2.89	1.8	1.8	0.61	1.13					1429	2.1	11.2	BASIN F-G2 & G2 FLOW, CAPTURED AT DP8, SWALE FLOW TO DP10
	9	G3	0.63	0.31	13.9	0.20	3.63	0.7	45.9	2.36	1.84	4.3	4.3	2.36	1.13					1429	2.1	11.2	DP7 & BASIN G3 FLOW CAPTURED AT DP9, SWALE FLOW TO DP11
		G4	2.50	0.18	36.5	0.45	2.19	1.0															BASIN G4 FLOW, SWALE FLOW TO DP11 (ROUTED IN SF2)
		G5	11.80	0.09	17.9	1.01	3.25	3.3															BASIN G5 FLOW, SWALE FLOW TO DP10 (ROUTED IN SF2)
		G6	4.00	0.06	22.7	0.25	2.90	0.7															BASIN G6 FLOW, SWALE FLOW TO DP11 (ROUTED IN SF2)
		G7	0.46	0.31	12.0	0.14	3.86	0.5															BASIN G7 FLOW, SWALE FLOW TO DP11 (ROUTED IN SF2)
	10								34.0	1.62	2.29	3.7				3.7	1.6	0.5	24	100	4.1	0.4	DP9 & BASIN G5 FLOW, CAPTURED AT DP10, PIPE TO DP11
	11								57.1	4.82	1.51	7.3											DP9, DP10, BASIN G4 & G6 FLOW, TOTAL FLOW ENTERING POND G
		F1	11.30	0.06	26.7	0.71	2.66	1.9								1.9	0.7	0.5	18	60	3.5	0.3	BASIN F1 FLOW, CAPTURED AT DP12, PIPE TO SED. BASIN F1
		F2	0.40	0.01	12.8	0.00	3.75	0.0															BASIN F12 FLOW, CAPTURED AT DP12, SWALE FLOW TO SED. BASIN F1
	12								12.8	0.71	3.75	2.7											TOTAL FLOW ENTERING SEDIMENT BASIN F1 (SEE GESC PLANS)
		F3	2.00	0.03	26.9	0.06	2.65	0.2															BASIN F3 FLOW, SWALE FLOW INTO SEDIMENT BASIN F2
		F4	0.30	0.31	10.2	0.09	4.10	0.4															BASIN F4 FLOW, SWALE FLOW INTO SEDIMENT BASIN F2
	13								26.9	0.15	2.65	0.4											TOTAL FLOW ENTERING SEDIMENT BASIN F2

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

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

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

Project Name: Saddlehorn Ranch
Project No.: 25142.02
Calculated By: NQJ
Checked By: TBD
Date: 2/18/19

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				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} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
		OS1	1.00	0.29	27.2	0.29	4.41	1.3															
	1	H1	7.90	0.24	26.1	1.92	4.52	8.7	27.2	2.21	4.41	9.7	8.67	1.92	1					840	2.0	7.0	BASIN H1 FLOW CAPTURED AT DP1, SWALE FLOW TO DP2
		OS2	0.76	0.25	14.8	0.19	5.95	1.1															
	2	H2	10.40	0.24	23.6	2.54	4.76	12.1	33.1	2.73	3.92	10.7				10.7	2.7	0.5	24	56	5.4	0.2	BASIN H1 & H2 FLOW COMBINED/CAPTURED, CULVERT FLOW TO DP3
		H3	0.96	0.46	14.7	0.44	5.96	2.6															BASIN H3 FLOW, SWALE FLOW TO DP3. (ROUTED IN SF2)
		H4	1.90	0.13	7.9	0.24	7.54	1.81															BASIN H4 FLOW
	3								33.3	3.41	3.90	13.3											BASIN H1-H4 FLOW, TOTAL FLOW ENTERING POND H
		I1	1.30	0.49	16.0	0.64	5.75	3.7															BASIN I1 FLOW, SWALE FLOW TO DP5 (ROUTED IN SF2)
	4	I2	0.74	0.49	11.3	0.36	6.63	2.4					2.4	0.4	1.9					790	2.8	4.8	BASIN I2 FLOW, CAPTURED AT DP4, SWALE FLOW TO DP6
		I3	0.64	0.48	11.8	0.31	6.51	2.0															BASIN I3 FLOW, CAPTURED AT DP6 (ROUTED IN SF2)
		I4	15.30	0.27	17.9	4.08	5.46	22.3															BASIN I4 FLOW, CAPTURED AT DP5 (ROUTED IN SF2)
		I5	0.95	0.46	11.0	0.44	6.68	2.9															BASIN I5 FLOW, CAPTURED AT DP5 (ROUTED IN SF2)
		I6	17.00	0.23	20.3	3.86	5.15	19.9															BASIN I5 FLOW, CAPTURED AT DP6 (ROUTED IN SF2)
		I7	1.50	0.20	5.5	0.29	8.42	2.4															BASIN I7 FLOW (POND BASIN)
	5								17.9	5.16	5.46	28.2				28.2	5.2	0.5	24	80	9.0	0.1	BASIN I1, I4, & I5 FLOW, CAPTURED AT DP5, PIPED TO DP6
	6								20.3	9.98	5.15	51.4											DP4, I3, I6, I7 FLOW, TOTAL FLOW ENTERING POND I

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

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

Project Name: Saddlehorn Ranch
Project No.: 25142.02
Calculated By: NQJ
Checked By: TBD
Date: 2/18/19

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				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} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
		F-G1	12.40	0.23	38.4	2.86	3.54	10.1					10.1	2.9	1.7					1135	2.6	7.3	F-G1 BASIN FLOW, SWALE FLOW TO DP7
		G1	13.20	0.24	30.5	3.19	4.13	13.2															BASIN G1 FLOW, SWALE FLOW TO DP7 (ROUTED IN SF2)
	7								45.7	6.05	3.10	18.8				18.8	6.1	0.5	24	56	6.0	0.2	BASIN F-G1 & G1 FLOW, CAPTURED AT DP7, PIPE TO DP9
		F-G2	1.00	0.46	15.5	0.46	5.82	2.7					2.7	0.46	1.7					1135	2.6	7.3	BASIN F-G2 FLOW, SWALE FLOW TO DP8
		G2	0.98	0.46	15.8	0.45	5.78	2.6															BASIN G2 FLOW, SWALE FLOW TO DP8 (ROUTED IN SF2)
	8								22.8	0.91	4.86	4.4	4.4	0.91	1.13					1429	2.1	11.2	BASIN F-G2 & G2 FLOW, CAPTURED AT DP8, SWALE FLOW TO DP10
	9	G3	0.63	0.46	13.9	0.29	6.09	1.8	45.9	6.34	3.09	19.6	19.6	6.34	1.13					1429	2.1	11.2	DP7 & BASIN G3 FLOW CAPTURED AT DP9, SWALE FLOW TO DP11
		G4	2.50	0.34	36.5	0.85	3.67	3.1															BASIN G4 FLOW, SWALE FLOW TO DP11 (ROUTED IN SF2)
		G5	11.80	0.24	17.9	2.81	5.46	15.3															BASIN G5 FLOW, SWALE FLOW TO DP10 (ROUTED IN SF2)
		G6	4.00	0.33	22.7	1.33	4.86	6.5															BASIN G6 FLOW, SWALE FLOW TO DP11 (ROUTED IN SF2)
		G7	0.46	0.46	12.0	0.21	6.47	1.4															BASIN G7 FLOW, SWALE FLOW TO DP11 (ROUTED IN SF2)
	10								34.0	3.72	3.85	14.3				14.3	3.7	0.5	24	100	5.8	0.3	DP9 & BASIN G5 FLOW, CAPTURED AT DP10, PIPE TO DP11
	11								57.1	12.45	2.54	31.7											DP9, DP10, BASIN G4 & G6 FLOW, TOTAL FLOW ENTERING POND G
		F1	11.30	0.21	26.7	2.37	4.46	10.6								10.6	2.4	0.5	18	60	6.0	0.2	BASIN F1 FLOW, CAPTURED AT DP12, PIPE TO SED. BASIN F1
		F2	0.40	0.13	12.8	0.05	6.30	0.3															BASIN F12 FLOW, CAPTURED AT DP12, SWALE FLOW TO SED. BASIN F1
	12								12.8	2.42	6.30	15.3											TOTAL FLOW ENTERING SEDIMENT BASIN F1 (SEE GESC PLANS)
		F3	2.00	0.17	26.9	0.34	4.44	1.5															BASIN F3 FLOW, SWALE FLOW INTO SEDIMENT BASIN F2
		F4	0.30	0.46	10.2	0.14	6.88	1.0															BASIN F4 FLOW, SWALE FLOW INTO SEDIMENT BASIN F2
	13								26.9	0.48	4.44	2.1											TOTAL FLOW ENTERING SEDIMENT BASIN F2

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

APPENDIX C

HYDRAULIC CALCULATIONS

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Mar 29 2019

Design Point #1 Q5 = 2.2 cfs & Q100 = 9.7 cfs

Invert Elev Dn (ft)	=	6753.68
Pipe Length (ft)	=	73.18
Slope (%)	=	1.04
Invert Elev Up (ft)	=	6754.44
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft)	=	6758.71
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2.20
Qmax (cfs)	=	10.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	9.70
Qpipe (cfs)	=	9.70
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.79
Veloc Up (ft/s)	=	6.40
HGL Dn (ft)	=	6755.03
HGL Up (ft)	=	6755.64
Hw Elev (ft)	=	6756.64
Hw/D (ft)	=	1.46
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Feb 27 2019

Design Point #2 Q5 = 2.2 cfs & Q100 = 9.9 cfs

Invert Elev Dn (ft)	=	6744.34
Pipe Length (ft)	=	65.00
Slope (%)	=	2.52
Invert Elev Up (ft)	=	6745.98
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft)	=	6749.43
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2.20
Qmax (cfs)	=	10.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	9.90
Qpipe (cfs)	=	9.90
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.89
Veloc Up (ft/s)	=	6.47
HGL Dn (ft)	=	6745.70
HGL Up (ft)	=	6747.19
Hw Elev (ft)	=	6748.22
Hw/D (ft)	=	1.49
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Feb 25 2019

Design Point #4 Q5 = 0.9 cfs & Q100 = 2.4 cfs

Invert Elev Dn (ft)	=	6723.39
Pipe Length (ft)	=	56.00
Slope (%)	=	0.75
Invert Elev Up (ft)	=	6723.81
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft)	=	6727.05
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.90
Qmax (cfs)	=	2.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	2.40
Qpipe (cfs)	=	2.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.83
Veloc Up (ft/s)	=	3.72
HGL Dn (ft)	=	6724.43
HGL Up (ft)	=	6724.40
Hw Elev (ft)	=	6724.63
Hw/D (ft)	=	0.54
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Feb 25 2019

Design Point #5 Q5 = 6.2 cfs & Q100 = 28.2 cfs

Invert Elev Dn (ft)	=	6709.74
Pipe Length (ft)	=	69.90
Slope (%)	=	0.59
Invert Elev Up (ft)	=	6710.15
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

Top Elevation (ft)	=	6714.69
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	6.20
Qmax (cfs)	=	28.20
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	28.20
Qpipe (cfs)	=	28.20
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.11
Veloc Up (ft/s)	=	8.98
HGL Dn (ft)	=	6711.66
HGL Up (ft)	=	6712.71
Hw Elev (ft)	=	6714.08
Hw/D (ft)	=	1.96
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Feb 25 2019

Design Point #7 Q5 = 4.0 cfs & Q100 = 18.8 cfs

Invert Elev Dn (ft)	=	6708.07
Pipe Length (ft)	=	56.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	6708.35
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft)	=	6712.27
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	4.00
Qmax (cfs)	=	18.80
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	18.80
Qpipe (cfs)	=	18.80
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.37
Veloc Up (ft/s)	=	7.16
HGL Dn (ft)	=	6709.85
HGL Up (ft)	=	6709.91
Hw Elev (ft)	=	6711.11
Hw/D (ft)	=	1.38
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Feb 25 2019

Design Point #8 Q5 = 1.8 cfs & Q100 = 4.4 cfs

Invert Elev Dn (ft)	=	6709.99
Pipe Length (ft)	=	56.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	6710.27
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft)	=	6712.33
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1.80
Qmax (cfs)	=	4.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	4.40
Qpipe (cfs)	=	4.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.02
Veloc Up (ft/s)	=	4.56
HGL Dn (ft)	=	6711.14
HGL Up (ft)	=	6711.07
Hw Elev (ft)	=	6711.46
Hw/D (ft)	=	0.79
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Feb 28 2019

Design Point #10 Q5 = 3.7 cfs & Q100 = 14.3 cfs

Invert Elev Dn (ft)	=	6691.28
Pipe Length (ft)	=	89.08
Slope (%)	=	0.73
Invert Elev Up (ft)	=	6691.93
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.020
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

Top Elevation (ft)	=	6695.23
Top Width (ft)	=	28.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	10.00
Qmax (cfs)	=	14.50
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	14.30
Qpipe (cfs)	=	14.30
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.07
Veloc Up (ft/s)	=	6.28
HGL Dn (ft)	=	6692.96
HGL Up (ft)	=	6693.29
Hw Elev (ft)	=	6694.29
Hw/D (ft)	=	1.18
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 11 2019

Pond H Mainteneace & Access Road Culvert (Q_100 = 0.5 cfs)

Invert Elev Dn (ft)	=	6745.09
Pipe Length (ft)	=	32.57
Slope (%)	=	1.66
Invert Elev Up (ft)	=	6745.63
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

Top Elevation (ft)	=	6748.00
Top Width (ft)	=	12.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	1.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	0.50
Qpipe (cfs)	=	0.50
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	0.46
Veloc Up (ft/s)	=	2.42
HGL Dn (ft)	=	6745.97
HGL Up (ft)	=	6745.89
Hw Elev (ft)	=	6746.00
Hw/D (ft)	=	0.25
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 11 2019

Pond G Maintenance & Access Road Culvert (Q_100 = 1.4 cfs)

Invert Elev Dn (ft)	=	6690.90
Pipe Length (ft)	=	33.40
Slope (%)	=	1.59
Invert Elev Up (ft)	=	6691.43
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

Top Elevation (ft)	=	6694.00
Top Width (ft)	=	12.00
Crest Width (ft)	=	25.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	2.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	1.40
Qpipe (cfs)	=	1.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.16
Veloc Up (ft/s)	=	3.21
HGL Dn (ft)	=	6691.87
HGL Up (ft)	=	6691.87
Hw Elev (ft)	=	6692.07
Hw/D (ft)	=	0.42
Flow Regime	=	Inlet Control

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 11 2019

Pond I Maintenance & Access Road Culvert (Q_100 = 1.5 cfs)

Invert Elev Dn (ft)	=	6709.84
Pipe Length (ft)	=	32.21
Slope (%)	=	1.68
Invert Elev Up (ft)	=	6710.38
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.022
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment

Top Elevation (ft)	=	6713.63
Top Width (ft)	=	12.00
Crest Width (ft)	=	25.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	3.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	1.50
Qpipe (cfs)	=	1.50
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	1.23
Veloc Up (ft/s)	=	3.27
HGL Dn (ft)	=	6710.82
HGL Up (ft)	=	6710.84
Hw Elev (ft)	=	6711.04
Hw/D (ft)	=	0.44
Flow Regime	=	Inlet Control

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 100 cfs

Design Flow: 130 cfs

Maximum Flow: 150 cfs

Table 1 - Summary of Culvert Flows at Crossing: Drainageway T6: Onsite Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Del Cerro Trail Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6714.16	100.00	100.00	0.00	1
6714.27	105.00	105.00	0.00	1
6714.38	110.00	110.00	0.00	1
6714.49	115.00	115.00	0.00	1
6714.60	120.00	120.00	0.00	1
6714.71	125.00	125.00	0.00	1
6714.81	130.00	130.00	0.00	1
6714.92	135.00	135.00	0.00	1
6715.02	140.00	140.00	0.00	1
6715.12	145.00	145.00	0.00	1
6715.22	150.00	150.00	0.00	1
6721.06	409.08	409.08	0.00	Overtopping

Rating Curve Plot for Crossing: Drainageway T6: Onsite Culvert

Table 2 - Culvert Summary Table: Del Cerro Trail Culvert

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
100.00	100.00	6714.16	3.719	4.160	2-M2c	3.517	2.564	2.564	1.554	7.830	3.969
105.00	105.00	6714.27	3.823	4.273	2-M2c	3.622	2.631	2.631	1.593	7.942	4.025
110.00	110.00	6714.38	3.925	4.384	2-M2c	3.727	2.696	2.696	1.632	8.051	4.078
115.00	115.00	6714.49	4.025	4.494	2-M2c	3.831	2.756	2.756	1.670	8.172	4.129
120.00	120.00	6714.60	4.123	4.602	2-M2c	3.935	2.819	2.819	1.707	8.272	4.179
125.00	125.00	6714.71	4.218	4.708	2-M2c	4.040	2.881	2.881	1.743	8.372	4.227
130.00	130.00	6714.81	4.312	4.813	2-M2c	4.144	2.941	2.941	1.778	8.470	4.273
135.00	135.00	6714.92	4.404	4.917	2-M2c	4.250	2.998	2.998	1.812	8.577	4.318
140.00	140.00	6715.02	4.495	5.020	2-M2c	4.357	3.057	3.057	1.846	8.668	4.362
145.00	145.00	6715.12	4.584	5.122	2-M2c	4.464	3.115	3.115	1.879	8.759	4.405
150.00	150.00	6715.22	4.672	5.222	2-M2c	4.574	3.172	3.172	1.912	8.850	4.446

****

Straight Culvert

Inlet Elevation (invert): 6710.00 ft, Outlet Elevation (invert): 6709.46 ft

Culvert Length: 108.00 ft, Culvert Slope: 0.0050

****

Culvert Performance Curve Plot: Del Cerro Trail Culvert

Water Surface Profile Plot for Culvert: Del Cerro Trail Culvert

Site Data - Del Cerro Trail Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6710.00 ft

Outlet Station: 108.00 ft

Outlet Elevation: 6709.46 ft

Number of Barrels: 1

Culvert Data Summary - Del Cerro Trail Culvert

Barrel Shape: Circular

Barrel Diameter: 7.00 ft

Barrel Material: Corrugated Aluminum

Embedment: 0.00 in

Barrel Manning's n: 0.0310

Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Drainageway T6: Onsite

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
100.00	6711.38	1.55	3.97	0.97	0.66
105.00	6711.42	1.59	4.02	0.99	0.66
110.00	6711.46	1.63	4.08	1.02	0.66
115.00	6711.50	1.67	4.13	1.04	0.67
120.00	6711.54	1.71	4.18	1.06	0.67
125.00	6711.57	1.74	4.23	1.09	0.67
130.00	6711.61	1.78	4.27	1.11	0.67
135.00	6711.64	1.81	4.32	1.13	0.67
140.00	6711.68	1.85	4.36	1.15	0.68
145.00	6711.71	1.88	4.40	1.17	0.68
150.00	6711.74	1.91	4.45	1.19	0.68

Tailwater Channel Data - Drainageway T6: Onsite Culvert

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 10.00 ft

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0100

Channel Manning's n: 0.0400

Channel Invert Elevation: 6709.83 ft

Roadway Data for Crossing: Drainageway T6: Onsite Culvert

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 163.00 ft

Crest Elevation: 6721.06 ft

Roadway Surface: Paved

Roadway Top Width: 30.00 ft

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 11 2019

Haegler Ranch Tributary 6 - Prop. Cross Section (Q_100 = 130 cfs)

Trapezoidal

Bottom Width (ft)	=	50.00
Side Slopes (z:1)	=	10.00, 10.00
Total Depth (ft)	=	3.00
Invert Elev (ft)	=	6700.00
Slope (%)	=	0.97
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	130.00

Highlighted

Depth (ft)	=	0.67
Q (cfs)	=	130.00
Area (sqft)	=	37.99
Velocity (ft/s)	=	3.42
Wetted Perim (ft)	=	63.47
Crit Depth, Yc (ft)	=	0.58
Top Width (ft)	=	63.40
EGL (ft)	=	0.85

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

Swale Section A-A: Basin H Capacity Check - Min. Swale Slope for Basin H - (Q_100 = D

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 6700.00
Slope (%)	= 1.06
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.70

Highlighted

Depth (ft)	= 1.00
Q (cfs)	= 10.70
Area (sqft)	= 3.50
Velocity (ft/s)	= 3.06
Wetted Perim (ft)	= 7.29
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 7.00
EGL (ft)	= 1.15

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

Swale B-B: Basin H Velocity Check - Max. Swale Slope for Basin H - (Q_100 = DP2 = 10.7

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 6700.00
Slope (%)	= 1.75
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.70

Highlighted

Depth (ft)	= 0.91
Q (cfs)	= 10.70
Area (sqft)	= 2.90
Velocity (ft/s)	= 3.69
Wetted Perim (ft)	= 6.63
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 6.37
EGL (ft)	= 1.12

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

Swale C-C: Basin I Capcity Check - Max. Q w/ Min. Swale Slope w/in Basin I - (Q_100 = B

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 6700.00
Slope (%)	= 1.11
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 22.30

Highlighted

Depth (ft)	= 1.30
Q (cfs)	= 22.30
Area (sqft)	= 5.91
Velocity (ft/s)	= 3.77
Wetted Perim (ft)	= 9.47
Crit Depth, Yc (ft)	= 1.21
Top Width (ft)	= 9.10
EGL (ft)	= 1.52

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

Swale D-D: Basin I Velocity Check - Max. Swale Slope w/in Basin I - (Q_100 = Basin I5 =

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 6700.00
Slope (%)	= 5.49
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.90

Highlighted

Depth (ft)	= 0.45
Q (cfs)	= 2.900
Area (sqft)	= 0.71
Velocity (ft/s)	= 4.09
Wetted Perim (ft)	= 3.28
Crit Depth, Yc (ft)	= 0.54
Top Width (ft)	= 3.15
EGL (ft)	= 0.71

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

Swale E-E: Basin I Velocity Check #2 - Max. Q w/ Max. Swale Slope w/in Basin I - (Q_100

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 6700.00
Slope (%)	= 2.43
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 22.30

Highlighted

Depth (ft)	= 1.12
Q (cfs)	= 22.30
Area (sqft)	= 4.39
Velocity (ft/s)	= 5.08
Wetted Perim (ft)	= 8.16
Crit Depth, Yc (ft)	= 1.21
Top Width (ft)	= 7.84
EGL (ft)	= 1.52

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

Swale F-F: Basin I Velocity Check #3 - Max. Swale Slope w/in Basin I - (Q_100 = Basin I2

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 6700.00
Slope (%)	= 4.38
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.40

Highlighted

Depth (ft)	= 0.44
Q (cfs)	= 2.400
Area (sqft)	= 0.68
Velocity (ft/s)	= 3.54
Wetted Perim (ft)	= 3.21
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 3.08
EGL (ft)	= 0.64

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

Swale G-G: Basin G Capacity Check - Min. Swale Slope w/in Basin G - (Q_100 = DP9 +G4

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 6700.00
Slope (%)	= 1.08
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 22.70

Highlighted

Depth (ft)	= 1.31
Q (cfs)	= 22.70
Area (sqft)	= 6.01
Velocity (ft/s)	= 3.78
Wetted Perim (ft)	= 9.54
Crit Depth, Yc (ft)	= 1.22
Top Width (ft)	= 9.17
EGL (ft)	= 1.53

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 1 2019

Swale H-H: Basin G Velocity Check - Max. Swale Slope w/in Basin G - (Q_100 = Basin G1

Triangular

Side Slopes (z:1)	= 3.00, 4.00
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 6700.00
Slope (%)	= 1.69
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 13.20

Highlighted

Depth (ft)	= 0.99
Q (cfs)	= 13.20
Area (sqft)	= 3.43
Velocity (ft/s)	= 3.85
Wetted Perim (ft)	= 7.21
Crit Depth, Yc (ft)	= 0.98
Top Width (ft)	= 6.93
EGL (ft)	= 1.22

Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 4 2019

Pond G Spillway (Q_100 = 19.9 cfs per UD-Detention)

Trapezoidal Weir

Crest	= Sharp
Bottom Length (ft)	= 8.00
Total Depth (ft)	= 2.00
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 19.90

Highlighted

Depth (ft)	= 0.73
Q (cfs)	= 19.90
Area (sqft)	= 7.97
Velocity (ft/s)	= 2.50
Top Width (ft)	= 13.84

Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 4 2019

Pond H Spillway (Q_100_Undetained = 15.2 cfs (Per UD-Detention)

Trapezoidal Weir

Crest	= Sharp
Bottom Length (ft)	= 6.00
Total Depth (ft)	= 2.00
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.50
Compute by:	Known Q
Known Q (cfs)	= 15.20

Highlighted

Depth (ft)	= 0.66
Q (cfs)	= 15.20
Area (sqft)	= 5.70
Velocity (ft/s)	= 2.67
Top Width (ft)	= 11.28

Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Apr 4 2019

Pond I Spillway (Q_100_Undetained = 43.0 cfs (Per UD-Detention)

Trapezoidal Weir

Crest	= Sharp
Bottom Length (ft)	= 10.00
Total Depth (ft)	= 2.00
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 43.00

Highlighted

Depth (ft)	= 1.03
Q (cfs)	= 43.00
Area (sqft)	= 14.54
Velocity (ft/s)	= 2.96
Top Width (ft)	= 18.24

APPENDIX D

WATER QUALITY AND DETENTION CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: **SADDLEHORN RANCH FILING NO. 1**

Basin ID: **BASIN G**

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	33.57	acres
Watershed Length =	3,700	ft
Watershed Slope =	0.015	ft/ft
Watershed Imperviousness =	18.60%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.307	acre-feet
Excess Urban Runoff Volume (EURV) =	0.546	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.361	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.487	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.627	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.869	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.331	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	2.058	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.336	acre-feet
Approximate 5-yr Detention Volume =	0.454	acre-feet
Approximate 10-yr Detention Volume =	0.580	acre-feet
Approximate 25-yr Detention Volume =	0.756	acre-feet
Approximate 50-yr Detention Volume =	0.918	acre-feet
Approximate 100-yr Detention Volume =	1.244	acre-feet

Note: L / W R

L / W Ratio =

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.307	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.239	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.698	acre-feet
Total Detention Basin Volume =	1.244	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 = 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)
6689.24	**Top of Micropool**	--	0.00	--	--	--	0	0.000		
6689.5		--	0.26	--	--	--	650	0.015	78	0.002
6690		--	0.76	--	--	--	4,976	0.114	1,442	0.033
6690.50		--	1.26	--	--	--	13,170	0.302	5,896	0.135
6691.00		--	1.76	--	--	--	22,741	0.522	14,779	0.339
6691.50		--	2.26	--	--	--	26,247	0.603	27,252	0.626
6692.00		--	2.76	--	--	--	28,736	0.660	40,998	0.941
6692.50		--	3.26	--	--	--	31,294	0.718	56,005	1.286

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: SADDLEHORN RANCH FILING NO. 1

Basin ID: BASIN G

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.69	0.307	Orifice Plate
Zone 2 (EURV)	2.13	0.239	Orifice Plate
Zone 3 (100-year)	3.21	0.698	Weir&Pipe (Restrict)
		1.244	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.13	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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	1.50	2.00					
Orifice Area (sq. inches)	2.50	0.25	0.25					

	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)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.92	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.92	N/A	feet
Overflow Weir Slope =	3.44	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.92	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.77	N/A	feet
Over Flow Weir Slope Length =	3.04	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.91	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	6.22	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.11	N/A	ft^2

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 =	0.65	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	12.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.79	N/A	ft^2
Outlet Orifice Centroid =	0.50	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.20	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	8.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.74	feet
Stage at Top of Freeboard =	4.94	feet
Basin Area at Top of Freeboard =	0.72	acres

Routed Hydrograph Results

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) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.307	0.546	0.361	0.487	0.627	0.869	1.331	2.058	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.307	0.546	0.361	0.487	0.626	0.868	1.332	2.058	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.00	0.01	0.02	0.11	0.28	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.2	0.5	3.9	9.4	0.0
Peak Inflow Q (cfs) =	3.0	5.4	3.6	4.8	6.1	8.5	12.9	19.9	#N/A
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	0.1	0.1	0.9	1.8	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.2	0.6	0.3	0.2	0.2	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	N/A	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.1	0.2	#N/A
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) =	40	63	45	57	69	88	109	109	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	65	47	59	72	92	114	116	#N/A
Maximum Ponding Depth (ft) =	1.63	2.06	1.73	1.96	2.20	2.58	3.16	3.26	#N/A
Area at Maximum Ponding Depth (acres) =	0.46	0.57	0.51	0.55	0.59	0.64	0.71	0.72	#N/A
Maximum Volume Stored (acre-ft) =	0.276	0.508	0.329	0.452	0.584	0.824	1.207	1.286	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
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]
8.48 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:08:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:16:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:25:26	0.14	0.24	0.16	0.21	0.27	0.37	0.56	0.85	#N/A
0.590	0:33:55	0.37	0.64	0.43	0.57	0.73	1.01	1.53	2.33	#N/A
	0:42:24	0.94	1.64	1.10	1.47	1.88	2.59	3.92	5.99	#N/A
	0:50:53	2.58	4.52	3.02	4.04	5.17	7.11	10.78	16.45	#N/A
	0:59:22	3.03	5.35	3.56	4.78	6.13	8.48	12.93	19.88	#N/A
	1:07:50	2.89	5.11	3.39	4.56	5.85	8.10	12.37	19.04	#N/A
	1:16:19	2.63	4.65	3.09	4.15	5.33	7.37	11.26	17.33	#N/A
	1:24:48	2.34	4.15	2.75	3.70	4.76	6.59	10.09	15.56	#N/A
	1:33:17	2.01	3.58	2.36	3.19	4.11	5.70	8.75	13.53	#N/A
	1:41:46	1.75	3.12	2.06	2.78	3.58	4.96	7.61	11.76	#N/A
	1:50:14	1.59	2.82	1.87	2.52	3.24	4.50	6.90	10.66	#N/A
	1:58:43	1.30	2.33	1.53	2.07	2.67	3.72	5.73	8.89	#N/A
	2:07:12	1.05	1.90	1.24	1.69	2.18	3.05	4.71	7.33	#N/A
	2:15:41	0.80	1.46	0.95	1.29	1.68	2.36	3.67	5.75	#N/A
	2:24:10	0.59	1.08	0.70	0.96	1.25	1.77	2.77	4.39	#N/A
	2:32:38	0.43	0.79	0.51	0.70	0.91	1.27	2.02	3.23	#N/A
	2:41:07	0.34	0.61	0.40	0.54	0.70	0.98	1.55	2.45	#N/A
	2:49:36	0.28	0.50	0.33	0.45	0.58	0.81	1.26	1.99	#N/A
	2:58:05	0.24	0.43	0.28	0.38	0.49	0.69	1.07	1.68	#N/A
	3:06:34	0.21	0.37	0.24	0.33	0.43	0.60	0.94	1.47	#N/A
	3:15:02	0.19	0.34	0.22	0.30	0.39	0.54	0.84	1.32	#N/A
	3:23:31	0.17	0.31	0.20	0.28	0.36	0.50	0.77	1.21	#N/A
	3:32:00	0.13	0.23	0.15	0.20	0.26	0.37	0.57	0.89	#N/A
	3:40:29	0.09	0.17	0.11	0.15	0.19	0.27	0.42	0.65	#N/A
	3:48:58	0.07	0.12	0.08	0.11	0.14	0.20	0.31	0.48	#N/A
	3:57:26	0.05	0.09	0.06	0.08	0.10	0.15	0.23	0.35	#N/A
	4:05:55	0.04	0.06	0.04	0.06	0.07	0.10	0.16	0.26	#N/A
	4:14:24	0.02	0.05	0.03	0.04	0.05	0.07	0.12	0.18	#N/A
	4:22:53	0.02	0.03	0.02	0.03	0.04	0.05	0.08	0.13	#N/A
	4:31:22	0.01	0.02	0.01	0.02	0.02	0.04	0.06	0.09	#N/A
	4:39:50	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.06	#N/A
	4:48:19	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.03	#N/A
	4:56:48	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	#N/A
	5:05:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:13:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:22:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:30:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:39:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:47:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:56:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:04:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:13:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:21:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:30:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:38:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:47:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:55:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:04:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:12:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:20:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:29:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:37:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:46:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:54:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	8:03:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	8:11:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	8:20:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	8:28:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	8:37:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	8:45:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	8:54:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	9:02:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	9:11:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	9:19:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	9:28:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	9:36:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	9:45:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	9:53:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	10:02:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	10:10:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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]
	0.00	0	0.000	0	0.000	0.00
	0.25	600	0.014	72	0.002	0.04
	0.50	2,640	0.061	463	0.011	0.06
	0.75	4,803	0.110	1,393	0.032	0.07
	1.00	8,745	0.201	3,069	0.070	0.08
	1.25	12,842	0.295	5,767	0.132	0.09
	1.50	17,573	0.403	9,563	0.220	0.10
WQCV	1.69	21,210	0.487	13,247	0.304	0.11
	1.75	22,358	0.513	14,554	0.334	0.11
	2.00	24,354	0.559	20,421	0.469	0.12
EURV	2.13	25,335	0.582	23,899	0.549	0.13
	2.25	26,177	0.601	26,990	0.620	0.14
	2.50	27,442	0.630	33,695	0.774	0.15
	2.75	28,686	0.659	40,711	0.935	0.16
	3.00	29,964	0.688	48,042	1.103	0.28
100-YR	3.21	31,038	0.713	54,447	1.250	1.15
	3.25	31,243	0.717	55,693	1.279	1.64
SPILLWAY CREST	3.26	31,294	0.718	56,005	1.286	1.80

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).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: SADDLEHORN RANCH FILING NO. 1

Basin ID: BASIN H

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	21.16	acres
Watershed Length =	1,800	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	17.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.181	acre-feet
Excess Urban Runoff Volume (EURV) =	0.307	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.202	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.274	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.353	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.494	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.775	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	1.231	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.188	acre-feet
Approximate 5-yr Detention Volume =	0.255	acre-feet
Approximate 10-yr Detention Volume =	0.327	acre-feet
Approximate 25-yr Detention Volume =	0.428	acre-feet
Approximate 50-yr Detention Volume =	0.526	acre-feet
Approximate 100-yr Detention Volume =	0.730	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.181	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.126	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.423	acre-feet
Total Detention Basin Volume =	0.730	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 = 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)
6736	**Top of Micropool**	--	0.00	--	--	--	40	0.001		
6737		--	1.00	--	--	--	2,700	0.062	1,343	0.031
6738		--	2.00	--	--	--	7,616	0.175	6,452	0.148
6739.00		--	3.00	--	--	--	13,296	0.305	16,984	0.390
6740.00		--	4.00	--	--	--	19,991	0.459	33,627	0.772

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: SADDLEHORN RANCH FILING NO. 1

Basin ID: BASIN H

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.17	0.181	Orifice Plate
Zone 2 (EURV)	2.71	0.126	Orifice Plate
Zone 3 (100-year)	3.91	0.423	Weir&Pipe (Restrict)
		0.730	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.71	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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	1.75	2.00					
Orifice Area (sq. inches)	1.34	0.33	0.25					

	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)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.17	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.92	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.92	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.17	N/A	feet
Over Flow Weir Slope Length =	2.92	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.39	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	5.97	N/A	ft^2
Overflow Grate Open Area w/ Debris =	2.98	N/A	ft^2

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 =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	7.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.64	N/A	ft^2
Outlet Orifice Centroid =	0.34	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.35	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	6.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.71	feet
Stage at Top of Freeboard =	5.71	feet
Basin Area at Top of Freeboard =	0.46	acres

Routed Hydrograph Results

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) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.181	0.307	0.202	0.274	0.353	0.494	0.775	1.231	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.181	0.306	0.202	0.273	0.353	0.494	0.775	1.231	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.00	0.01	0.02	0.13	0.33	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.2	0.4	2.8	6.9	0.0
Peak Inflow Q (cfs) =	2.3	3.8	2.5	3.4	4.4	6.2	9.6	15.2	#N/A
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	0.1	0.4	3.8	6.5	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.2	0.6	1.0	1.3	0.9	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.6	1.1	#N/A
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) =	40	56	43	52	62	74	72	69	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	59	44	54	64	78	77	76	#N/A
Maximum Ponding Depth (ft) =	2.09	2.64	2.19	2.51	2.81	3.21	3.44	3.80	#N/A
Area at Maximum Ponding Depth (acres) =	0.19	0.26	0.20	0.24	0.28	0.34	0.37	0.43	#N/A
Maximum Volume Stored (acre-ft) =	0.164	0.286	0.185	0.254	0.331	0.457	0.539	0.683	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
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]
6.67 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:06:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:13:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:20:01	0.10	0.17	0.12	0.16	0.20	0.28	0.42	0.66	#N/A
0.750	0:26:41	0.28	0.46	0.31	0.41	0.53	0.74	1.15	1.80	#N/A
	0:33:21	0.71	1.19	0.79	1.07	1.37	1.90	2.94	4.62	#N/A
	0:40:01	1.96	3.27	2.18	2.93	3.76	5.22	8.09	12.70	#N/A
	0:46:41	2.28	3.85	2.55	3.44	4.43	6.17	9.62	15.21	#N/A
	0:53:22	2.17	3.66	2.42	3.27	4.22	5.88	9.19	14.54	#N/A
	1:00:02	1.97	3.33	2.20	2.98	3.84	5.36	8.37	13.24	#N/A
	1:06:42	1.75	2.96	1.95	2.65	3.42	4.78	7.48	11.86	#N/A
	1:13:22	1.50	2.55	1.67	2.27	2.94	4.12	6.46	10.28	#N/A
	1:20:02	1.31	2.22	1.46	1.99	2.57	3.59	5.63	8.94	#N/A
	1:26:43	1.18	2.01	1.32	1.80	2.32	3.25	5.10	8.11	#N/A
	1:33:23	0.96	1.65	1.08	1.47	1.91	2.68	4.22	6.73	#N/A
	1:40:03	0.78	1.34	0.87	1.19	1.55	2.18	3.45	5.53	#N/A
	1:46:43	0.59	1.02	0.66	0.90	1.18	1.67	2.66	4.30	#N/A
	1:53:23	0.43	0.75	0.48	0.66	0.87	1.24	1.99	3.25	#N/A
	2:00:04	0.31	0.55	0.35	0.48	0.63	0.90	1.44	2.36	#N/A
	2:06:44	0.25	0.43	0.28	0.38	0.49	0.70	1.11	1.81	#N/A
	2:13:24	0.20	0.35	0.23	0.31	0.41	0.58	0.91	1.48	#N/A
	2:20:04	0.17	0.30	0.19	0.27	0.35	0.49	0.78	1.25	#N/A
	2:26:44	0.15	0.26	0.17	0.23	0.30	0.43	0.68	1.10	#N/A
	2:33:25	0.14	0.24	0.15	0.21	0.27	0.39	0.61	0.99	#N/A
	2:40:05	0.13	0.22	0.14	0.20	0.25	0.36	0.57	0.91	#N/A
	2:46:45	0.09	0.16	0.11	0.14	0.19	0.26	0.41	0.67	#N/A
	2:53:25	0.07	0.12	0.08	0.11	0.14	0.19	0.30	0.49	#N/A
	3:00:05	0.05	0.09	0.06	0.08	0.10	0.14	0.22	0.36	#N/A
	3:06:46	0.04	0.06	0.04	0.06	0.07	0.10	0.16	0.27	#N/A
	3:13:26	0.03	0.04	0.03	0.04	0.05	0.07	0.12	0.19	#N/A
	3:20:06	0.02	0.03	0.02	0.03	0.04	0.05	0.08	0.14	#N/A
	3:26:46	0.01	0.02	0.01	0.02	0.03	0.04	0.06	0.10	#N/A
	3:33:26	0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.07	#N/A
	3:40:07	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.04	#N/A
	3:46:47	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	#N/A
	3:53:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	#N/A
	4:00:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:06:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:13:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:20:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:26:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:33:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:40:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:46:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:53:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:00:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:06:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:13:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:20:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:26:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:33:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:40:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:46:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:53:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:00:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:06:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:13:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:20:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:26:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:33:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:40:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:46:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:53:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:00:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:06:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:13:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:20:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:26:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:33:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:40:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:46:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:53:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	8:00:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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]
	0.00	40	0.001	0	0.000	0.00
	0.25	678	0.016	86	0.002	0.02
	0.50	1,343	0.031	339	0.008	0.03
	0.75	2,008	0.046	758	0.017	0.04
	1.00	2,673	0.061	1,343	0.031	0.04
	1.25	3,880	0.089	2,160	0.050	0.05
	1.50	5,109	0.117	3,283	0.075	0.05
	1.75	6,338	0.145	4,714	0.108	0.06
	2.00	7,567	0.174	6,452	0.148	0.07
WQCV	2.17	8,582	0.197	7,905	0.181	0.08
	2.25	9,036	0.207	8,609	0.198	0.08
	2.50	10,456	0.240	11,046	0.254	0.09
EURV	2.71	11,649	0.267	13,367	0.307	0.09
	2.75	11,876	0.273	13,837	0.318	0.09
	3.00	13,296	0.305	16,984	0.390	0.10
	3.25	14,970	0.344	20,517	0.471	0.71
	3.50	16,643	0.382	24,469	0.562	4.95
	3.75	18,317	0.421	28,839	0.662	6.43
100-YR	3.91	19,388	0.445	31,855	0.731	6.54
SPILLWAY CREST	4.00	19,991	0.459	33,627	0.772	6.61

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).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: **SADDLEHORN RANCH FILING NO. 1**

Basin ID: **BASIN I**

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	37.43	acres
Watershed Length =	1,900	ft
Watershed Slope =	0.053	ft/ft
Watershed Imperviousness =	17.00%	percent
Percentage Hydrologic Soil Group A =	91.5%	percent
Percentage Hydrologic Soil Group B =	8.5%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.320	acre-feet
Excess Urban Runoff Volume (EURV) =	0.549	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.366	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.500	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.676	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.021	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.549	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	2.384	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.340	acre-feet
Approximate 5-yr Detention Volume =	0.466	acre-feet
Approximate 10-yr Detention Volume =	0.620	acre-feet
Approximate 25-yr Detention Volume =	0.809	acre-feet
Approximate 50-yr Detention Volume =	0.974	acre-feet
Approximate 100-yr Detention Volume =	1.334	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.320	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.229	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.785	acre-feet
Total Detention Basin Volume =	1.334	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 = 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)
6698.75	**Top of Micropool**	--	0.00	--	--	--	0	0.000		
6699.75		--	1.00	--	--	--	3,007	0.069	1,473	0.034
6700.75		--	2.00	--	--	--	13,627	0.313	9,685	0.222
6701.75		--	3.00	--	--	--	26,141	0.600	29,704	0.682
6702.75		--	4.00	--	--	--	35,657	0.819	60,603	1.391

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: SADDLEHORN RANCH FILING NO. 1

Basin ID: BASIN I

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.27	0.320	Orifice Plate
Zone 2 (EURV)	2.77	0.229	Orifice Plate
Zone 3 (100-year)	3.93	0.785	Weir&Pipe (Restrict)
		1.334	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.77	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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	1.00	1.80					
Orifice Area (sq. inches)	2.00	0.50	0.30					

	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)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.35	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.92	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.92	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.08	N/A	feet
Over Flow Weir Slope Length =	3.01	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.48	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	6.15	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.08	N/A	ft^2

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 =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	18.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.77	N/A	ft^2
Outlet Orifice Centroid =	0.75	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	8.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	1.14	feet
Stage at Top of Freeboard =	6.14	feet
Basin Area at Top of Freeboard =	0.82	acres

Routed Hydrograph Results

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) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.320	0.549	0.366	0.500	0.676	1.021	1.549	2.384	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.319	0.549	0.365	0.499	0.675	1.020	1.548	2.382	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.03	0.09	0.28	0.59	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.3	1.2	3.3	10.6	22.3	0.0
Peak Inflow Q (cfs) =	5.9	10.1	6.7	9.2	12.4	18.6	28.1	43.0	#N/A
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.1	0.1	0.4	3.5	4.5	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.1	0.1	0.3	0.2	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	N/A	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.6	0.7	#N/A
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) =	39	58	43	54	67	89	90	88	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	61	45	57	71	94	96	96	#N/A
Maximum Ponding Depth (ft) =	2.22	2.72	2.33	2.63	2.95	3.46	3.92	4.00	#N/A
Area at Maximum Ponding Depth (acres) =	0.37	0.52	0.41	0.49	0.58	0.70	0.80	0.82	#N/A
Maximum Volume Stored (acre-ft) =	0.297	0.525	0.344	0.475	0.646	0.981	1.318	1.391	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
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]
4.53 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:04:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:09:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:13:35	0.27	0.45	0.30	0.41	0.55	0.81	1.22	1.84	#N/A
1.103	0:18:07	0.71	1.20	0.81	1.10	1.47	2.21	3.31	5.03	#N/A
	0:22:39	1.82	3.10	2.08	2.82	3.79	5.66	8.50	12.92	#N/A
	0:27:11	5.02	8.51	5.72	7.76	10.41	15.56	23.35	35.45	#N/A
	0:31:43	5.90	10.08	6.74	9.18	12.36	18.59	28.08	42.96	#N/A
	0:36:14	5.62	9.61	6.42	8.75	11.80	17.77	26.86	41.17	#N/A
	0:40:46	5.11	8.75	5.84	7.97	10.74	16.17	24.45	37.47	#N/A
	0:45:18	4.55	7.81	5.20	7.11	9.59	14.48	21.93	33.68	#N/A
	0:49:50	3.91	6.73	4.48	6.13	8.28	12.54	19.04	29.32	#N/A
	0:54:22	3.41	5.87	3.91	5.34	7.22	10.91	16.54	25.51	#N/A
	0:58:53	3.09	5.32	3.54	4.84	6.54	9.89	15.00	23.11	#N/A
	1:03:25	2.53	4.38	2.90	3.98	5.40	8.20	12.48	19.29	#N/A
	1:07:57	2.05	3.57	2.36	3.25	4.41	6.72	10.27	15.93	#N/A
	1:12:29	1.56	2.74	1.80	2.49	3.40	5.21	8.02	12.52	#N/A
	1:17:01	1.15	2.04	1.33	1.85	2.53	3.92	6.08	9.58	#N/A
	1:21:32	0.84	1.48	0.97	1.34	1.83	2.84	4.45	7.07	#N/A
	1:26:04	0.65	1.15	0.75	1.04	1.42	2.18	3.39	5.35	#N/A
	1:30:36	0.54	0.94	0.62	0.86	1.17	1.79	2.77	4.34	#N/A
	1:35:08	0.46	0.80	0.53	0.73	0.99	1.52	2.34	3.66	#N/A
	1:39:40	0.40	0.70	0.46	0.64	0.87	1.33	2.05	3.20	#N/A
	1:44:11	0.36	0.63	0.42	0.58	0.78	1.20	1.84	2.86	#N/A
	1:48:43	0.34	0.59	0.39	0.53	0.72	1.10	1.69	2.63	#N/A
	1:53:15	0.25	0.43	0.28	0.39	0.53	0.81	1.24	1.94	#N/A
	1:57:47	0.18	0.32	0.21	0.29	0.39	0.59	0.91	1.41	#N/A
	2:02:19	0.13	0.23	0.15	0.21	0.29	0.44	0.67	1.04	#N/A
	2:06:50	0.10	0.17	0.11	0.15	0.21	0.32	0.49	0.77	#N/A
	2:11:22	0.07	0.12	0.08	0.11	0.15	0.23	0.36	0.56	#N/A
	2:15:54	0.05	0.09	0.06	0.08	0.11	0.16	0.25	0.40	#N/A
	2:20:26	0.03	0.06	0.04	0.05	0.08	0.12	0.18	0.29	#N/A
	2:24:58	0.02	0.04	0.03	0.04	0.05	0.08	0.12	0.20	#N/A
	2:29:29	0.01	0.02	0.01	0.02	0.03	0.05	0.08	0.13	#N/A
	2:34:01	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.07	#N/A
	2:38:33	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	#N/A
	2:43:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	#N/A
	2:47:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:52:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:56:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:01:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:05:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:10:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:14:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:19:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:23:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:28:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:32:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:37:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:41:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:46:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:51:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:55:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:00:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:04:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:09:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:13:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:18:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:22:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:27:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:31:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:36:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:40:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:45:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:49:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:54:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:58:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:03:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:08:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:12:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:17:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:21:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:26:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

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]
	0.00	0	0.000	0	0.000	0.00
	0.25	722	0.017	87	0.002	0.03
	0.50	1,473	0.034	361	0.008	0.05
	0.75	2,225	0.051	823	0.019	0.06
	1.00	2,977	0.068	1,473	0.034	0.07
	1.25	5,556	0.128	2,531	0.058	0.08
	1.50	8,211	0.188	4,252	0.098	0.09
	1.75	10,866	0.249	6,636	0.152	0.10
	2.00	13,521	0.310	9,685	0.222	0.12
	2.25	16,755	0.385	13,618	0.313	0.13
WQCV	2.27	17,006	0.390	13,956	0.320	0.13
	2.50	19,884	0.456	18,198	0.418	0.13
	2.75	23,012	0.528	23,560	0.541	0.14
EURV	2.77	23,263	0.534	24,023	0.551	0.14
	3.00	26,141	0.600	29,704	0.682	0.15
	3.25	28,520	0.655	36,537	0.839	0.16
	3.50	30,899	0.709	43,964	1.009	0.49
	3.75	33,278	0.764	51,986	1.193	1.93
100-YR	3.93	34,991	0.803	58,131	1.334	3.68
SPILLWAY CREST	4.00	35,657	0.819	60,603	1.391	4.52

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).

APPENDIX E

REFERENCE MATERIALS

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BFEs presented in this LOMR may be changed.

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below.

LOCAL NEWSPAPER Name: *El Paso County News*
Dates: 11/10/2004 11/17/2004

PUBLIC NOTIFICATION

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD)		MAP PANEL NUMBER(S)
		EFFECTIVE	REVISED	
Haegler Ranch Tributary 2	Approximately 310 feet upstream of confluence with Geick Ranch West Tributary	None	6,735	08041C0575 F
	Approximately 3,140 feet upstream of confluence with Geick Ranch West Tributary	None	6,779	08041C0575 F
Haegler Ranch Tributary 3	Approximately 8,100 feet downstream of Curtis Road	None	6,672	08041C0575 F
	Approximately 300 feet upstream of Curtis Road	None	6,769	08041C0575 F
Haegler Ranch Tributary 4	Approximately 4,000 feet downstream of Curtis Road	None	6,688	08041C0575 F
	Approximately 300 feet upstream of Curtis Road	None	6,758	08041C0575 F

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Kevin C. Long

Kevin C. Long, CFM, Project Engineer
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate

102929 101104080587 102IAC

CHANGES ARE MADE IN DETERMINATIONS OF BASE FLOOD ELEVATIONS FOR THE UNINCORPORATED AREAS OF EL PASO COUNTY, COLORADO, UNDER THE NATIONAL FLOOD INSURANCE PROGRAM

On March 17, 1997, the Department of Homeland Security's Federal Emergency Management Agency identified Special Flood Hazard Areas (SFHAs) in the unincorporated areas of El Paso County, Colorado, through issuance of a Flood Insurance Rate Map (FIRM). The Mitigation Division has determined that modification of the elevations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) for certain locations in this community is appropriate. The modified Base Flood Elevations (BFEs) revise the FIRM for the community.

The changes are being made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and are in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65.

A hydraulic analysis was performed to incorporate new hydrologic, hydraulic, and topographic data for Haegler Ranch Tributary 2 from approximately 310 feet upstream to approximately 3,140 feet upstream of the confluence with Geick Ranch West Tributary; for Haegler Ranch Tributary 3 from approximately 8,100 feet downstream to approximately 400 feet upstream of Curtis Road; and for Haegler Ranch Tributary 4 from approximately 4,100 feet downstream to approximately 400 feet upstream of Curtis Road. This has resulted in increases and decreases in SFHA width and increased BFEs for the above-mentioned tributaries. The table below indicates existing and modified BFEs for selected locations along the affected lengths of the flooding source(s) cited above.

Location	Existing BFE (feet)*	Modified BFE (feet)*
Haegler Ranch Tributary 2:		
Approximately 310 feet upstream of confluence with Geick Ranch West Tributary	None	6,735
Approximately 3,140 feet upstream of confluence with Geick Ranch West Tributary	None	6,779
Haegler Ranch Tributary 3:		
Approximately 8,100 feet downstream of Curtis Road	None	6,672
Approximately 300 feet upstream of Curtis Road	None	6,769
Haegler Ranch Tributary 4:		
Approximately 4,000 feet downstream of Curtis Road	None	6,688
Approximately 300 feet upstream of Curtis Road	None	6,758

*National Geodetic Vertical Datum, rounded to nearest whole foot

Under the above-mentioned Acts of 1968 and 1973, the Mitigation Division must develop criteria for floodplain management. To participate in the National Flood Insurance Program (NFIP), the community must use the modified BFEs to administer the floodplain management measures of the NFIP. These modified BFEs will also be used to calculate the appropriate flood insurance premium rates for new buildings and their contents and for the second layer of insurance on existing buildings and contents.

Upon the second publication of notice of these changes in this newspaper, any person has 90 days in which he or she can request, through the Chief Executive Officer of the community, that the Mitigation Division reconsider the determination. Any request for reconsideration must be based on knowledge of changed conditions or new scientific or technical data. All interested parties are on notice that until the 90-day period elapses, the Mitigation Division's determination to modify the BFEs may itself be changed.

Any person having knowledge or wishing to comment on these changes should immediately notify:

The Honorable Chuck Brown
Chairman, El Paso County
Board of Commissioners
27 Vermijo Avenue
Colorado Springs, CO 80903-2208

Table 3. Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Year	50-Year	100-Year	500-Year
Haegler Ranch Tributary 2 At the confluence with Geick Ranch West Tributary	1.47	__1	__1	592	__1
Haegler Ranch Tributary 3 At approximately 2,300 feet upstream of the confluence with Haegler Ranch Tributary 4	1.09	__1	__1	505	__1
Haegler Ranch Tributary 4 At approximately 3,700 feet upstream of the confluence with Haegler Ranch Tributary 3	0.60	__1	__1	130	__1

1 Data Not Available

REVISED TO REFLECT LOMR DATED FEB 16 2005

VICINTY MAP

1"=5000'

LEGEND

- EX. MAJOR CONTOUR 6420
- DRAINAGE BASIN BOUNDARY
- OVERLAND FLOW DIRECTION
- CHANNELIZED FLOW DIRECTION
- HAEGLER/GIECK BASIN BOUNDARY
- DESIGN POINT 1
- 100-YEAR FLOODPLAIN PER FIRM MAPS
- BASIN I.D. — HA3
- BASIN AREA (Acres) — 187.9

RUNOFF SUMMARY TABLE

BASIN	DRAINAGE AREA (ACRES)	RUNOFF 100 YR (cfs)
HA	238.7	191.4
HA1	200.3	139.6
HA2	66.9	64.7
HA3	187.9	126.8
HA4	115.7	94.4
HA5	329.6	178.5
HA6	196.5	167.5
HA7	125.1	138.8
HA8	11.8	20.1
HB	498.0	245.8
OS1	218.5	195.2
OS2	59.4	57.6

DESIGN POINT SUMMARY TABLE

DESIGN POINT	RUNOFF 100 YR (cfs)	COMMENTS
*HG2	465.2	FLOW TO HWY 24- H1,H2,H4,H6
*HG3	286.1	FLOW TO HWY 24- H3,H5
*HG8	236.5	FLOW TO HWY 24- H7,H8
1	417.3	FLOW TO JUDGE ORR- HA,HG8
2	591.3	FLOW JUDGE ORR - HA1,HG2
3	1058.6	FLOW TO JUDGE ORR- HB,HG3,DP2
4	451.4	FLOW TO CURTIS RD- HA2,DP1
5	506.2	FLOW FROM HA4,DP4
6	676.0	FLOW TO SITE BNDY- HA5,DP5
7	126.8	FLOW TO CURTIS RD- HA3
8	287.1	FLOW TO SITE BNDY- DP7,HA6
9	1055.8	FLOW FROM SITE BNDY- DP6,8;HA7,8;OS1-2

* DENOTES LIMITS OF FEMA CASE #04-08-0012P FOURWAY RANCH STUDY

GRAPHIC SCALE
1000 0 500 1000
1 inch = 1000 ft.

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION

TRI-CORE ENGINEERING
5526 N. ACADEMY BLVD., SUITE 204
COLORADO SPRINGS, CO 80918
PHONE (719) 264-1560
FAX (719) 264-1193

SCALE (H): 1"=1000'
SCALE (V): N/A
DRAWN BY: DMM
DESIGNED BY: RLS
CHECKED BY: RLS
DATE: 05/21/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO, COUNTY
REALTY DEVELOPMENT SERVICES
25 NORTH TEJON
SUITE 300

EXHIBIT 1
HYDROLOGIC SUBBASIN MAP

PROJECT NO. 6005-0001
FILENAME 01DR_HIST.DWG
DRAWING NO. EXH. 1

ZONE X
ZONE A
AREA REVISED BY LOMR DATED MARCH 9, 2004
33
34
32
ZONE A
ZONE A
ZONE A
Haegler Ranch Tributary 2
Geick Ranch West Tributary
ZONE A
JUDGE ORR ROAD
LIMIT OF DETAILED STUDY
6770
6775
6765
6750
6736
LIMIT OF DETAILED STUDY
ZONE AE
ZONE AE
LIMIT OF DETAILED STUDY
6760
6740
6768
ZONE X
ZONE A
4
6740
6711
LIMIT OF DETAILED STUDY
3
6720
6758
6750
6700
6735
ZONE AE
REVISED AREA
6720
6689
Haegler Ranch Tributary 3
6705
ZONE A
6675
6690
6675
LIMIT OF DETAILED STUDY
LIMIT OF DETAILED STUDY
9
10
Haegler Ranch Tributary 4
ZONE X
CURTIS ROAD
ZONE A
EL PASO COUNTY UNINCORPORATED AREAS 080059
16
15
APPROXIMATE SCALE IN FEET
2,000
0
2,000
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS
PANEL 575 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0575 F
COLORADO SPRINGS, CITY OF 080060 0575 F
REVISED TO REFLECT LOMR DATED FEB 16 2005
MAP NUMBER 08041C0575 F
EFFECTIVE DATE: March 17, 1997
Federal Emergency Management Agency

EFFECTIVE CONDITION

MAP PANEL NO. 0575F

REVISED EFFECTIVE CONDITION

APPROXIMATE SCALE IN FEET
2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 575 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY NAME	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0575	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0575	F

MAP NUMBER 08041C0575 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

GRAPHIC SCALE
2000 0 1000 2000
1 inch = 2000 ft

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION

TRI-CORE ENGINEERING
5526 N. ACADEMY BLVD., SUITE 204
COLORADO SPRINGS, CO 80918
PHONE (719) 264-1560
FAX (719) 264-1193

SCALE (H): 1"=2000'
SCALE (V): N/A

DRAWN BY: DMM
DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 05/21/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO, COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON
SUITE 300

EXHIBIT 2
REVISED FLOOD INSURANCE RATE MAP

PROJECT NO.
6005-0001

FILENAME
RATE_MAP_LOMR.DWG

DRAWING NO.
EXH. 2

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION

TRI-CORE ENGINEERING
5526 N. ACADEMY BLVD., SUITE 204
COLORADO SPRINGS, CO 80918
PHONE (719) 264-1560
FAX (719) 264-1193

SCALE (H): 1"=200'
SCALE (V): 1"=10'

DRAWN BY: KMV
DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 06/04/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON, SUITE 300
COLORADO SPRINGS, CO 80903

EXHIBIT 3 100-YEAR FLOODPLAIN BOUNDARY & PROFILE WORKMAP

PROJECT NO. 6005.0001

FILENAME PP-LOMR.DWG

DRAWING NO. EXH. 3

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION

TRI-CORE ENGINEERING
5526 N. ACADEMY BLVD., SUITE 204
COLORADO SPRINGS, CO 80918
PHONE (719) 264-1560
FAX (719) 264-1193

SCALE (H): 1"=200'
SCALE (V): 1"=10'

DRAWN BY: KMV
DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 06/04/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON, SUITE 300
COLORADO SPRINGS, CO 80903

EXHIBIT 4 100-YEAR FLOODPLAIN BOUNDARY & PROFILE WORKMAP

PROJECT NO. 6005.0001

FILENAME PP-LOMR.DWG

DRAWING NO. EXH. 4

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION

TRI-CORE ENGINEERING
5526 N. ACADEMY BLVD., SUITE 204
COLORADO SPRINGS, CO 80918
PHONE (719) 264-1560
FAX (719) 264-1193

SCALE (H): 1"=200'
SCALE (V): 1"=10'

DRAWN BY: KMV
DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 06/04/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON, SUITE 300
COLORADO SPRINGS, CO 80903

EXHIBIT 5 100-YEAR FLOODPLAIN BOUNDARY & PROFILE WORKMAP

PROJECT NO.
6005.0001

PP-LOMR.DWG

DRAWING NO.
EXH. 5

NO.	DESCRIPTION	REV BY	CKD BY	DATE

REVISION

TRI-CORE ENGINEERING
5526 N. ACADEMY BLVD., SUITE 204
COLORADO SPRINGS, CO 80918
PHONE (719) 264-1560
FAX (719) 264-1193

SCALE (H): 1"=200'
SCALE (V): 1"=10'

DRAWN BY: KMV
DESIGNED BY: RLS
CHECKED BY: RLS

DATE: 06/04/04

SANTA FE SPRINGS
HAEGLER RANCH DRAINAGE BASIN LOMR
EL PASO COUNTY

REALTY DEVELOPMENT SERVICES
25 NORTH TEJON, SUITE 300
COLORADO SPRINGS, CO 80903

EXHIBIT 6 100-YEAR FLOODPLAIN BOUNDARY & PROFILE WORKMAP

PROJECT NO.
6005.0001

DRAWING NO.
PP-LOMR.DWG

EXH. 6

Hayden Ranch Basin

Drainage Basin Planning Study

May 2009

URS

URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

6,000 3,000 0 6,000 Feet
1" = 6,000'

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN

VICINITY MAP
FIGURE 1-1

URS NO. 21711039

URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN

FUTURE LAND USE
FIGURE 3-3

URS NO. 21711039

URS
9960 Federal Dr.
Suite 300
Colorado Springs, CD 80921
719.531.0001

5,000 2,500 0 5,000 Feet
1" = 5,000'

DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN

WETLANDS
FIGURE 3-4

URS NO. 21711039

URS
9960 Federal Dr.
Suite 300
Colorado Springs, CO 80921
719.531.0001

5,000 2,500 0 5,000 Feet
1" = 5,000'

DATE: 09/08

HAEGLER RANCH DRAINAGE BASIN

SUBBASIN DELINEATION
FIGURE 4-1

URS NO. 21711039

Table 5-3 Existing Hydraulic Deficiencies

Facility Number	Road Crossing	Channel	Existing Size	Existing 100-yr Flow (cfs)	Deficiency
633	Sagecreek Road	N/A	24" CMP	N/A	N/A
634	Sagecreek Road	N/A	24" CMP	N/A	N/A
701	Curtis Road	N/A	18" CMP	N/A	N/A
702	Curtis Road	Tributary 6 (T6)	36" CMP	120	Overtops
703	Curtis Road	Main Stem (MS-06)	24" CMP	590	Overtops
704	Judge Orr Road	Main Stem (MS-06)	Blocked Culvert	540	Overtops
705	Judge Orr Road	N/A	18" CMP	N/A	N/A
706	US 24	N/A	20" Steel Pipe	N/A	N/A
707	US 24	N/A	24" CMP	N/A	N/A
801	Pedestrain Bridge	Main Stem (MS-06)	Bridge	350	Meets Capacity
802	US24	Main Stem (MS-06)	2-66" CMPs	350	Meets Capacity
803	Eastonville Road	Main Stem (MS-07)	27"X21" CMP	25	Overtops
804	Eastonville Road	Tributary 7 (T7)	18" CMP	99	Overtops

Note. 69 Structures were cataloged and located. N/A indicates that the structure was not analyzed because it was not on one of the main channels.

5.14. Results

Hydraulic conditions from the hydraulic model results are summarized in Table 5-4. This includes channel velocity, flow depth, and top width for existing conditions at key locations. Water surface profiles for Haegler Ranch Drainage Basin for the 100-year recurrence interval flood for the existing conditions are presented in Figure 5-4 the HEC-RAS model for Haegler Ranch Drainage Basin for the existing conditions is provided in Appendix B.

The approximate 100-year floodplain as seen in Figure 5-4 varies from a contained floodplain with in a defined channel to a wide floodplain with shallow flooding. Three areas were designated as flooding: 1) the approximate 100-year floodplain as delineated by HEC-RAS, 2) split flow flooding that was estimated from HEC-RAS elevation upstream and contours, and 3) shallow areas connected to the floodplain with less than 1 foot of flooding.

Table 5-4 Existing Conditions HEC-RAS Model

Key Location	Reach and Station	HEC-RAS Result	Recurrence Intervals			
			2-yr	5-yr	10-yr	100-yr
Main stem at US 24	MS-06 72276	Channel velocity (ft/sec)	1.1	1.63	1.98	2.92
		Water surface depth in channel (ft)	1.36	2.44	3.24	6.49
		Top width (ft)	18.23	24.85	29.7	255.62
Main stem at Judge Orr Road	MS-06 67666	Channel velocity (ft/sec)	3.33	4.09	1.76	3.48
		Water surface depth in channel (ft)	0.52	1.04	1.05	1.35
		Top width (ft)	174.53	534.34	535.52	569.34
Main stem at Falcon Highway	MS-05 52353	Channel velocity (ft/sec)	1.05	1.6	2.04	3.59
		Water surface depth in channel (ft)	1.79	3.69	4.96	5.74
		Top width (ft)	31.42	83.76	556.41	592.33
Main stem at Jones Road	MS-03 33189	Channel velocity (ft/sec)	2.45	3.7	1.27	2.51
		Water surface depth in channel (ft)	3.2	5.83	9.25	10.46
		Top width (ft)	47.98	105.51	580.28	667.17
Main stem at Peyton Highway	MS-02 18474	Channel velocity (ft/sec)	0.16	0.4	0.59	1.43
		Water surface depth in channel (ft)	4.14	4.35	4.51	5.15
		Top width (ft)	813.21	871.68	882.22	925.27
Southeast Tributary at Jones Road	T1 22297	Channel velocity (ft/sec)	0.62	1.02	1.47	3.2
		Water surface depth in channel (ft)	2.45	3.52	3.59	3.82
		Top width (ft)	197.35	345.68	351.74	372.17
Southeast Tributary at Peyton Highway	T1 16611	Channel velocity (ft/sec)	1.67	2.25	2.65	4.05
		Water surface depth in channel (ft)	0.08	0.17	0.24	0.51
		Top width (ft)	239.82	241.36	242.51	247.41
Southeast Tributary at Confluence with Main stem	T1 410	Channel velocity (ft/sec)	3.44	0.11	0.18	0.67
		Water surface depth in channel (ft)	1.69	2.01	2.01	2.01
		Top width (ft)	31.89	1169.3	1169.3	1169.3
At Confluence with Geick Basin	MS-01 82	Channel velocity (ft/sec)	2.68	3.85	19.89	17.33
		Water surface depth in channel (ft)	1.45	2.17	1.11	2.36
		Top width (ft)	75.88	255.32	60.67	262.84

Grass channels are designed for depths and velocities to be within the limits of allowable shear stress. Grass lined channels are limited to 1.0 psf shear stress. If calculated shear stress is above this, drop structures must be added to flatten the natural slope of the channel.

Using these criteria, several channel sections were developed to accommodate a range of future flow rates from 100 cfs to 3500 cfs, as shown in Table 6-2. The approximate channel sections were used in the alternatives to accommodate future flows as necessary,

Table 6-2 Channel Dimensions based on Flow Rates

Q (cfs)	Grass		
	Sideslope (h:v)	Bottom (ft)	Depth (ft)
300	4	6	5
500	4	8	5
600	4	15	5
800	4	20	5
900	4	25	5
1000	4	30	5
1500	4	50	5
2000	4	80	5
3000	4	120	5
3500	4	140	5

6.2.2. Culvert Design

Culvert sizes for use in alternative evaluation were estimated based on full flow capacity of reinforced concrete pipe with a minimum slope of 0.50% and concrete end sections. For flows up to 300 cfs single RC pipe culverts with a maximum of 72" diameter were used. For greater flows, multiple RC pipes or 6-foot by 6-foot concrete box culverts with headwalls and flared wingwalls were used. Proposed culverts sizes based on existing flow rates are listed in Table 6-3.

Table 6-3 Existing Conditions Culvert Design

Facility Number	Road Crossing	Channel	Existing Size	Existing 100-yr Flow (cfs)	Deficiency	Necessary Facility
N/A	Peyton Highway	Tributary 1 (T1)	No Culvert	500	Overtops	2-72" RCPs
N/A	Falcon Highway	Tributary 1 (T1)	No Culvert	33	Overtops	36" RCP
301	Peyton Highway	Main Stem (MS-02)	2-33"X48" CMPs	2,500	Overtops	7-6'X6' RCBs
401	Jones Road	Tributary 1 (T1)	2-24" CMPs	370	Overtops	6'X6' RCB
403	Jones Road	Main Stem (MS-03)	3-60" CMPs	2,300	Overtops	6-6'X6' RCBs
405	Murr Road	Main Stem (MS-04)	66" RCP	1,700	Overtops	5-6'X6' RCBs
407	Murr Road	Tributary 3 (T3-01)	66" RCP	670	Overtops	2-6'X6' RCBs
507	Peerless Farms Road	Tributary 3 (T3-01)	60" CMP	600	Overtops	2-6'X6' RCBs
509	Murr Road	Tributary 1 (T1)	2-15" RCPs	220	Overtops	66" RCP
601	Whiting Way	Tributary 1 (T1)	24" CMP	220	Overtops	66" RCP
604	Max Road	Tributary 1 (T1)	18" CMP	220	Overtops	66" RCP
609	Falcon Highway	Tributary 3 (T3-02)	18" CMP	180	Overtops	66" RCP
610	Falcon Highway	Tributary 4 (T4)	24" CMP	200	Overtops	66" RCP
612	Falcon Highway	Tributary 5 (T5)	24" CMP	150	Overtops	60" RCP
628	Falcon Highway	Main Stem (MS-05)	2-60" CMPs	1,000	Overtops	3-6'X6' RCBs
702	Curtis Road	Tributary 6 (T6)	36" CMP	120	Overtops	54" RCP
703	Curtis Road	Main Stem (MS-06)	24" CMP	590	Overtops	2-6'X6' RCBs
704	Judge Orr Road	Main Stem (MS-06)	Blocked Culvert	540	Overtops	2-72" RCPs
801	Pedestrain Bridge	Main Stem (MS-06)	Bridge	350	Meets Capacity	Existing Bridge
802	US24	Main Stem (MS-06)	2-66" CMPs	350	Meets Capacity	Existing Culvert
803	Eastonville Road	Main Stem (MS-07)	27"X21" CMP	25	Overtops	30" RCP
804	Eastonville Road	Tributary 7 (T7)	18" CMP	99	Overtops	48" RCP

6.2.3. Detention Design

All detention pond design is based on Chapter 10, Storage, of the UDFCD SDCM. All ponds were assumed to be "full spectrum" per the SDCM. For final design to be performed later, some of the ponds may be separated into a water quality pond and an off-line major detention pond.

For the Regional Detention Alternative, either the simplified full spectrum sizing method or the hydrograph method was used to size the facility. If the contributing area is less than 160 acres and no

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719.531.0001

5,000 2,500 0 5,000 Feet

1" = 5,000'

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
REGIONAL DETENTION
ALTERNATIVES
FIGURE 6-1

URS NO. 21711039

Table 6-5 Regional Detention Pond Summary

Pond	Volume (AF)	Peak Inflow (cfs)		Peak Outflow (cfs)	
		2-yr	100-yr	2-yr	100-yr
RG-01	9.02	100	320	11	63
RG-02	170	600	4800	150	2200
RG-03	0.04	3	70	2	9
RG-04	1.07	19	140	1	55
RG-05	0.03	12	120	11	3

For the 100-year peak flow, flood impacts downstream from the regional detention pond will not increase.

6.3.1.1. Channels

Channels upstream of the regional detention ponds need to be sized for the future undetained 100-year peak flow rates from development, while culverts and channels downstream of regional ponds are sized for the existing 100-year peak flow rates. Proposed channel improvements along the corresponding reaches are summarized in Table 6-6.

proposed flows

Table 6-6 Channel Designs for Regional Detention Alternative

Channel	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Material
Main Stem (MS-04)	1700	3400	3500	7140	Riprap
Main Stem (MS-05)	1500	3000	3000	11100	Grass
Main Stem (MS-06)	590	890	900	7330	Grass
Main Stem (MS-06)	660	930	1000	3170	Grass
Main Stem (MS-06)	720	1500	1500	4450	Grass
Main Stem (MS-06)	750	1600	2000	3330	Grass
Tributary 3 (T3-01)	720	1500	1500	10710	Grass
Tributary 4 (T4)	200	570	600	1840	Grass
Tributary 5 (T5)	150	240	300	930	Grass
Tributary 5 (T5)	270	410	500	7770	Grass
Tributary 6 (T6)	200	440	500	4270	Grass
Tributary 6 (T6)	240	570	600	3940	Grass

6.3.1.2. Culverts

As with the channels, culverts upstream of a regional detention pond need to be sized for the future undetained 100-year peak flow rates, while culverts and channels downstream are sized for the existing 100-year peak flow rates. Proposed culvert improvements along the corresponding reaches are summarized in Table 6-7 for the Regional Detention Alternative.

Table 6-7 Culvert Designs for Regional Detention

Facility Number	Road Crossing	Channel	Existing Size	Proposed 100-yr Flow (cfs)	Deficiency	Necessary Facility for Proposed 100-year Flow
405	Murr Road	Main Stem (MS-04)	66" RCP	3,400	Overtops	6-10'X6' RCBs
507	Peerless Farms Road	Tributary 3 (T3-01)	60" CMP	1200	Overtops	2-10'X6' RCBs
609	Falcon Highway	Tributary 3 (T3-02)	18" CMP	460	Overtops	2-66" RCPs
610	Falcon Highway	Tributary 4 (T4)	24" CMP	570	Overtops	2-72" RCPs
612	Falcon Highway	Tributary 5 (T5)	24" CMP	240	Overtops	72" RCP
628	Falcon Highway	Main Stem (MS-05)	2-60" CMPs	2,200	Overtops	4-10'X6' RCBs
702	Curtis Road	Tributary 6 (T6)	36" CMP	140	Overtops	60" RCP
703	Curtis Road	Main Stem (MS-06)	24" CMP	890	Overtops	2-8'X6' RCBs
704	Judge Orr Road	Main Stem (MS-06)	Blocked Culvert	830	Overtops	2-8'X6' RCBs
1001	Future Pastura Street	Main Stem (MS-06)	N/A	930	Future Road	2-8'X6' RCBs
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	N/A	930	Future Road	2-8'X6' RCBs
1003	Future Arroyo Hondo Blvd. S.	Main Stem (MS-06)	N/A	1500	Future Road	3-8'X6' RCBs
1004	Future Pastura Street	Tributary 6 (T6)	N/A	440	Future Road	2-66" RCPs
1005	Future El Vado Road	Tributary 6 (T6)	N/A	440	Future Road	2-66" RCPs
1006	Future Socorro Trail	Tributary 6 (T6)	N/A	440	Future Road	2-66" RCPs

Note: Changes recommended to other culverts under existing conditions still apply

6.3.2. Subregional Detention

For this alternative, subregional detention ponds are located and sized to address development as it will occur. Locations of proposed subregional detention ponds are shown in Figure 6-2 and are summarized in Table 6-8. A connectivity diagram for the sub-regional HEC-HMS model is shown in Figure 6-3.

Table 6-8 Subregional Detention Pond Summary

Pond	Size (AF)	Peak Inflow (cfs)		Peak Outflow (cfs)	
		2-yr	100-yr	2-yr	100-yr
SR-01	10	100	320	8	90
SR-02	5	14	300	3	250
SR-03	16	210	640	29	530
SR-04	25	200	1120	33	740
SR-05	24	76	570	9	250
SR-06	9	14	180	1	20
SR-07	5	6	140	1	88
SR-08	5	23	240	15	210
SR-09	20	50	430	3	66
SR-10	23	85	860	23	600
SR-11	2	3	70	1	61
SR-12	9	19	140	1	35
SR-13	3	12	120	6	110

Subregional ponds have been sized using the hydrograph routing method described above. In this alternative, all proposed channels and culverts are sized for the existing 100-year peak flow rates, except within proposed developments where it is necessary to provide conveyance for developed flow rates. Flood impacts for the 100-year peak flow downstream of the subregional, full spectrum detention ponds will not increase.

6.3.2.1. Channels

In this alternative, only channel improvements through proposed developments are included, unless an area is undersized for existing conditions. Existing deficiencies are the responsibility of the current land owner or the County, and not the developer, and corrective measures for existing deficiencies are not included in the cost estimates. Proposed channel improvements along the corresponding reaches are summarized in Table 6-9.

Table 6-9 Channel Design for Subregional Detention Alternative

Channel	Existing 100-yr Flow (cfs)	Proposed 100-yr Flow (cfs)	Design Flow (cfs)	Channel Length (ft)	Material
Main Stem (MS-05)	1460	1680	2000	1560	Grass
Main Stem (MS-06)	660	530	600	3120	Grass
Main Stem (MS-06)	720	970	1000	4535	Grass
Main Stem (MS-06)	750	740	800	3190	Grass
Tributary 3 (T3-01)	600	600	600	5000	Grass
Tributary 3 (T3-02)	220	500	500	420	Grass
Tributary 4 (T4)	220	500	500	940	Grass
Tributary 6 (T6)	200	440	500	4280	Grass
Tributary 6 (T6)	240	250	300	1400	Grass

6.3.2.2. Culverts

As with the channels, only the culverts through proposed developments will be effected unless an area is undersized for existing conditions. Any existing deficiencies in the roadway culverts are the responsibility of the County and not the developer, and required culvert improvements are not included in the cost estimates for the alternative. Proposed culvert improvements are summarized in Table 6-10.

Table 6-10 Culvert Design for Subregional Detention Alternative

Facility Number	Road Crossing	Channel	Proposed 100-yr Flow (cfs)	Deficiency	Necessary Facility for Proposed 100-year Flow
301	Peyton Highway	Main Stem (MS-02)	3,370	Overtops	9-6'X6' RCBs
403	Jones Road	Main Stem (MS-03)	2,970	Overtops	8-6'X6' RCBs
405	Murr Road	Main Stem (MS-04)	2,870	Overtops	8-6'X6' RCBs
609	Falcon Highway	Tributary 3 (T3-02)	460	Overtops	2-6'X6' RCBs
1001	Future Pastura Street	Main Stem (MS-06)	930	Future Road	3-6'X6' RCBs
1002	Future Arroyo Hondo Blvd. N.	Main Stem (MS-06)	930	Future Road	3-6'X6' RCBs
1003	Future Arroyo Hondo Blvd. S.	Main Stem (MS-06)	1500	Future Road	4-6'X6' RCBs
1004	Future Pastura Street	Tributary 6 (T6)	440	Future Road	2-66" RCPs
1005	Future El Vado Road	Tributary 6 (T6)	440	Future Road	2-66" RCPs
1006	Future Socorro Trail	Tributary 6 (T6)	440	Future Road	2-66" RCPs

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5,000 2,500 0 5,000 Feet
1" = 5,000'

DATE: 05/08

HAEGLER RANCH DRAINAGE BASIN
SUBREGIONAL DETENTION
ALTERNATIVES
FIGURE 6-2

URS NO. 21711039

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0070

STA: 0+00 TO STA: 31+34

Q: 600 CFS

Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	CHANNEL.DWG
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Structure Numbers

Profiles

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 1

MATCHLINE MS-06 PG 1

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0070

STA: 0+00 TO STA: 31+34

Q: 600 CFS

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0080

STA: 31+34 TO STA: 74+61

Q: 1000 CFS

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Profiles

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 2

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0080

STA: 31+34 TO STA: 74+61

Q: 1000 CFS

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B		
C		

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HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 3

MATCHLINE MS-06 PG 3

HR0110

HR0080

HR0130

HR0090

HR0090

MAIN STEM MS-06
(SEE PROFILE MS-06)

MATCHLINE MS-06 PG 5

N

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0080

STA: 31+34 TO STA: 74+61

Q: 1000 CFS

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0090

STA: 74+61 TO STA: 103+62

Q: 800 CFS

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Sheet Number MAIN STEM PG 4

MATCHLINE MS-06 PG 4

MAIN STEM MS-06
(SEE PROFILE MS-06)

HR0090

HR0130

HR0210

POND SR-05
(SEE SHEET SR05)

POND SR-04
(SEE SHEET SR04)

HR0090

MAIN STEM MS-06
(SEE MAINSTEM PAGE 5)

TRIBUTARY 6 (T6)
(SEE PROFILE TRIBUTARY 6)

HR0140

MATCHLINE MS-06 PG 6

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: MAIN STEM (MS-06)
BASIN: HR0090

STA: 74+61 TO STA: 103+62

Q: 800 CFS

Profiles

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 5

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0110

STA: 0+00 TO STA: 41+73

Q: 500 CFS

Computer File Information

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Full Path:	P:\21711039\CAD\PLANSHTS
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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 6 PG 1

MATCHLINE T6 PG 1

HR0110

TRIBUTARY 6 (T6)
(SEE PROFILE TRIBUTARY 6)

HR0110

HR0110

MATCHLINE T6 PG 3

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0110

STA: 0+00 TO STA: 41+73

Q: 500 CFS

Computer File Information

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HAEGLER RANCH SUB-REGIONAL DETENTION
ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 6 PG 2

MATCHLINE T6 PG 2

HR0110

HR0110

TRIBUTARY 6 (T6)
(SEE PROFILE TRIBUTARY 6)

HR0090

HR0120

HR0120

MATCHLINE T6 PG 4

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0110

STA: 0+00 TO STA: 41+73

Q: 500 CFS

CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0120

STA: 41+73 TO STA: 75+50

Q: 300 CFS

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Profiles

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 6 PG 3

MATCHLINE MS-06 PG 2

TRIBUTARY 6 (T6)
(SEE PROFILE TRIBUTARY 6)

HR0120

POND SR-05
(SEE SHEET SR05)

POND SR-04
(SEE SHEET SR04)

HR0090

MAIN STEM MS-06
(SEE MAINSTEM PAGE 5)

TRIBUTARY 6 (T6)
(SEE PROFILE TRIBUTARY 6)

HR0120

56+00 57+00 58+00 59+00 60+00 61+00 62+00 63+00 64+00 65+00 66+00 67+00 68+00 69+00

92+00 93+00 94+00 95+00 96+00 97+00 98+00 99+00 100+00

6630 6640 6650 6660

MATCHLINE MS-06 PG 6

LEGEND

6630	CONTOURS – MAJOR ELEVATION
	CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	BASIN BOUNDARY
	ROADS
20+00	RIVER AND ALIGNMENT

1"=200'

200 0 200 400

CHANNEL: TRIBUTARY 6 (T6)
BASIN: HR0120

STA: 41+73 TO STA: 75+50

Q: 300 CFS

Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	CHANNEL.DWG
Acad. Ver. 2006	Scale: 1"=200' Units: Feet

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION
ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number TRIBUTARY 6 PG 4

MS-06 HR0070

SLOPE = 0.60%

(7) 4' DROPS

MS-06 HR0080

SLOPE = 0.60%

(7) 4' DROPS

PROFILE MAIN STEM (MS-06 & MS-05)

LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: MAINSTEM PROFILES_PROPOSED.DWG

Acad. Ver. 2006 Scale: 1"=20' Units: Feet

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MS 06

MS-06 HR0080

SLOPE = 0.60%

(7) 4' DROPS

MS-06 HR0090

SLOPE = 0.60%

(8) 4' DROPS

PROFILE MAIN STEM (MS-06 & MS-05)

LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: MAINSTEM PROFILES_PROPOSED.DWG

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MS06 (2)

MS-06 HR0090

SLOPE = 0.60%

(8) 4' DROPS

MS-05 HR0200

SLOPE = 0.40%

(4) 4' DROPS

PROFILE MAIN STEM (MS-06 & MS-05)

LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: MAINSTEM PROFILES_PROPOSED.DWG

Acad. Ver. 2006 Scale: 1"=20' Units: Feet

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number MS06 & MS05 (3)

POND SR-03

LEGEND

6630	PROPOSED CONTOURS – MAJOR ELEVATION
	PROPOSED CONTOURS – MINOR ELEVATION
6630	EXISTING CONTOURS – MAJOR ELEVATION
	EXISTING CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	ROADS
	RIVER
	100 YEAR WATER SURFACE ELEVATION
⊠	OUTLET

POND SR-03
DISCHARGE

Q100	530 CFS
Q2	29 CFS
POND VOLUME AC FT	16
BERM WIDTH	10'
SIDESLOPES	8:1

N

1"=200'

200 0 200 400

Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	PONDS.DWG
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Structure Numbers

HAEGLER RANCH DRAINAGE BASIN

Sheet Number SR03

POND SR-04

MAIN STEM MS-06
(SEE MAINSTEM PG 5)
(SEE PROFILE MS-06)

100 YEAR
WS 6653.25'

TOP OF BERM
6656.25'

LOW POINT

MAIN STEM MS-06
(SEE MAINSTEM PG 5)
(SEE PROFILE MS-06)

6670 6660 6650 6640

LEGEND

6630	PROPOSED CONTOURS – MAJOR ELEVATION
	PROPOSED CONTOURS – MINOR ELEVATION
6630	EXISTING CONTOURS – MAJOR ELEVATION
	EXISTING CONTOURS – MINOR ELEVATION
	WATERSHED BOUNDARY
	ROADS
	RIVER
	100 YEAR WATER SURFACE ELEVATION
⊠	OUTLET

POND SR-04
DISCHARGE

Q100	740 CFS
Q2	33 CFS
POND VOLUME AC FT	25
BERM WIDTH	10'
SIDESLOPES	8:1

N

1"=200'

200 0 200 400

Computer File Information

Full Path:	P:\21711039\CAD\PLANSHTS
Drawing File Name:	PONDS.DWG
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Structure Numbers

HAEGLER RANCH DRAINAGE BASIN

Sheet Number SR04

POND SR-05

TRIBUTARY 6 (T6)
(SEE TRIBUTARY 6 PG 4)
(SEE PROFILE TRIBUTARY 6)
LOW POINT
100 YEAR
WS 6655.50'
TOP OF BERM
6658.50'
TRIBUTARY 6 (T6)
(SEE TRIBUTARY 6 PG 4)
(SEE PROFILE TRIBUTARY 6)
6670
6660
6650
6640
6630
6630
6630

T6 HR0110

SLOPE = 0.70%

(9) 4' DROPS

PROFILE TRIBUTARY 6 (T6)

LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: T PROFILE SHEETS 6_PROPOSED.DWG

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Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number T6

T6 HR0110

SLOPE = 0.70%

(9) 4' DROPS

T6 HR0120

SLOPE = 0.90%

(6) 4' DROPS

PROFILE TRIBUTARY 6 (T6)

LEGEND

- PROPOSED DROP STRUCTURE
- EXISTING THALWEG
- HYDRAULIC GRADE LINE

Computer File Information

Full Path: P:\21711039\CAD\PLANSHTS

Drawing File Name: T PROFILE SHEETS 6_PROPOSED.DWG

Acad. Ver. 2006 Scale: 1"=20' Units: Feet

Index of Revisions

EL PASO COUNTY DEPARTMENT OF TRANSPORTATION

URS 9950 Federal Drive, Suite 300 Colorado Springs, CO. 80921 (719) 531-0001 Fax (719) 531-0007

Profiles

Designed by: KAP

Detailed by: DRM

Checked by:

Structure Numbers

HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL PROFILES

Sheet Number T6 (2)

FIGURE 4-4 SHEET 1

SUBBASINS

NAME	2 YR FLOWS (cfs)		100 YR FLOWS (cfs)		SUBBASIN
	Existing	Future	Existing	Future	AREA (sq. mi)
HR0010	3.1	11	25	52	0.022
HR0020	11	100	99	320	0.108
HR0030	9.0	13	260	300	0.393
HR0040	0.36	0.36	26	26	0.045
HR0050	2.7	4.3	170	200	0.377
HR0060	2.0	3.5	54	66	0.101
HR0070	5.4	210	99	580	0.180
HR0080	2.5	190	87	970	0.482
HR0090	0.95	11	44	160	0.154
HR0100	4.3	5.8	120	140	0.394
HR0110	1.9	72	84	420	0.310
HR0120	2.0	4.0	73	150	0.226
HR0130	0.27	15	29	180	0.185
HR0140	3.5	6.4	110	140	0.283
HR0150	21	21	210	210	0.290
HR0160	6.6	6.6	96	96	0.267
HR0170	15	17	130	150	0.241
HR0180	6.4	6.4	85	85	0.194
HR0190	19	19	190	190	0.340
HR0200	6.3	6.8	140	150	0.272
HR0210	13	24	150	240	0.359
HR0220	6.3	6.6	85	90	0.168
HR0260	0.88	36	60	240	0.186
HR0290	20	57	180	460	0.340

JUNCTIONS

NAME	2 YR FLOWS (cfs)		100 YR FLOWS (cfs)		DRAINAGE
	Existing	Future	Existing	Future	AREA (sq. mi)
JHR0025	14	110	120	370	0.130
JHR0030	21	120	350	630	0.523
JHR0056	24	120	540	830	0.945
JHR0060	25	120	590	890	1.046
JHR0070	28	210	660	930	1.226
JHR0080	29	340	720	1500	1.708
JHR0110	6.1	72	200	440	0.704
JHR0125	37	410	980	2100	2.792
JHR0145	39	420	1100	2400	3.260
JHR0150	42	440	1100	2600	3.550
JHR0160	44	440	1200	2600	3.817
JHR0185	50	450	1400	2700	4.252
JHR0190	65	470	1400	2900	4.592

URS

URS NO. 21711039

DATE: 09/08

FIGURE 4-4 SHEET 2

SUBBASINS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	SUBBASIN AREA (sq. mi)
HR0160	6.6	6.6	96	96	0.267
HR0190	19	19	190	190	0.340
HR0200	6.3	6.8	140	150	0.272
HR0210	13	24	150	240	0.359
HR0220	6.3	6.6	85	90	0.168
HR0230	7.2	7.5	86	91	0.169
HR0240	2.0	2.0	75	77	0.226
HR0250	10	21	190	330	0.349
HR0260	0.88	36	60	240	0.186
HR0270	2.1	38	64	280	0.169
HR0280	6.5	7.6	87	100	0.192
HR0290	20	57	180	460	0.340
HR0300	2.7	3.6	60	67	0.111
HR0310	2.8	8.8	75	110	0.154
HR0320	4.7	5.8	51	58	0.088
HR0330	13	21	180	230	0.366
HR0340	22	24	170	190	0.194
HR0350	19	20	150	150	0.154
HR0360	8.0	8.0	88	88	0.140
HR0370	21	21	230	230	0.376
HR0380	5.9	6.1	130	140	0.212
HR0390	31	34	280	310	0.457
HR0400	18	18	160	160	0.290
HR0410	7.4	8.4	68	77	0.084
HR0420	1.8	2.5	59	70	0.124
HR0430	4.7	4.7	90	90	0.295
HR0440	5.5	5.5	130	130	0.357
HR0450	9.5	9.5	85	85	0.140
HR0510	0.35	19	33	140	0.157
HR0520	23	24	200	210	0.488
HR0530	1.2	1.2	76	80	0.258
HR0540	0.30	0.30	37	37	0.206
HR0550	0.56	0.57	50	51	0.110
HR0560	0.22	0.22	25	25	0.150
HR0570	8.6	8.9	170	180	0.453
HR0580	10	11	96	98	0.124
HR0590	2.2	2.2	84	84	0.408
HR0600	1.4	1.4	41	41	0.128
HR0610	5.7	5.8	100	110	0.202

JUNCTIONS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	DRAINAGE AREA (sq mi)
JHR0160	44	440	1200	2600	3.817
JHR0185	50	450	1400	2700	4.252
JHR0190	65	470	1400	2900	4.592
JHR0220	17	30	210	330	0.527
JHR0235	87	480	1700	3300	5.560
JHR0240	88	470	1700	3400	5.786
JHR0275	2.9	69	120	480	0.355
JHR0280	6.5	75	200	570	0.547
JHR0305	29	96	400	870	0.998
JHR0325	36	110	490	1000	1.240
JHR0330	44	120	600	1200	1.606
JHR0340	49	130	640	1300	1.800
JHR0350	52	130	670	1400	1.954
JHR0365	150	600	2200	4800	8.229
JHR0370	150	600	2300	5000	8.605
JHR0380	150	600	2300	5000	8.817
JHR0400	170	600	2400	5300	9.564
JHR0430	5.6	6.7	150	150	0.419
JHR0520	23	43	220	350	0.645
JHR0540	24	44	270	420	1.109
JHR0560	25	44	300	460	1.369
JHR0570	29	48	370	520	1.822
JHR0605	33	52	480	630	2.482

URS

HAEGLER RANCH DRAINAGE BASIN

EXISTING AND FUTURE CONDITIONS HYDROLOGIC MODEL

URS NO. 21711039

DATE: 09/08

FIGURE 4-4 SHEET 3

SUBBASINS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	SUBBASIN AREA (sq. mi)
HR0390	31	34	280	310	0.457
HR0400	18	18	160	160	0.290
HR0410	7.4	8.4	68	77	0.084
HR0440	5.5	5.5	130	130	0.357
HR0450	9.5	9.5	85	85	0.140
HR0460	4.0	4.0	76	76	0.109
HR0470	7.3	7.6	73	77	0.102
HR0480	0.86	0.86	34	34	0.244
HR0490	9.2	9.8	210	220	0.312
HR0500	3.3	3.4	140	150	0.326
HR0580	10	11	96	98	0.124
HR0590	2.2	2.2	84	84	0.408
HR0600	1.4	1.4	41	41	0.128
HR0610	5.7	5.8	100	110	0.202
HR0620	1.9	1.9	110	120	0.647
HR0630	2.2	2.2	86	86	0.616
HR0640	0.88	0.88	37	37	0.237
HR0650	4.2	4.3	45	46	0.092
HR0660	0.87	0.87	52	52	0.296
HR0670	0.63	0.63	31	31	0.153
HR0680	11	12	110	120	0.206

JUNCTIONS

NAME	2 YR FLOWS (cfs) Existing	2 YR FLOWS (cfs) Future	100 YR FLOWS (cfs) Existing	100 YR FLOWS (cfs) Future	DRAINAGE AREA (sq. mi)
JHR0400	170	600	2400	5300	9.564
JHR0445	180	590	2500	5400	10.424
JHR0465	180	570	2600	5400	10.673
JHR0480	180	570	2600	5400	11.019
JHR0490	180	570	2600	5500	11.331
JHR0605	33	52	480	630	2.482
JHR0610	34	52	500	650	2.684
JHR0620	35	53	560	700	3.331
JHR0640	38	54	670	780	4.184
JHR0655	190	570	3200	5600	15.933
JHR0685	190	550	3200	5600	16.588
HAEGLER	190	550	3200	5600	16.588

URS

HAEGLER RANCH DRAINAGE BASIN

EXISTING AND FUTURE CONDITIONS HYDROLOGIC MODEL

URS NO. 21711039

DATE: 09/08

El Paso County Drainage Basin Fees

Resolution No. 17-348

Basin Number	Receiving Waters	Year Studied	Drainage Basin Name	2018 Drainage Fee (per Impervious Acre)	2018 Bridge Fee (per Impervious Acre)
Drainage Basins with DBPS's:					
CHMS0200	Chico Creek	2013	Haegler Ranch	$9,676	$1,428
CHWS1200	Chico Creek	2001	Bennett Ranch	$10,832	$4,155
CHWS1400	Chico Creek	2013	Falcon	$27,762	$3,814
FOFO2000	Fountain Creek	2001	West Fork Jimmy Camp Creek	$11,775	$3,484
FOFO2600	Fountain Creek	1991*	Big Johnson / Crews Gulch	$17,197	$2,221
FOFO2800	Fountain Creek	1988*	Widefield	$17,197	$0
FOFO2900	Fountain Creek	1988*	Security	$17,197	$0
FOFO3000	Fountain Creek	1991*	Windmill Gulch	$17,197	$258
FOFO3100 / FOFO3200	Fountain Creek	1988*	Carson Street / Little Johnson	$10,490	$0
FOFO3400	Fountain Creek	1984*	Peterson Field	$12,404	$941
FOFO3600	Fountain Creek	1991*	Fisher's Canyon	$17,197	$0
FOFO4000	Fountain Creek	1996	Sand Creek	$17,197	$5,210
FOFO4200	Fountain Creek	1977	Spring Creek	$8,919	$0
FOFO4600	Fountain Creek	1984*	Southwest Area	$17,197	$0
FOFO4800	Fountain Creek	1991	Bear Creek	$17,197	$941
FOFO5400	Fountain Creek	1977	21st Street	$5,174	$0
FOFO5600	Fountain Creek	1964	19th Street	$3,385	$0
FOFO5800	Fountain Creek	1964	Camp Creek	$1,906	$0
FOMO0400	Monument Creek	1986*	Mesa	$8,995	$0
FOMO1000	Monument Creek	1981	Douglas Creek	$10,815	$239
FOMO1200	Monument Creek	1977	Templeton Gap	$11,103	$258
FOMO1400	Monument Creek	1976	Pope's Bluff	$3,445	$588
FOMO1600	Monument Creek	1976	South Rockrimmon	$4,043	$0
FOMO1800	Monument Creek	1973	North Rockrimmon	$5,174	$0
FOMO2000	Monument Creek	1971	Pulpit Rock	$5,703	$0
FOMO2200	Monument Creek	1994	Cottonwood Creek / S. Pine	$17,197	$941
FOMO2400	Monument Creek	1966	Dry Creek	$13,576	$492
FOMO3600	Monument Creek	1989*	Black Squirrel Creek	$7,808	$492
FOMO3700	Monument Creek	1987*	Middle Tributary	$14,351	$0
FOMO3800	Monument Creek	1987*	Monument Branch	$17,197	$0
FOMO4000	Monument Creek	1996	Smith Creek	$7,011	$941
FOMO4200	Monument Creek	1989*	Black Forest	$17,197	$468
FOMO5200	Monument Creek	1993*	Dirty Woman Creek	$17,197	$941
FOMO5300	Fountain Creek	1993*	Crystal Creek	$17,197	$941
Miscellaneous Drainage Basins: [1]					
CHBS0800	Chico Creek		Book Ranch	$16,136	$2,336
CHEC0400	Chico Creek		Upper East Chico	$8,791	$255
CHWS0200	Chico Creek		Telephone Exchange	$9,659	$226
CHWS0400	Chico Creek		Livestock Company	$15,910	$189
CHWS0600	Chico Creek		West Squirrel	$8,293	$3,442
CHWS0800	Chico Creek		Solberg Ranch	$17,197	$0
FOFO1200	Fountain Creek		Crooked Canyon	$5,192	$0
FOFO1400	Fountain Creek		Calhan Reservoir	$4,335	$253
FOFO1600	Fountain Creek		Sand Canyon	$3,132	$0
FOFO2000	Fountain Creek		Jimmy Camp Creek[3]	$17,197	$804
FOFO2200	Fountain Creek		Fort Carson	$13,576	$492
FOFO2700	Fountain Creek		West Little Johnson	$1,133	$0
FOFO3800	Fountain Creek		Stratton	$8,249	$369
FOFO5000	Fountain Creek		Midland	$13,576	$492
FOFO6000	Fountain Creek		Palmer Trail	$13,576	$492
FOFO6800	Fountain Creek		Black Canyon	$13,576	$492
FOMO4600	Monument Creek		Beaver Creek	$10,281	$0
FOMO3000	Monument Creek		Kettle Creek	$9,287	$0
FOMO3400	Monument Creek		Elkhorn	$1,560	$0
FOMO5000	Monument Creek		Monument Rock	$7,454	$0
FOMO5400	Monument Creek		Palmer Lake	$11,919	$0
FOMO5600	Monument Creek		Raspberry Mountain	$4,009	$0
PLPL0200	Monument Creek		Bald Mountain	$8,544	$0
Interim Drainage Basins: [2]					
FOFO1800	Fountain Creek		Little Fountain Creek	$2,199	$0
FOMO4400	Monument Creek		Jackson Creek	$6,807	$0
FOMO4800	Monument Creek		Teachout Creek	$4,727	$710

1. The miscellaneous drainage fee previous to September 1999 resolution was the average of all drainage fees for basins with Basin Planning Studies performed within the last 14 years.

2. Interim Drainage Fees are based upon draft Drainage Basin Planning Studies or the Drainage Basin Identification and Fee Estimation Report. (Best available information suitable for setting a fee.)

3. This is an interim fee and will be adjusted when a DBPS is completed. In addition to the Drainage Fee a surety in the amount of $7,285 per impervious acre shall be provided to secure payment of additional fees in the event that the DBPS results in a fee greater than the current fee. Fees paid in excess of the future revised fee will be reimbursed. See Resolution 06-326 (9/14/06) and Resolution 16-320 (9/07/16).

EPC Stormwater Management

Jennifer Irvine, P.E.

APPENDIX F

DRAINAGE MAPS & PLANS

SADDLEHORN RANCH - FILING 1

PROPOSED DRAINAGE MAP

LEGEND

- I.D. (A / B / C) — BASIN DESIGNATION
  - I.D.: BASIN IDENTIFIER
  - A: BASIN AREA
  - B: C_5
  - C: C_{100}
- X — DESIGN POINT
- BASIN DELINEATION
- 6100 — EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- 6100 — PROPOSED INDEX CONTOURS
- PROPOSED INTERMEDIATE CONTOURS
- EXISTING FLOW DIRECTION
- PROPOSED FLOW DIRECTION
- HP — PROPOSED HIGH POINT
- LP — PROPOSED LOW POINT

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	17%	0.09	0.24	26.1	1.9	8.7
H2	10.40	17%	0.09	0.24	23.6	2.7	12.1
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.30	45%	0.32	0.49	16.0	1.4	3.7
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.64	45%	0.32	0.48	11.8	0.8	2.0
I4	15.30	14%	0.08	0.27	17.9	3.9	22.3
I5	0.95	45%	0.31	0.46	11.0	1.2	2.9
I6	17.00	15%	0.08	0.23	20.3	4.0	19.9
I7	1.50	2%	0.01	0.20	5.5	0.1	2.5
F-G1	12.40	16%	0.08	0.23	38.4	2.1	10.1
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	17%	0.09	0.24	30.5	2.9	13.2
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	29%	0.18	0.34	36.5	1.0	3.1
G5	11.80	16%	0.09	0.24	17.9	3.3	15.3
G6	4.00	11%	0.06	0.33	22.7	0.7	6.5
G7	0.46	45%	0.31	0.46	12.0	0.5	1.4
F1	11.30	13%	0.06	0.21	26.7	1.9	10.6
F2	0.40	45%	0.31	0.46	10.5	0.5	1.3
F3	2.00	8%	0.03	0.17	26.9	0.2	1.5
F4	0.30	45%	0.31	0.46	10.2	0.4	1.0
UD1	4.30	13%	0.06	0.21	8.8	1.2	6.6
UD2	13.00	14%	0.07	0.26	17.7	3.2	18.4
UD3	9.60	14%	0.08	0.30	14.1	2.8	17.6
UD4	16.50	13%	0.06	0.21	21.9	3.1	17.2
UD5	10.00	13%	0.08	0.32	24.1	2.1	15.0
UD6	6.80	13%	0.07	0.27	10.8	1.9	12.3
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY

Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	2.2	9.7
2	2.3	10.7
3	3.0	13.3
4	0.9	2.4
5	6.2	28.2
6	11.2	51.4
7	4.0	18.8
8	1.8	4.4
9	4.3	19.6
10	3.7	14.3
11	7.3	31.1
12	3.4	17.3
13	0.4	2.1

N

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 1
PROPOSED DRAINAGE MAP
2514202
02/15/19
SHEET 1 OF 4

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X:\2510000.all\2514202\Drawings\Sheet Dwgs\Drainage\Filing 1 Drainage Map.dwg, DR01, 4/1/2019 8:50:15 AM, CS

SADDLEHORN RANCH - FILING 1

PROPOSED DRAINAGE MAP

LEGEND

I.D. (A / B / C)	BASIN DESIGNATION I.D.: BASIN IDENTIFIER A: BASIN AREA B: C_5 C: C_{100}
X	DESIGN POINT
	BASIN DELINEATION
6100	EXISTING INDEX CONTOURS
	EXISTING INTERMEDIATE CONTOURS
6100	PROPOSED INDEX CONTOURS
	PROPOSED INTERMEDIATE CONTOURS
	EXISTING FLOW DIRECTION
	PROPOSED FLOW DIRECTION
HP	PROPOSED HIGH POINT
LP	PROPOSED LOW POINT

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	17%	0.09	0.24	26.1	1.9	8.7
H2	10.40	17%	0.09	0.24	23.6	2.7	12.1
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.30	45%	0.32	0.49	16.0	1.4	3.7
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.64	45%	0.32	0.48	11.8	0.8	2.0
I4	15.30	14%	0.08	0.27	17.9	3.9	22.3
I5	0.95	45%	0.31	0.46	11.0	1.2	2.9
I6	17.00	15%	0.08	0.23	20.3	4.0	19.9
I7	1.50	2%	0.01	0.20	5.5	0.1	2.5
F-G1	12.40	16%	0.08	0.23	38.4	2.1	10.1
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	17%	0.09	0.24	30.5	2.9	13.2
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	29%	0.18	0.34	36.5	1.0	3.1
G5	11.80	16%	0.09	0.24	17.9	3.3	15.3
G6	4.00	11%	0.06	0.33	22.7	0.7	6.5
G7	0.46	45%	0.31	0.46	12.0	0.5	1.4
F1	11.30	13%	0.06	0.21	26.7	1.9	10.6
F2	0.40	45%	0.31	0.46	10.5	0.5	1.3
F3	2.00	8%	0.03	0.17	26.9	0.2	1.5
F4	0.30	45%	0.31	0.46	10.2	0.4	1.0
UD1	4.30	13%	0.06	0.21	8.8	1.2	6.6
UD2	13.00	14%	0.07	0.26	17.7	3.2	18.4
UD3	9.60	14%	0.08	0.30	14.1	2.8	17.6
UD4	16.50	13%	0.06	0.21	21.9	3.1	17.2
UD5	10.00	13%	0.08	0.32	24.1	2.1	15.0
UD6	6.80	13%	0.07	0.27	10.8	1.9	12.3
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY

Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	2.2	9.7
2	2.3	10.7
3	3.0	13.3
4	0.9	2.4
5	6.2	28.2
6	11.2	51.4
7	4.0	18.8
8	1.8	4.4
9	4.3	19.6
10	3.7	14.3
11	7.3	31.1
12	3.4	17.3
13	0.4	2.1

N

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 1
PROPOSED DRAINAGE MAP
2514202
02/15/19
SHEET 2 OF 4

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SADDLEHORN RANCH - FILING 1

PROPOSED DRAINAGE MAP

LEGEND

- I.D. (A / B / C) — BASIN DESIGNATION
  - I.D.: BASIN IDENTIFIER
  - A: BASIN AREA
  - B: C_5
  - C: C_{100}
- X — DESIGN POINT
- BASIN DELINEATION
- 6100 — EXISTING INDEX CONTOURS
- EXISTING INTERMEDIATE CONTOURS
- 6100 — PROPOSED INDEX CONTOURS
- PROPOSED INTERMEDIATE CONTOURS
- EXISTING FLOW DIRECTION
- PROPOSED FLOW DIRECTION
- HP — PROPOSED HIGH POINT
- LP — PROPOSED LOW POINT

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	17%	0.09	0.24	26.1	1.9	8.7
H2	10.40	17%	0.09	0.24	23.6	2.7	12.1
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.30	45%	0.32	0.49	16.0	1.4	3.7
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.64	45%	0.32	0.48	11.8	0.8	2.0
I4	15.30	14%	0.08	0.27	17.9	3.9	22.3
I5	0.95	45%	0.31	0.46	11.0	1.2	2.9
I6	17.00	15%	0.08	0.23	20.3	4.0	19.9
I7	1.50	2%	0.01	0.20	5.5	0.1	2.5
F-G1	12.40	16%	0.08	0.23	38.4	2.1	10.1
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	17%	0.09	0.24	30.5	2.9	13.2
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	29%	0.18	0.34	36.5	1.0	3.1
G5	11.80	16%	0.09	0.24	17.9	3.3	15.3
G6	4.00	11%	0.06	0.33	22.7	0.7	6.5
G7	0.46	45%	0.31	0.46	12.0	0.5	1.4
F1	11.30	13%	0.06	0.21	26.7	1.9	10.6
F2	0.40	45%	0.31	0.46	10.5	0.5	1.3
F3	2.00	8%	0.03	0.17	26.9	0.2	1.5
F4	0.30	45%	0.31	0.46	10.2	0.4	1.0
UD1	4.30	13%	0.06	0.21	8.8	1.2	6.6
UD2	13.00	14%	0.07	0.26	17.7	3.2	18.4
UD3	9.60	14%	0.08	0.30	14.1	2.8	17.6
UD4	16.50	13%	0.06	0.21	21.9	3.1	17.2
UD5	10.00	13%	0.08	0.32	24.1	2.1	15.0
UD6	6.80	13%	0.07	0.27	10.8	1.9	12.3
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY

Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	2.2	9.7
2	2.3	10.7
3	3.0	13.3
4	0.9	2.4
5	6.2	28.2
6	11.2	51.4
7	4.0	18.8
8	1.8	4.4
9	4.3	19.6
10	3.7	14.3
11	7.3	31.1
12	3.4	17.3
13	0.4	2.1

N

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 1
PROPOSED DRAINAGE MAP
2514202
02/15/19
SHEET 3 OF 4

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SADDLEHORN RANCH - FILING 1

PROPOSED DRAINAGE MAP

LEGEND

I.D. (A / B / C)	BASIN DESIGNATION I.D.: BASIN IDENTIFIER A: BASIN AREA B: C_5 C: C_{100}
X	DESIGN POINT
	BASIN DELINEATION
6100	EXISTING INDEX CONTOURS
	EXISTING INTERMEDIATE CONTOURS
6100	PROPOSED INDEX CONTOURS
	PROPOSED INTERMEDIATE CONTOURS
	EXISTING FLOW DIRECTION
	PROPOSED FLOW DIRECTION
HP	PROPOSED HIGH POINT
LP	PROPOSED LOW POINT

FILING 1 - SUB-BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
H1	7.90	17%	0.09	0.24	26.1	1.9	8.7
H2	10.40	17%	0.09	0.24	23.6	2.7	12.1
H3	0.96	45%	0.31	0.46	14.7	1.1	2.6
H4	1.90	2%	0.01	0.13	7.9	0.1	1.8
I1	1.30	45%	0.32	0.49	16.0	1.4	3.7
I2	0.74	45%	0.32	0.49	11.3	0.9	2.4
I3	0.64	45%	0.32	0.48	11.8	0.8	2.0
I4	15.30	14%	0.08	0.27	17.9	3.9	22.3
I5	0.95	45%	0.31	0.46	11.0	1.2	2.9
I6	17.00	15%	0.08	0.23	20.3	4.0	19.9
I7	1.50	2%	0.01	0.20	5.5	0.1	2.5
F-G1	12.40	16%	0.08	0.23	38.4	2.1	10.1
F-G2	1.00	45%	0.31	0.46	15.5	1.1	2.7
G1	13.20	17%	0.09	0.24	30.5	2.9	13.2
G2	0.98	45%	0.31	0.46	15.8	1.0	2.6
G3	0.63	45%	0.31	0.46	13.9	0.7	1.8
G4	2.50	29%	0.18	0.34	36.5	1.0	3.1
G5	11.80	16%	0.09	0.24	17.9	3.3	15.3
G6	4.00	11%	0.06	0.33	22.7	0.7	6.5
G7	0.46	45%	0.31	0.46	12.0	0.5	1.4
F1	11.30	13%	0.06	0.21	26.7	1.9	10.6
F2	0.40	45%	0.31	0.46	10.5	0.5	1.3
F3	2.00	8%	0.03	0.17	26.9	0.2	1.5
F4	0.30	45%	0.31	0.46	10.2	0.4	1.0
UD1	4.30	13%	0.06	0.21	8.8	1.2	6.6
UD2	13.00	14%	0.07	0.26	17.7	3.2	18.4
UD3	9.60	14%	0.08	0.30	14.1	2.8	17.6
UD4	16.50	13%	0.06	0.21	21.9	3.1	17.2
UD5	10.00	13%	0.08	0.32	24.1	2.1	15.0
UD6	6.80	13%	0.07	0.27	10.8	1.9	12.3
OS1	1.00	24%	0.14	0.29	27.2	0.4	1.3
OS2	0.76	18%	0.09	0.25	14.8	0.3	1.1
OS3	0.30	18%	0.09	0.25	7.9	0.1	0.6

FILING 1 - DESIGN POINT SUMMARY

Design Point	Q_5 (cfs)	Q_{100} (Cfs)
1	2.2	9.7
2	2.3	10.7
3	3.0	13.3
4	0.9	2.4
5	6.2	28.2
6	11.2	51.4
7	4.0	18.8
8	1.8	4.4
9	4.3	19.6
10	3.7	14.3
11	7.3	31.1
12	3.4	17.3
13	0.4	2.1

N

100 50 0 100 200

ORIGINAL SCALE: 1" = 100'

SADDLEHORN RANCH FILING 1
PROPOSED DRAINAGE MAP
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