# FINAL DRAINAGE REPORT
# FOR
# SADDLEHORN RANCH – FILING 1

**Prepared For:**
**ROI Property Group, LLC**
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**April 29, 2019**
**Project No. 25142.02**

**Prepared By:**
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**5475 Tech Center Drive**
**Colorado Springs, CO 80919**
**719-593-2593**

**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 6$^{th}$ 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. A fee reduction for low density lots was applied to the drainage basin fee per El Paso County Engineering Criteria Manual, Section 3.10.2.a. 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 (ac) | Composite % Impervious | Total Impervious Acreage (ac) | 2018 Drainage Fee (per Impervious Acre) | 2018 Bridge Fee (per Impervious Acre) | Filing 1 Drainage Fee | Filing 1 Drainage Fee (25% Reduction for Low Density Lots) | Filing 1 Bridge Fee |
| 179.8 | 15.90% | 28.59 | $10,324 | $1,524 | $295,163.16 | $221,372 | $43,571 |

### *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. Engineering, 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. Thursday, Jul 18 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 | = | Groove end projecting (C) |
| Coeff. K,M,c,Y,k | = | 0.0045, 2, 0.0317, 0.69, 0.2 |

**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) | = | 6756.42 |
| Hw/D (ft) | = | 1.32 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 2019

## Design Point #2 Q5 = 2.3 cfs & Q100 = 10.7 cfs

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 6744.34 |
| Pipe Length (ft) | = | 65.00 |
| Slope (%) | = | 0.88 |
| Invert Elev Up (ft) | = | 6744.91 |
| Rise (in) | = | 24.0 |
| Shape | = | Circular |
| Span (in) | = | 24.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.012 |
| 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) | = | 6749.43 |
| Top Width (ft) | = | 28.00 |
| Crest Width (ft) | = | 20.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 2.20 |
| Qmax (cfs) | = | 11.00 |
| Tailwater Elev (ft) | = | (dc+D)/2 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 10.70 |
| Qpipe (cfs) | = | 10.70 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 4.01 |
| Veloc Up (ft/s) | = | 5.60 |
| HGL Dn (ft) | = | 6745.93 |
| HGL Up (ft) | = | 6746.08 |
| Hw Elev (ft) | = | 6746.61 |
| Hw/D (ft) | = | 0.85 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 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 | = | Groove end projecting (C) |
| Coeff. K,M,c,Y,k | = | 0.0045, 2, 0.0317, 0.69, 0.2 |

**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) | = | 6724.62 |
| Hw/D (ft) | = | 0.54 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 2019

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

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 6709.74 |
| Pipe Length (ft) | = | 69.90 |
| Slope (%) | = | 0.54 |
| Invert Elev Up (ft) | = | 6710.12 |
| Rise (in) | = | 27.0 |
| Shape | = | Circular |
| Span (in) | = | 27.0 |
| 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) | = | 7.42 |
| Veloc Up (ft/s) | = | 7.09 |
| HGL Dn (ft) | = | 6711.79 |
| HGL Up (ft) | = | 6712.41 |
| Hw Elev (ft) | = | 6713.26 |
| Hw/D (ft) | = | 1.40 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 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 | = | Groove end projecting (C) |
| Coeff. K,M,c,Y,k | = | 0.0045, 2, 0.0317, 0.69, 0.2 |

**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) | = | 6710.86 |
| Hw/D (ft) | = | 1.26 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 2019

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

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 6707.99 |
| Pipe Length (ft) | = | 56.00 |
| Slope (%) | = | 0.50 |
| Invert Elev Up (ft) | = | 6708.27 |
| Rise (in) | = | 18.0 |
| Shape | = | Circular |
| Span (in) | = | 18.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.012 |
| 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) | = | 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) | = | 6709.14 |
| HGL Up (ft) | = | 6709.07 |
| Hw Elev (ft) | = | 6709.42 |
| Hw/D (ft) | = | 0.77 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 2019

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

| | | |
|---|---|---|
| Invert Elev Dn (ft) | = | 6690.80 |
| Pipe Length (ft) | = | 89.08 |
| Slope (%) | = | 1.06 |
| Invert Elev Up (ft) | = | 6691.74 |
| Rise (in) | = | 24.0 |
| Shape | = | Circular |
| Span (in) | = | 24.0 |
| No. Barrels | = | 1 |
| n-Value | = | 0.020 |
| 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) | = | 6695.25 |
| Top Width (ft) | = | 28.00 |
| Crest Width (ft) | = | 20.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 3.70 |
| 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) | = | 6692.48 |
| HGL Up (ft) | = | 6693.10 |
| Hw Elev (ft) | = | 6693.80 |
| Hw/D (ft) | = | 1.03 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 2019

## Pond G Maintenance & Access Road Culvert (Q_5 = 0.5 cfs & 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 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) | = | 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) | = | 6692.02 |
| Hw/D (ft) | = | 0.40 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 2019

## Pond H Mainteneace & Access Road Culvert (Q_5= 0.3 cfsQ_100 = 0.8 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 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) | = | 6748.00 |
| Top Width (ft) | = | 12.00 |
| Crest Width (ft) | = | 20.00 |

**Calculations**

| | | |
|---|---|---|
| Qmin (cfs) | = | 0.00 |
| Qmax (cfs) | = | 1.10 |
| Tailwater Elev (ft) | = | (dc+D)/2 |

**Highlighted**

| | | |
|---|---|---|
| Qtotal (cfs) | = | 0.80 |
| Qpipe (cfs) | = | 0.80 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 0.71 |
| Veloc Up (ft/s) | = | 2.75 |
| HGL Dn (ft) | = | 6746.01 |
| HGL Up (ft) | = | 6745.96 |
| Hw Elev (ft) | = | 6746.07 |
| Hw/D (ft) | = | 0.29 |
| Flow Regime | = | Inlet Control |

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Jul 18 2019

## Pond I Maintenance & Access Road Culvert (Q_5 = 0.8 cfs Q_100 = 2.0 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 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) | = | 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) | = | 2.00 |
| Qpipe (cfs) | = | 2.00 |
| Qovertop (cfs) | = | 0.00 |
| Veloc Dn (ft/s) | = | 1.57 |
| Veloc Up (ft/s) | = | 3.56 |
| HGL Dn (ft) | = | 6710.86 |
| HGL Up (ft) | = | 6710.91 |
| Hw Elev (ft) | = | 6711.10 |
| Hw/D (ft) | = | 0.48 |
| 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. Friday, Jul 19 2019

## Swale A-A: Basin H Capacity Check - (Q_100 = DP2 = 10.7 cfs)

**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 |

Froude number = 0.5

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

## Swale B-B: Basin H Velocity Check - (Q_100 = DP2 = 10.7 cfs)

**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 |

Froude number = 0.7

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

## Swale C-C: Basin I Capcity Check - (Q_100 = Basin I4 = 22.3 cfs)

**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 |

Froude number = 0.6

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

## Swale D-D: Basin I Velocity Check - (Q_100 = Basin I5 = 2.9 cfs)

**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 |

Froude number = 1.0

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

## Swale E-E: Basin I Velocity Check #2 - (Q_100 = Basin I4 = 22.3 cfs)

**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 |

Froude number = 0.8

SWALE TO BE LINED WITH EROSION CONTROL BLANKET.

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

## Swale F-F: Basin I Velocity Check #3 - (Q_100 = Basin I2 = 2.4 cfs)

**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 |

Froude number = 0.9

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

## Swale G-G: Basin G Capacity Check - (Q_100 = DP9 +G4 = 22.7 cfs)

**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 |

Froude number = 0.6

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

## Swale H-H: Basin G Velocity Check - (Q_100 = Basin G1 = 13.2 cfs)

**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 |

Froude number = 0.7

# Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

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

**Trapezoidal Weir**

| | |
|---|---|
| Crest | = Sharp |
| Bottom Length (ft) | = 30.00 |
| 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) | = 0.35 |
| Q (cfs) | = 19.90 |
| Area (sqft) | = 10.99 |
| Velocity (ft/s) | = 1.81 |
| Top Width (ft) | = 32.80 |

# Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Apr 5 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 | = 3.10 |
| Compute by: | Known Q |
| Known Q (cfs) | = 15.20 |

**Highlighted**

| | |
|---|---|
| Depth (ft) | = 0.71 |
| Q (cfs) | = 15.20 |
| Area (sqft) | = 6.28 |
| Velocity (ft/s) | = 2.42 |
| Top Width (ft) | = 11.68 |

# Weir Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jul 19 2019

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

**Trapezoidal Weir**

| | |
|---|---|
| Crest | = Sharp |
| Bottom Length (ft) | = 30.00 |
| 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) | = 0.58 |
| Q (cfs) | = 43.00 |
| Area (sqft) | = 18.75 |
| Velocity (ft/s) | = 2.29 |
| Top Width (ft) | = 34.64 |

# 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 | -- | -- | -- | 740 | 0.017 | 89 | 0.002 |
| 6690 | | -- | 0.76 | -- | -- | -- | 5,129 | 0.118 | 1,512 | 0.035 |
| 6690.50 | | -- | 1.26 | -- | -- | -- | 12,530 | 0.288 | 5,853 | 0.134 |
| 6691.00 | | -- | 1.76 | -- | -- | -- | 21,798 | 0.500 | 14,343 | 0.329 |
| 6691.50 | | -- | 2.26 | -- | -- | -- | 26,052 | 0.598 | 26,522 | 0.609 |
| 6692.00 | | -- | 2.76 | -- | -- | -- | 28,346 | 0.651 | 40,122 | 0.921 |
| 6992.50 | | -- | 3.26 | -- | -- | -- | 30,394 | 0.698 | 54,807 | 1.258 |
| 6993.00 | | -- | 3.76 | -- | -- | -- | 32,428 | 0.744 | 70,512 | 1.619 |

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) | 1.71 | 0.307 | Orifice Plate |
| Zone 2 (EURV) | 2.16 | 0.239 | Orifice Plate |
| Zone 3 (100-year) | 3.24 | 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 = | 2.16 | 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) | 2.60 | 0.40 | 0.12 | | | | | |

| | 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 = | 5.33 | N/A | feet |
| Overflow Weir Slope = | 0.00 | N/A | H:V (enter zero for flat grate) |
| Horiz. Length of Weir Sides = | 3.00 | 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, $H_t$ = | 2.92 | N/A | feet |
| Over Flow Weir Slope Length = | 3.00 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area = | 11.10 | N/A | should be $\geq$ 4 |
| Overflow Grate Open Area w/o Debris = | 11.19 | N/A | $ft^2$ |
| Overflow Grate Open Area w/ Debris = | 5.60 | 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 = | 0.00 | 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 = | 10.00 | | inches |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

| | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|
| Outlet Orifice Area = | 1.01 | N/A | $ft^2$ |
| Outlet Orifice Centroid = | 0.48 | N/A | feet |
| Half-Central Angle of Restrictor Plate on Pipe = | 1.68 | N/A | radians |

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | |
|---|---|---|
| Spillway Invert Stage= | 3.91 | ft (relative to basin bottom at Stage = 0 ft) |
| Spillway Crest Length = | 30.00 | feet |
| Spillway End Slopes = | 4.00 | H:V |
| Freeboard above Max Water Surface = | 1.00 | feet |

Calculated Parameters for Spillway

| | | |
|---|---|---|
| Spillway Design Flow Depth= | 0.35 | feet |
| Stage at Top of Freeboard = | 5.26 | feet |
| Basin Area at Top of Freeboard = | 0.74 | 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 | 0.2 | 2.3 | 8.2 | #N/A |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 1.3 | 0.6 | 0.3 | 0.6 | 0.9 | #N/A |
| Structure Controlling Flow = | Plate | Plate | Plate | Plate | Plate | Plate | Overflow Grate 1 | Outlet Plate 1 | #N/A |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | 0.2 | 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) = | 38 | 59 | 44 | 54 | 66 | 84 | 98 | 95 | #N/A |
| Time to Drain 99% of Inflow Volume (hours) = | 40 | 62 | 45 | 57 | 68 | 87 | 102 | 101 | #N/A |
| Maximum Ponding Depth (ft) = | 1.64 | 2.09 | 1.75 | 1.98 | 2.22 | 2.61 | 3.07 | 3.35 | #N/A |
| Area at Maximum Ponding Depth (acres) = | 0.45 | 0.56 | 0.49 | 0.54 | 0.59 | 0.63 | 0.68 | 0.71 | #N/A |
| Maximum Volume Stored (acre-ft) = | 0.273 | 0.504 | 0.324 | 0.449 | 0.585 | 0.818 | 1.127 | 1.314 | #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 | 683 | 0.016 | 82 | 0.002 | 0.04 |
| | 0.50 | 2,759 | 0.063 | 498 | 0.011 | 0.06 |
| | 0.75 | 4,953 | 0.114 | 1,462 | 0.034 | 0.07 |
| | 1.00 | 8,533 | 0.196 | 3,134 | 0.072 | 0.09 |
| | 1.25 | 12,234 | 0.281 | 5,730 | 0.132 | 0.10 |
| | 1.50 | 16,793 | 0.386 | 9,350 | 0.215 | 0.11 |
| WQCV | 1.71 | 20,686 | 0.475 | 13,285 | 0.305 | 0.12 |
| | 1.75 | 21,427 | 0.492 | 14,128 | 0.324 | 0.12 |
| | 2.00 | 23,755 | 0.545 | 19,799 | 0.455 | 0.13 |
| EURV | 2.16 | 25,201 | 0.579 | 23,960 | 0.550 | 0.14 |
| | 2.25 | 25,967 | 0.596 | 26,262 | 0.603 | 0.14 |
| | 2.50 | 27,153 | 0.623 | 32,907 | 0.755 | 0.15 |
| | 2.75 | 28,300 | 0.650 | 39,839 | 0.915 | 0.16 |
| | 3.00 | 29,329 | 0.673 | 47,043 | 1.080 | 0.98 |
| 100-YR | 3.24 | 30,312 | 0.696 | 54,200 | 1.244 | 6.68 |
| | 3.50 | 31,370 | 0.720 | 62,219 | 1.428 | 8.44 |
| | 3.75 | 32,387 | 0.744 | 70,188 | 1.611 | 8.78 |

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).

# Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected  Worksheet Protected

Stormwater Facility Name: SADDLEHORN RANCH - FILING 1 - POND G

Facility Location & Jurisdiction: EL PASO COUNTY - SADDLEHORN RANCH METROPOLITAN DISTRICT

User Input: Watershed Characteristics

| | | |
|---|---|---|
| Watershed Slope = | 0.015 | ft/ft |
| Watershed Length = | 3700 | ft |
| Watershed Area = | 33.57 | acres |
| Watershed Imperviousness = | 18.6% | 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 |

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

| User Defined Stage [ft] | User Defined Area [ft^2] | User Defined Stage [ft] | User Defined Discharge [cfs] |
|---|---|---|---|
| 0.00 | 0 | 0.00 | 0.00 |
| 0.26 | 740 | 0.26 | 0.04 |
| 0.76 | 5,129 | 0.76 | 0.08 |
| 1.26 | 12,530 | 1.26 | 0.10 |
| 1.76 | 21,798 | 1.76 | 0.12 |
| 2.26 | 26,052 | 2.26 | 0.14 |
| 2.76 | 28,346 | 2.76 | 0.16 |
| 3.26 | 30,394 | 3.26 | 7.30 |
| 3.76 | 32,428 | 3.76 | 8.80 |

After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

| Design Storm Return Period = | WQCV | 2 Year | 5 Year | 10 Year | 50 Year | 100 Year | |
|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth = | 0.53 | 1.19 | 1.50 | 1.75 | 2.25 | 2.52 | in |
| Calculated Runoff Volume = | 0.307 | 0.361 | 0.487 | 0.627 | 1.331 | 2.058 | acre-ft |
| OPTIONAL Override Runoff Volume = | | | | | | | acre-ft |
| Inflow Hydrograph Volume = | 0.307 | 0.361 | 0.486 | 0.626 | 1.331 | 2.057 | acre-ft |
| Time to Drain 97% of Inflow Volume = | 37.7 | 42.8 | 54.1 | 65.7 | 90.1 | 87.3 | hours |
| Time to Drain 99% of Inflow Volume = | 39.3 | 44.5 | 56.2 | 68.2 | 94.6 | 93.5 | hours |
| Maximum Ponding Depth = | 1.64 | 1.75 | 1.98 | 2.23 | 2.97 | 3.34 | ft |
| Maximum Ponded Area = | 0.45 | 0.49 | 0.54 | 0.59 | 0.67 | 0.70 | acres |
| Maximum Volume Stored = | 0.277 | 0.328 | 0.450 | 0.586 | 1.057 | 1.311 | acre-ft |

# Stormwater Detention and Infiltration Design Data Sheet

# 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).

# Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected  Worksheet Protected

Stormwater Facility Name: SADDLEHORN RANCH - FILING 1 - POND H

Facility Location & Jurisdiction: EL PASO COUNTY - SADDLEHORN RANCH METROPOLITAN DISTRICT

User Input: Watershed Characteristics

| | | |
|---|---|---|
| Watershed Slope = | 0.010 | ft/ft |
| Watershed Length = | 1800 | ft |
| Watershed Area = | 21.16 | acres |
| Watershed Imperviousness = | 17.0% | 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 |

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

| User Defined Stage [ft] | User Defined Area [ft^2] | User Defined Stage [ft] | User Defined Discharge [cfs] |
|---|---|---|---|
| 0.00 | 40 | 0.00 | 0.00 |
| 1.00 | 2,700 | 1.00 | 0.04 |
| 2.00 | 7,616 | 2.00 | 0.07 |
| 3.00 | 13,296 | 3.00 | 0.10 |
| 4.00 | 19,991 | 4.00 | 6.61 |

After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

| Design Storm Return Period = | WQCV | 2 Year | 5 Year | 10 Year | 50 Year | 100 Year | |
|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth = | 0.53 | 1.19 | 1.50 | 1.75 | 2.25 | 2.52 | in |
| Calculated Runoff Volume = | 0.181 | 0.202 | 0.274 | 0.353 | 0.775 | 1.231 | acre-ft |
| OPTIONAL Override Runoff Volume = | | | | | | | acre-ft |
| Inflow Hydrograph Volume = | 0.180 | 0.201 | 0.273 | 0.353 | 0.774 | 1.231 | acre-ft |
| Time to Drain 97% of Inflow Volume = | 42.7 | 45.6 | 54.7 | 63.9 | 66.6 | 62.7 | hours |
| Time to Drain 99% of Inflow Volume = | 46.1 | 49.2 | 58.9 | 68.6 | 73.6 | 71.4 | hours |
| Maximum Ponding Depth = | 2.09 | 2.20 | 2.51 | 2.81 | 3.46 | 3.91 | ft |
| Maximum Ponded Area = | 0.19 | 0.20 | 0.24 | 0.28 | 0.37 | 0.45 | acres |
| Maximum Volume Stored = | 0.166 | 0.186 | 0.256 | 0.333 | 0.543 | 0.731 | acre-ft |

# Stormwater Detention and Infiltration Design Data Sheet

# 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 | -- | -- | -- | 2,798 | 0.064 | 1,371 | 0.031 |
| 6700.75 | | -- | 2.00 | -- | -- | -- | 11,086 | 0.254 | 8,230 | 0.189 |
| 6701.75 | | -- | 3.00 | -- | -- | -- | 23,748 | 0.545 | 25,758 | 0.591 |
| 6702.75 | | -- | 4.00 | -- | -- | -- | 34,426 | 0.790 | 54,845 | 1.259 |
| 6703.15 | | -- | 4.40 | -- | -- | -- | 37,536 | 0.862 | 69,237 | 1.589 |

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) | 2.42 | 0.320 | Orifice Plate |
| Zone 2 (EURV) | 2.93 | 0.229 | Orifice Plate |
| Zone 3 (100-year) | 4.10 | 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 = | 2.93 | 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 | 2.20 | | | | | |
| Orifice Area (sq. inches) | 1.95 | 0.60 | 0.12 | | | | | |

| | 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 = | 3.00 | N/A | feet |
| Overflow Weir Slope = | 0.00 | N/A | H:V (enter zero for flat grate) |
| Horiz. Length of Weir Sides = | 5.00 | 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, $H_t$ = | 3.35 | N/A | feet |
| Over Flow Weir Slope Length = | 5.00 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area = | 5.94 | N/A | should be $\geq$ 4 |
| Overflow Grate Open Area w/o Debris = | 10.50 | N/A | $ft^2$ |
| Overflow Grate Open Area w/ Debris = | 5.25 | 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= | 4.42 | ft (relative to basin bottom at Stage = 0 ft) |
| Spillway Crest Length = | 30.00 | feet |
| Spillway End Slopes = | 4.00 | H:V |
| Freeboard above Max Water Surface = | 1.00 | feet |

Calculated Parameters for Spillway

| | | |
|---|---|---|
| Spillway Design Flow Depth= | 0.58 | feet |
| Stage at Top of Freeboard = | 6.00 | feet |
| Basin Area at Top of Freeboard = | 0.86 | 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 | 2.2 | 9.9 | 20.5 | #N/A |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.5 | 0.1 | 0.7 | 0.9 | 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 | 0.2 | 0.9 | 1.9 | #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) = | 38 | 57 | 42 | 53 | 67 | 78 | 76 | 72 | #N/A |
| Time to Drain 99% of Inflow Volume (hours) = | 40 | 60 | 44 | 56 | 70 | 82 | 82 | 80 | #N/A |
| Maximum Ponding Depth (ft) = | 2.36 | 2.88 | 2.48 | 2.78 | 3.11 | 3.50 | 3.78 | 4.08 | #N/A |
| Area at Maximum Ponding Depth (acres) = | 0.36 | 0.51 | 0.39 | 0.48 | 0.57 | 0.67 | 0.73 | 0.80 | #N/A |
| Maximum Volume Stored (acre-ft) = | 0.298 | 0.523 | 0.343 | 0.474 | 0.647 | 0.895 | 1.084 | 1.323 | #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 | 672 | 0.015 | 80 | 0.002 | 0.03 |
| | 0.50 | 1,371 | 0.031 | 336 | 0.008 | 0.05 |
| | 0.75 | 2,071 | 0.048 | 766 | 0.018 | 0.06 |
| | 1.00 | 2,770 | 0.064 | 1,371 | 0.031 | 0.06 |
| | 1.25 | 4,787 | 0.110 | 2,309 | 0.053 | 0.08 |
| | 1.50 | 6,859 | 0.157 | 3,765 | 0.086 | 0.09 |
| | 1.75 | 8,931 | 0.205 | 5,739 | 0.132 | 0.10 |
| | 2.00 | 11,003 | 0.253 | 8,230 | 0.189 | 0.11 |
| | 2.25 | 14,251 | 0.327 | 11,508 | 0.264 | 0.12 |
| WQCV | 2.42 | 16,404 | 0.377 | 14,114 | 0.324 | 0.13 |
| | 2.50 | 17,417 | 0.400 | 15,467 | 0.355 | 0.13 |
| | 2.75 | 20,582 | 0.473 | 20,217 | 0.464 | 0.14 |
| EURV | 2.93 | 22,862 | 0.525 | 24,126 | 0.554 | 0.14 |
| | 3.00 | 23,748 | 0.545 | 25,758 | 0.591 | 0.14 |
| | 3.25 | 26,417 | 0.606 | 32,028 | 0.735 | 0.15 |
| | 3.50 | 29,087 | 0.668 | 38,967 | 0.895 | 2.16 |
| | 3.75 | 31,756 | 0.729 | 46,572 | 1.069 | 8.89 |
| 100-YR | 4.00 | 34,426 | 0.790 | 54,845 | 1.259 | 18.25 |
| | 4.10 | 35,203 | 0.808 | 58,326 | 1.339 | 20.58 |
| | 4.40 | 37,536 | 0.862 | 69,237 | 1.589 | 21.10 |

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).

# Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected  Worksheet Protected

Stormwater Facility Name: SADDLEHORN RANCH - FILING 1 - POND I

Facility Location & Jurisdiction: EL PASO COUNTY - SADDLEHORN RANCH METROPOLITAN DISTRICT

User Input: Watershed Characteristics

| | | |
|---|---|---|
| Watershed Slope = | 0.053 | ft/ft |
| Watershed Length = | 1900 | ft |
| Watershed Area = | 37.43 | acres |
| Watershed Imperviousness = | 17.0% | 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 |

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

| User Defined Stage [ft] | User Defined Area [ft^2] | User Defined Stage [ft] | User Defined Discharge [cfs] |
|---|---|---|---|
| 0.00 | 0 | 0.00 | 0.00 |
| 1.00 | 2,798 | 1.00 | 0.06 |
| 2.00 | 11,086 | 2.00 | 0.11 |
| 3.00 | 23,748 | 3.00 | 0.14 |
| 4.00 | 34,426 | 4.00 | 18.25 |
| 4.40 | 37,536 | 4.40 | 21.10 |

After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

| Design Storm Return Period = | WQCV | 2 Year | 5 Year | 10 Year | 50 Year | 100 Year | |
|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth = | 0.53 | 1.19 | 1.50 | 1.75 | 2.25 | 2.52 | in |
| Calculated Runoff Volume = | 0.320 | 0.366 | 0.500 | 0.676 | 1.549 | 2.384 | acre-ft |
| OPTIONAL Override Runoff Volume = | | | | | | | acre-ft |
| Inflow Hydrograph Volume = | 0.319 | 0.366 | 0.500 | 0.675 | 1.549 | 2.384 | acre-ft |
| Time to Drain 97% of Inflow Volume = | 41.6 | 45.6 | 56.8 | 65.7 | 60.9 | 57.1 | hours |
| Time to Drain 99% of Inflow Volume = | 44.7 | 48.9 | 60.6 | 70.1 | 67.6 | 65.6 | hours |
| Maximum Ponding Depth = | 2.36 | 2.48 | 2.78 | 3.05 | 3.60 | 4.05 | ft |
| Maximum Ponded Area = | 0.36 | 0.39 | 0.48 | 0.56 | 0.69 | 0.80 | acres |
| Maximum Volume Stored = | 0.302 | 0.347 | 0.478 | 0.615 | 0.961 | 1.295 | acre-ft |

# Stormwater Detention and Infiltration Design Data Sheet

# 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 |
|---|---|---|---|---|

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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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**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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**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**

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| Acad. Ver. 2006 | Scale: 1"=200' Units: Feet |

**Index of Revisions**

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| Detailed by: | DRM |
| Checked by: | JAJ |

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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HAEGLER RANCH SUB-REGIONAL DETENTION ALTERNATIVE CONCEPTUAL CHANNELS

Sheet Number MAIN STEM PG 2

LEGEND

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|---|---|
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| | 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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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

| | |
|---|---|
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| | 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

| | |
|---|---|
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| | 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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Sheet Number MAIN STEM PG 5

LEGEND

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|---|---|
| 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

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Sheet Number TRIBUTARY 6 PG 1

MATCHLINE T6 PG 1

HR0110

TRIBUTARY 6 (T6)
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HR0110

HR0110

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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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Profiles

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

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Designed by: KAP
Detailed by: DRM
Checked by: JAJ

Structure Numbers

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

Computer File Information

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Profiles

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|---|---|
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| Drawing File Name: | CHANNEL.DWG |
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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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| | |
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| Checked by: | JAJ |

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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**Profiles**

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Checked by:

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

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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

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

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| | |
|---|---|
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| Checked by: | JAJ |

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 |
| Acad. Ver. 2006 | Scale: 1"=200' Units: Feet |

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| | |
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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**

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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

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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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# SADDLEHORN RANCH - FILING 1

## PROPOSED DRAINAGE MAP

## LEGEND

| | |
|---|---|
| I.D. (A / B / C) | BASIN DESIGNATION<br>I.D.: BASIN IDENTIFIER<br>A: BASIN AREA<br>B: $C_5$<br>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<br>I.D.: BASIN IDENTIFIER<br>A: BASIN AREA<br>B: $C_5$<br>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 4 OF 4


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