



INNOVATIVE DESIGN. **CLASSIC RESULTS.**

FINAL DRAINAGE REPORT
HANNAH RIDGE AT FEATHERGRASS
FILINGS 5, 6 & 7

December 2018

Prepared for:
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COLORADO SPRINGS, CO 80919

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SF-18-040

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**FINAL DRAINAGE REPORT FOR HANNAH RIDGE
AT FEATHERGRASS FILINGS NO. 5, 6 & 7**

DRAINAGE REPORT STATEMENT

DESIGN 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 the County for drainage report and said report is in conformity with the applicable master plan and drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Marc A. Whorton, Colorado P.E. #37155

Date

OWNERS/DEVELOPER'S STATEMENT:

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

Business Name: Feathergrass Investments LLC

Date

Title: _____

Address: 6385 Corporate Dr., Suite 200

Colorado Springs, CO 80919

EL PASO COUNTY:

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

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

Date

Conditions:



FINAL DRAINAGE REPORT FOR HANNAH RIDGE AT FEATHERGRASS FILINGS NO. 5, 6 & 7

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FINAL DRAINAGE REPORT FOR HANNAH RIDGE AT FEATHERGRASS FILINGS NO. 5, 6 & 7

PURPOSE

This document is the Final Drainage Report for Hannah Ridge at Feathergrass Filings No. 5, 6 & 7. The purpose of this report is to identify onsite and offsite drainage patterns, storm sewer, inlet locations, and areas tributary to the site, and to safely route developed storm water runoff to adequate detention and water quality facilities while releasing storm water at or below historic rates and in accordance with all applicable master drainage plans. This report will discuss the proposed storm system to be built with Filing 5, 6 and 7 and discuss the final construction details, and more specifically, the final design details of the proposed sub-regional public detention/water quality facility located at the southerly end of Filing 6 that will handle the treatment for Filings 5, 6 and 7. Final design information for the Filing No. 5, 6 and 7 detention/water quality facility included in this report.

GENERAL DESCRIPTION

The Hannah Ridge at Feathergrass development is a 121.2 acre residential and commercial district within the south half of Section 32, Township 13 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is located on the west side of Akers Drive just north of Constitution Avenue. The existing abandoned Chicago Rock Island and Pacific Railroad sits directly north and west of the site, with Akers Drive bordering the east side and Constitution adjoining the south side of the site. The entire proposed development includes a total of 345 single-family residences and will be developed in seven filings. The Filing No. 5, 6 and 7 are the only remaining areas that are currently undeveloped within the community and was previously re-platted under Hannah Ridge at Feathergrass Filing No. 1. Filing No. 5 includes 55 residential lots on approximately 12.92 acres. Filing No. 6 will include 33 lots on approximately 7.94 acres, and Filing No. 7 is 81 lots on approximately 15.40 acres.

The average soil condition of the entire site and tributary area to the proposed ponds reflects Hydrologic Group "A" (Blakeland, loamy sand) as determined by the "Soil Survey of El Paso County Area," prepared by the National Cooperative Soil Survey (see map in Appendix).



EXISTING DRAINAGE CONDITIONS

The site is located within the Sand Creek Drainage Basin. More specifically, it is situated in the north half of the overall Hannah Ridge at Feathergrass residential portion of the development. These last three residential filings makeup nearly all of the Basin A4, as shown on the existing drainage map provided by MVE, Inc. (See Appendix) The abandoned railroad bed along the north edge of the development serves as the northerly basin boundary and Winslow Park Dr. to the south as the southerly basin boundary. The recent construction of Filing 3 improvements included a 6'x10' CBC under Winslow Park Dr. out-falling into a 90" RCP storm. Adjacent to the 6'x10' CBC, a stormwater quality facility (Sand Filter Basin) was also constructed within Tract E, Hannah Ridge at Feathergrass Filing 1. The on-site pre-development drainage patterns sheet flow towards the natural channel through the middle of the property and ultimately into the 6'x10' CBC. This facility was constructed to allow the significant off-site flows from the north, passing under the railroad bed ($Q_{10} = 360$ cfs and $Q_{100} = 640$ cfs per Sand Creek DBPS) historically, traversing the site within an unimproved natural channel within a drainage easement. These off-site flows will continue to flow through the site as planned with the Hannah Ridge at Feathergrass Filing 3 construction drawings, designed by MVE, Inc., approved October 2017. This concept will be finalized in the Filing 5 construction drawings.

DEVELOPED DRAINAGE CONDITIONS

Given some recent changes in City/County Drainage Criteria, the calculations for these last phases of development now reflect current criteria for stormwater quality requirements. Proposed Pond 1 will be designed as a full spectrum facility to accommodate the developed flows from Filings 5, 6 and 7. This will include the design of concrete forebays, concrete trickle channels, concrete micropool and an outlet structure designed to release flows based on full spectrum criteria. The attached developed conditions drainage map contains many design points related to proposed at-grade and sump conditions. All public Type R inlets have been designed at these various locations to accept both the 5-yr. and 100-yr. developed flows. All proposed storm facilities within the public Right-of-way will be public with ownership and maintenance by El Paso County. All proposed storm facilities within easements or tracts and the proposed Pond 1 will be owned and maintained by the Hannah Ridge HOA.

Design Point 1 ($Q_5 = 7$ cfs and $Q_{100} = 15$ cfs) and **Design Point 2** ($Q_5 = 0.7$ cfs and $Q_{100} = 1.4$ cfs) collect developed flows from Basins OS-2, A and F. At this sump condition, a 10' and a 5' Type R sump inlets,



respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and then be conveyed via a 24" RCP storm sewer in a southerly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 2 ($Q_5 = 7$ cfs and $Q_{100} = 16$ cfs)**. The emergency overflow route at this location is in the southerly direction directly into a drainage tract that will route the flows towards Pond 1.

Design Point 3 ($Q_5 = 9$ cfs and $Q_{100} = 21$ cfs) and **Design Point 4** ($Q_5 = 2$ cfs and $Q_{100} = 4$ cfs) collect developed flows from Basins OS-3, D and E. At this sump condition, a 10' and a 5' Type R sump inlets, respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and then be conveyed via a 30" RCP storm sewer towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 4 ($Q_5 = 11$ cfs and $Q_{100} = 24$ cfs)**. The emergency overflow route at this location is via a natural swale between two lots within a drainage easement and then directly into the natural channel. **Pipe Run 5 ($Q_5 = 17$ cfs and $Q_{100} = 38$ cfs)** represents the combined pipe flows from Design Points 1-4. This 36" RCP storm sewer will route these developed flows to a rip-rap chute and then directly into Pond 1. This pond inflow is designated later in this report as the easterly pond inflow.

Design Point 5 ($Q_5 = 9$ cfs and $Q_{100} = 25$ cfs) collects developed flows from Basins OS-4 and J. At this sump condition, a 15' Type R sump inlet will be installed to collect a portion of both the 5-year and 100-year developed flows. These flows being collected have a maximum ponding depth up to the crown of the street. The collected flows at this location equal ($Q_5 = 8$ cfs and $Q_{100} = 8$ cfs) with flow-by of ($Q_5 = 1$ cfs and $Q_{100} = 17$ cfs) that will overtop the crown and travel into basins K and L. Given the location of the inlet with respect to this "T" intersection, it is assumed that approximately 75% of the flow-by will enter Basin K and 25% of the flow-by will enter Basin L. The downstream design points account for this flow-by assumption.

Design Point 6 ($Q_5 = 6$ cfs and $Q_{100} = 24$ cfs) and **Design Point 7** ($Q_5 = 4$ cfs and $Q_{100} = 12$ cfs) collect developed flows from Basins K, L and the flow-by described above from DP-5. At this sump condition, a 10' and a 5' Type R sump inlets, respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth up to the crown in Electronic Drive and be conveyed via a 36" RCP storm sewer in a southerly direction towards Design Point 8. The



total flow within the pipe at this location is given by **Pipe Run 9 ($Q_5 = 17$ cfs and $Q_{100} = 44$ cfs)**. The emergency overflow route at this location is in the southerly direction over the crown of Electronic Drive towards Design Point 8.

Design Point 8 ($Q_5 = 3$ cfs and $Q_{100} = 7$ cfs) collects developed flows from Basin M. At this sump condition, a 10' Type R sump inlet will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and be conveyed via a 36" RCP storm sewer in a southerly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 10 ($Q_5 = 20$ cfs and $Q_{100} = 49$ cfs)**. The emergency overflow route at this location is in the southerly direction directly into a drainage tract that will route the flows towards the Grand Prix cul-de-sac.

Design Point 9 ($Q_5 = 9$ cfs and $Q_{100} = 19$ cfs) and **Design Point 10** ($Q_5 = 2$ cfs and $Q_{100} = 5$ cfs) collect developed flows from Basins OS-5, N and O. At this sump condition, a 10' and a 5' Type R sump inlets, respectively, will be installed to completely collect both the 5-year and 100-year developed flows. These flows will have a maximum ponding depth of 1.0' and then be conveyed via a 36" RCP storm sewer in an easterly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 12 ($Q_5 = 10$ cfs and $Q_{100} = 23$ cfs)**. The emergency overflow route at this location is in the southerly direction directly into a drainage tract that will route the flows towards the natural channel. **Pipe Run 13 ($Q_5 = 30$ cfs and $Q_{100} = 71$ cfs)** represents the combined pipe flows from Pipe Runs 10 and 12. This 42" RCP storm sewer will route these developed flows directly into Pond 1. This pond inflow is designated later in this report as the westerly pond inflow.

Basin OS-1 ($Q_5 = 0.6$ cfs and $Q_{100} = 1.3$ cfs) develops flows from the existing Akers Dr. roadway, north of the highpoint, that will continue to drain in a northerly direction as curb and gutter flow. **Basin C** ($Q_5 = 0.5$ cfs and $Q_{100} = 1$ cfs) develops flows from the existing Akers Dr. parkway landscape area adjacent to the roadway that will sheet flow into the road and continue to travel in a southerly direction. **Basin G** ($Q_5 = 0.7$ cfs and $Q_{100} = 1.4$ cfs) develops flows from a small portion of the proposed lots and roadway that cannot be collected on-site. These minor flow will continue to drain in a southerly direction directly into Winslow Park Dr. **Basin B1** ($Q_5 = 0.1$ cfs and $Q_{100} = 0.9$ cfs) develops flow from the northerly portion of



Tract A and does not include any impervious improvements. Thus, this basin will continue to sheet flow off-site. **Basin B** ($Q_5 = 1$ cfs and $Q_{100} = 3$ cfs), **Basin H** ($Q_5 = 1$ cfs and $Q_{100} = 2$ cfs) and **Basin P** ($Q_5 = 2$ cfs and $Q_{100} = 4$ cfs) develop flows from the rear yards of the proposed lots that cannot be reasonably collected by Pond 1. As noted on the drainage map, all impervious roof area within these basins will require roof drains to be routed to the front of the lots and directly into the public roadway. As such, these flows are then treated by Pond 1. Any remaining minor impervious areas not able to be routed to the front of the lot must travel across a grass buffer (sodded rear yard) prior to exiting the lot. **Basin Q** ($Q_5 = 2$ cfs and $Q_{100} = 6$ cfs) develops flows from rear yards of the proposed lots adjacent to Pond 1 and the facility itself. These flows are all tributary to Pond 1.

The total inflow into Pond 1 equals $Q_5 = 44$ cfs and $Q_{100} = 103$ cfs per the UD-Detention spreadsheet. (See Appendix) This facility will be constructed with the proposed Filing 7 development and the downstream flows will remain consistent with the previous filings. This facility will have two separate inflow points (westerly and easterly). The westerly inflow ($Q_5 = 30$ cfs and $Q_{100} = 71$ cfs) will be from a 42" RCP into a concrete forebay with a required size of 566 CF based on 3% of the WQCV from this inflow. The forebay is designed with 18" high walls, 6" notch and a 24" wide concrete trickle channel routing the flows towards the pond outlet. The easterly inflow ($Q_5 = 17$ cfs and $Q_{100} = 38$ cfs) will outlet from a 36" RCP, down a rip-rap chute into a concrete forebay with a required size of 305 CF based on 3% of the WQCV from this inflow. The forebay is designed with 12" high walls, 5" notch and an 28" wide concrete trickle channel routing the flows towards the pond outlet. These two forebays trickle channels will combine into a 30" wide concrete trickle channel conveying the flows to the outlet structure. The outlet structure consists of a 6'x4' concrete box with an integral 190 SF micropool allowing for 6" initial surcharge depth. The micropool total depth of 3.0' provides the required 0.3% of the WQCV. The outlet box height required to meet the EURV design volume equals 5.75'. (See UD-BMP Spreadsheets in Appendix) The orifice plate on the front of the outlet box consists of a series of 5 holes, 13.8" apart. (See UD-Detention Spreadsheets in Appendix) This facility will be owned and maintained by the Hannah Ridge HOA.

Pond 1 has the following design parameters as a full-spectrum facility:

0.74 Ac.-ft. WQCV required

2.44 Ac.-ft. EURV required

2.6 Ac.-ft. EURV design with 4:1 max. slopes

4.4 Ac.-ft. 100-yr. storage



Total In-flow:	Q₅ = 44 cfs, Q₁₀₀ = 103 cfs
Pond Design Release:	Q₅ = 0.8 cfs, Q₁₀₀ = 38 cfs
Pre-development Release:	Q₅ = 0.8 cfs, Q₁₀₀ = 46 cfs

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. Individual on-site developed basin design used for inlet sizing and storm system routing was calculated using the Rational Method. Full-Spectrum detention pond modeling developed using UD-Detention spreadsheet ver. 3.07, Urban Drainage and Flood Control District.

The City of Colorado Springs/El Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements.

This site adheres to this **Four Step Process** as follows:

1. **Employ Runoff Reduction Practices:** Proposed impervious areas (roof tops, patios) will sheet flow across landscaped yards and through open space areas to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets. This will minimize directly connected impervious areas within the project site.
2. **Stabilize Drainageways:** After developed flows utilize the runoff reduction practices through the front yards, these flows will travel via curb and gutter within the public streets and eventually public storm systems. These collected flows are then routed directly to the full-spectrum detention facility on-site (Pond 1). Where developed flows are not able to be routed to public streets (rear yards),



sheet flows will travel towards the natural drainage channel within the open space corridor. This corridor will be protected with rip-rap and erosion control matting as required to reduce velocities to non-erosive levels.

3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV in the proposed full-spectrum permanent Extended Detention Basin (Pond 1) designed per current El Paso County drainage criteria.
4. **Consider need for Industrial and Commercial BMPs:** No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative has been submitted along with the grading and erosion control plan. Details such as site specific source control construction BMP's as well as permanent BMP's were detailed in this plan and narrative to protect receiving waters. BMP's will be constructed and maintained as the development has been graded and erosion control methods employed.

ROCK ISLAND TRAIL (BOX CULVERT)

Kiowa Engineering Corporation prepared a report titled "Hydrology Analysis, East Fork Sand Creek, Tributary 6", having revision date of January 18, 2007. The report served to amend the Sand Creek DBPS and was reviewed and accepted by El Paso County during the same time frame as the Preliminary Plan approval for Hannah Ridge at Feathergrass. The amendment specified that the existing 7'x7' railroad culvert crossing, located just north of the proposed Filing 5, is to remain in place. Said DBPS amendment indicates that the existing ponding area on the upstream side of the railroad embankment is to remain in the current and future drainage conditions, thereby reducing the resultant developed flows through the properties downstream of the embankment, including flows through the tributary in Hannah Ridge. Flows at this structure are as follows: Inflow $Q_{10} = 374$ cfs and $Q_{100} = 915$ cfs, Outflow $Q_{10} = 360$ cfs and $Q_{100} = 640$ cfs with a 100 yr. upstream storage elevation of 6495.3. The 2007 DBPS Amendment Map is included in the Appendix for easy reference. In accordance with BOCC conditions of approval of the Preliminary Plan, maintenance on this existing structure was to take place in conjunction with the Hannah Ridge at Feathergrass Filing 3 improvements. As such, specified improvements were included in the approved construction drawings for Filing 3 (Sheet 31). These improvements included concrete surface repairs within



the box culvert, wingwall reconditioning and addition of rip-rap aprons. To date, these improvements have been completed by Classic Homes with the development of Filing 3 and inspected by El Paso County. The City of Colorado Springs is aware of the recent improvements and is scheduled to inspect them for completion, as they will maintain ownership and maintenance responsibility for this structure and associated improvements.

Mostly Resolved, However, the comment that the owner of the Box Culvert, The City of Colorado Springs has in writing accepted the improvements is still outstanding.

FLOODPLAIN STATEMENT

No portion of this site is located within a FEMA floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041C0752F, with effective dates of March 17, 1997 (See Appendix).

EROSION CONTROL PLAN

The Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate be submitted with the Final Drainage Report. We respectfully request that the Erosion Control Plan and cost estimate be submitted in conjunction with the Overlot Grading Plan and construction assurances posted prior to obtaining a grading permit.

DRAINAGE & BRIDGE FEES

This site lies within the Sand Creek Drainage Basin. The fees are calculated using the following impervious acreage method approved by El Paso County. All three Filings are re-plats of previously platted tracts within Filing 1. However, these tracts were designated as future development and no fees were paid at time of original platting. Thus, the percent imperviousness for each Filing is calculated below based on the following acreages:

Filing 5: 12.92 ac.

Filing 6: 7.94 ac.

Filing 7: 15.40 ac. However, 1.69 ac. is a re-plat of Tract A, Filing 6 with fees paid at that time
Filing 7 net acreage for drainage/bridge fees = 13.71 ac.

The total development area for each Filing is broken into different residential uses:

PUD zone (5000-6000 SF lots – 60% Impervious)

PUD zone (6000 SF avg. lots – 53% Impervious)

PUD zone Open space/drainage tracts (Greenbelts – 2% Impervious).



The following calculations are based on the 2018 drainage/bridge fees for the Sand Creek Basin:

FILING 5:

6000 SF avg. lots

(Per El Paso County Percent Impervious Chart for 6000 SF lots: 53%)

$$11.93 \text{ Ac.} \times 53\% = \mathbf{6.32 \text{ Impervious Ac.}}$$

Open Space Tracts

(Per El Paso County Percent Impervious Chart for greenbelts: 2%)

$$0.99 \text{ Ac.} \times 2\% = \mathbf{0.02 \text{ Impervious Ac.}}$$

Total Impervious Acreage: 6.34 Imp. Ac.

FILING 5 FEE TOTALS:

Bridge Fees

$$\$ 5,210.00 \times 6.34 \text{ Impervious Ac.} \quad = \quad \underline{\$ 33,031.40}$$

Drainage Fees

$$\$ 17,751.00 \times 6.34 \text{ Impervious Ac.} \quad = \quad \underline{\$ 112,541.34}$$

FILING 6:

5000 - 6000 SF avg. lots

(Per El Paso County Percent Impervious Chart for 5000 - 6000 SF lots: 60%)

$$6.25 \text{ Ac.} \times 60\% = \mathbf{3.75 \text{ Impervious Ac.}}$$

Open Space Tracts

(Per El Paso County Percent Impervious Chart for greenbelts: 2%)

$$1.69 \text{ Ac.} \times 2\% = \mathbf{0.03 \text{ Impervious Ac.}}$$



Total Impervious Acreage: 3.78 Imp. Ac.

FILING 6 FEE TOTALS:

Bridge Fees

\$ 5,210.00 x 3.78 Impervious Ac. = \$ 19,693.80

Drainage Fees

\$ 17,751.00 x 3.78 Impervious Ac. = \$ 67,098.78

FILING 7:

5000 - 6000 SF avg. lots

(Per El Paso County Percent Impervious Chart for 5000 - 6000 SF lots: 60%)

13.71 Ac. x 60% = **8.23 Impervious Ac.**

Total Impervious Acreage: 8.23 Imp. Ac.

FILING 7 FEE TOTALS:

Bridge Fees

\$ 5,210.00 x 8.23 Impervious Ac. = \$ 42,878.30

Drainage Fees

\$ 17,751.00 x 8.23 Impervious Ac. = \$ 146,090.73



SUMMARY

This proposed development remains consistent with the previously approved MDDP and Final Drainage Reports for Hannah Ridge at Feathergrass Filings 2, 3 and 4. The existing storm facilities continue to adequately handle both the 5-yr. and 100-yr. developed flows. All proposed detention facilities meet current criteria and provide full spectrum design. The proposed development will not adversely impact surrounding developments.

PREPARED BY:
Classic Consulting



Marc A. Whorton, P.E.
Project Manager

maw/1116.05/REPORTS/PDR-Fil. 5-6-7.doc

A Private Maintenance Agreement for all Filings that identifies the detention facility and outfall channel that are located on the other filings (5,6 & 7).

This document should confirm that the Hannah Ridge HOA will own and maintain these facilities.



REFERENCES

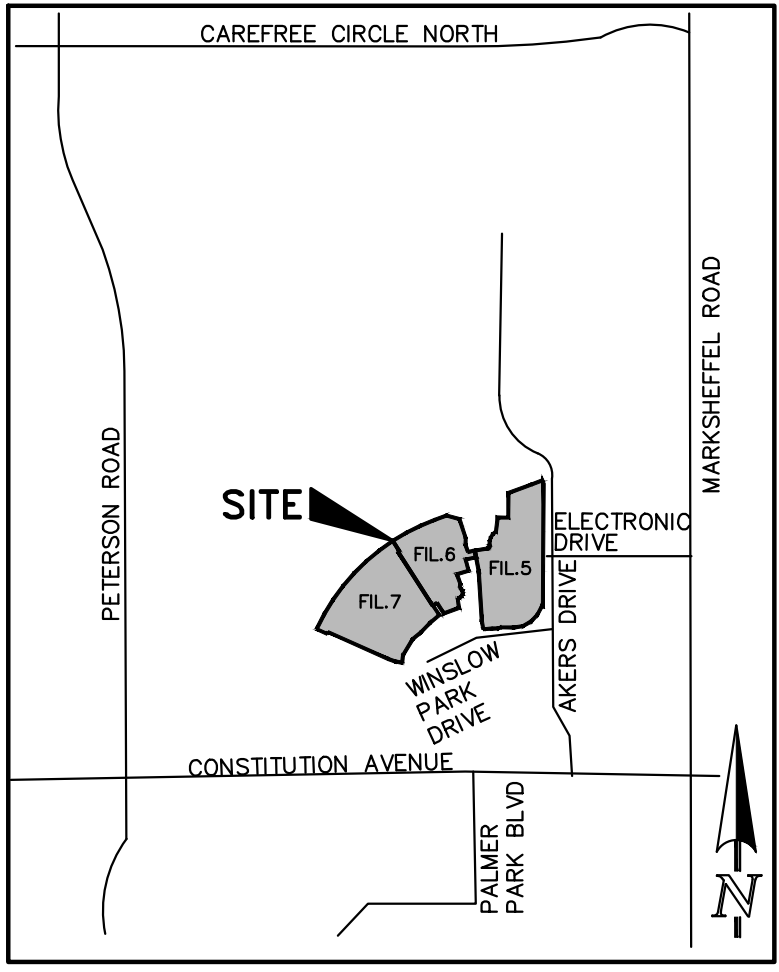
1. City of Colorado Springs/County of El Paso Drainage Criteria Manual dated October 1991.
2. “Sand Creek Drainage Basin Planning Study,” Kiowa Engineering Corp, dated March 1996.
3. “Master Development Drainage Plan for Hannah Ridge”, prepared by MVE, Inc. November 2007
4. “Hydrology Analysis, East Fork Sand Creek, Tributary 6”, prepared by Kiowa Engineering Corp, dated January 2007
5. “Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 3”, by MVE, Inc. October 2017.
6. Drainage Criteria Manual (Volume 3) latest revision April 2008, Urban Drainage and Flood Criteria District.



APPENDIX

VICINITY MAP





VICINITY MAP

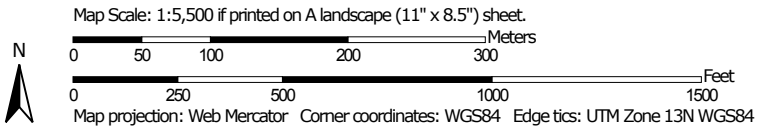
N.T.S.

SOILS MAP (S.C.S SURVEY)

Soil Map—El Paso County Area, Colorado




Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 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: Apr 15, 2011—Jun 17, 2014

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	119.8	88.4%
97	Truckton sandy loam, 3 to 9 percent slopes	15.7	11.6%
Totals for Area of Interest		135.4	100.0%

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v

Elevation: 4,600 to 5,800 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 46 to 48 degrees F

Frost-free period: 125 to 145 days

Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats

Landform position (three-dimensional): Side slope, talf

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand

AC - 11 to 27 inches: loamy sand

C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Somewhat excessively drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 5 percent

Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A

Ecological site: Sandy Foothill (R049BY210CO)

Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:

Hydric soil rating: No

Pleasant

Percent of map unit:

Landform: Depressions

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 16, Sep 10, 2018

F.E.M.A. MAP

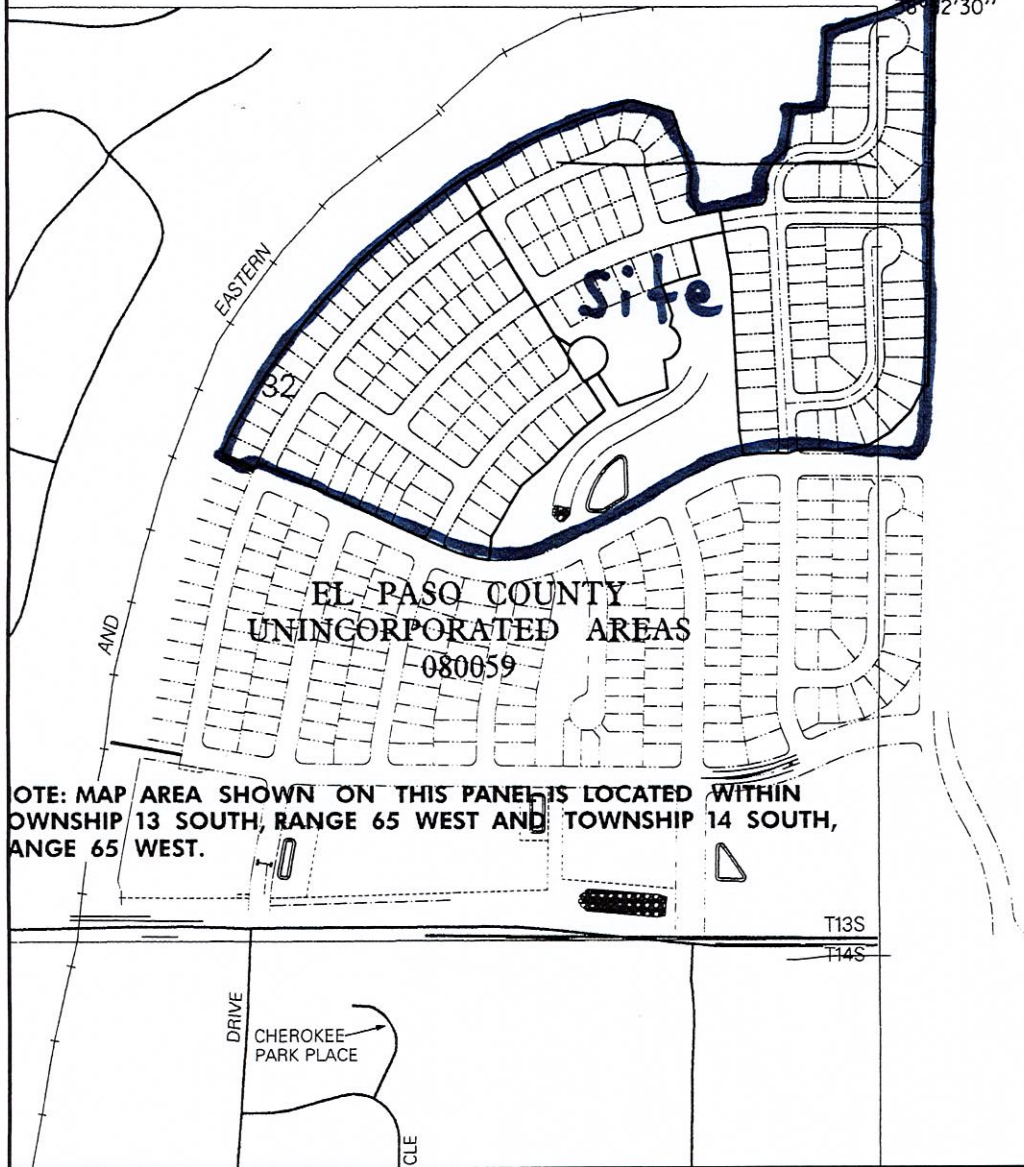




APPROXIMATE SCALE IN FEET

500 0 500

104°41'15"
104°2'30"



NATIONAL FLOOD INSURANCE PROGRAM

**FIRM
FLOOD INSURANCE RATE MAP**

**EL PASO COUNTY,
COLORADO AND
INCORPORATED AREAS**

PANEL 752 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:
COMMUNITY

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080080	0752	F
EL PASO COUNTY UNINCORPORATED AREAS	080059	0752	F

**MAP NUMBER
08041C0752 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

HYDROLOGIC / HYDRAULIC CALCULATIONS

JOB NAME: HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7
 JOB NUMBER: 1116.05
 DATE: 10/01/18
 CALCULATED BY: K. CERJAN

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS							LANDSCAPE/UNDEVELOPED AREAS							WEIGHTED			WEIGHTED CA		
		AREA (AC)	C(2)	C(5)	C(10)	C(25)	C(50)	C(100)	AREA (AC)	C(2)	C(5)	C(10)	C(25)	C(50)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)
OS-1	0.23	0.16	0.89	0.90	0.92	0.94	0.95	0.96	0.07	0.02	0.08	0.15	0.25	0.30	0.35	0.63	0.65	0.77	0.14	0.15	0.18
OS-2	0.35	0.25	0.89	0.90	0.92	0.94	0.95	0.96	0.10	0.02	0.08	0.15	0.25	0.30	0.35	0.64	0.67	0.79	0.22	0.23	0.28
OS-3	0.27	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.27	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	0.01	0.02	0.09
OS-4	3.40	0.00	0.89	0.90	0.92	0.94	0.95	0.96	3.40	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	0.07	0.27	1.19
OS-5	0.36	0.33	0.89	0.90	0.92	0.94	0.95	0.96	0.03	0.02	0.08	0.15	0.25	0.30	0.35	0.82	0.83	0.91	0.29	0.30	0.33
A	3.90	0.00	0.89	0.90	0.92	0.94	0.95	0.96	3.90	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	1.52	1.68	2.22
B	0.52	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.52	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.20	0.22	0.30
B1	0.28	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.28	0.02	0.08	0.15	0.25	0.30	0.35	0.02	0.08	0.35	0.01	0.02	0.10
C	0.21	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.21	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.08	0.09	0.12
D	5.60	0.00	0.89	0.90	0.92	0.94	0.95	0.96	5.60	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	2.18	2.41	3.19
E	0.96	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.96	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.37	0.41	0.55
F	0.26	0.08	0.89	0.90	0.92	0.94	0.95	0.96	0.18	0.39	0.43	0.47	0.52	0.55	0.57	0.54	0.57	0.69	0.14	0.15	0.18
G	0.25	0.10	0.89	0.90	0.92	0.94	0.95	0.96	0.15	0.39	0.43	0.47	0.52	0.55	0.57	0.59	0.62	0.73	0.15	0.15	0.18
H	0.40	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.40	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.16	0.17	0.23
I	Not Used																				
J	5.30	0.00	0.89	0.90	0.92	0.94	0.95	0.96	5.30	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	2.07	2.28	3.02
K	3.60	0.00	0.89	0.90	0.92	0.94	0.95	0.96	3.60	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	1.40	1.55	2.05
L	2.30	0.00	0.89	0.90	0.92	0.94	0.95	0.96	2.30	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.90	0.99	1.31
M	1.70	0.00	0.89	0.90	0.92	0.94	0.95	0.96	1.70	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.66	0.73	0.97
N	5.10	0.00	0.89	0.90	0.92	0.94	0.95	0.96	5.10	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	1.99	2.19	2.91
O	1.20	0.00	0.89	0.90	0.92	0.94	0.95	0.96	1.20	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.47	0.52	0.68
P	0.77	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.77	0.39	0.43	0.47	0.52	0.55	0.57	0.39	0.43	0.57	0.30	0.33	0.44
Q	3.20	0.90	0.39	0.43	0.47	0.52	0.55	0.57	2.30	0.02	0.08	0.15	0.25	0.30	0.35	0.12	0.18	0.41	0.40	0.57	1.32

JOB NAME: HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7
 JOB NUMBER: 1116.05
 DATE: 10/01/18
 CALC'D BY: K. CERJAN

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)* $t_e = \frac{L}{180} + 10$	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad V = C_v S_w^{0.5} \quad Tc = LV$$

*For buried riprap, select C_v value based on type of vegetative cover.

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED						OVERLAND				STREET / CHANNEL FLOW				Tc TOTAL (min)	INTENSITY						TOTAL FLOWS		
	CA(2)	CA(5)	CA(10)	CA(25)	CA(50)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)		I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	0.14	0.15	0.16	0.17	0.17	0.18	0.08	25	0.5	7.3	230	1.0%	2.0	1.9	9.2	3.39	4.25	4.96	5.66	6.37	7.13	0.5	0.6	1.3
OS-2	0.22	0.23	0.25	0.26	0.27	0.28	0.08	25	0.5	7.3	320	1.0%	2.0	2.7	10.0	3.30	4.13	4.82	5.51	6.20	6.93	0.7	1	2
OS-3	0.01	0.02	0.04	0.07	0.08	0.09	0.08	100	10	8.6					8.6	3.47	4.35	5.08	5.80	6.53	7.31	0.02	0.1	0.7
OS-4	0.07	0.27	0.51	0.85	1.02	1.19	0.08	180	10	14.0					14.0	2.89	3.62	4.22	4.83	5.43	6.08	0.2	1	7
OS-5	0.29	0.30	0.31	0.32	0.32	0.33	0.08	10	0.2	4.6	470	2.8%	3.3	2.3	7.0	3.72	4.67	5.45	6.23	7.01	7.84	1.1	1	3
A	1.52	1.68	1.83	2.03	2.15	2.22	0.43	100	2	9.6	750	1.5%	2.4	5.1	14.7	2.83	3.55	4.14	4.73	5.32	5.96	4	6	13
B	0.20	0.22	0.24	0.27	0.29	0.30	0.43	75	16	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1	1	3
B1	0.01	0.02	0.04	0.07	0.08	0.10	0.08	55	13	4.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	0.0	0.1	0.9
C	0.08	0.09	0.10	0.11	0.12	0.12	0.43	20	0.4	4.3					5.0	4.12	5.17	6.03	6.89	7.75	8.68	0.3	0.5	1
D	2.18	2.41	2.63	2.91	3.08	3.19	0.43	100	2	9.6	575	4.0%	4.0	2.4	12.0	3.08	3.85	4.50	5.14	5.78	6.47	7	9	21
E	0.37	0.41	0.45	0.50	0.53	0.55	0.43	50	1	6.8	375	2.7%	3.3	1.9	8.7	3.46	4.34	5.06	5.78	6.51	7.28	1	2	4
F	0.14	0.15	0.16	0.17	0.18	0.18	0.43	50	1	6.8					6.8	3.75	4.71	5.49	6.28	7.06	7.90	0.5	0.7	1.4
G	0.15	0.15	0.16	0.17	0.18	0.18	0.43	50	1	6.8	60	1.5%	2.4	0.4	7.2	3.68	4.62	5.39	6.16	6.93	7.76	0.5	0.7	1.4
H	0.16	0.17	0.19	0.21	0.22	0.23	0.43	30	0.6	5.3					5.3	4.06	5.09	5.94	6.79	7.64	8.55	1	1	2
I	Not Used																							
J	2.07	2.28	2.49	2.76	2.92	3.02	0.43	100	2	9.6	850	1.5%	2.4	5.8	15.4	2.78	3.48	4.06	4.64	5.22	5.84	6	8	18
K	1.40	1.55	1.69	1.87	1.98	2.05	0.43	100	2	9.6	425	1.5%	2.4	2.9	12.5	3.03	3.79	4.42	5.06	5.69	6.37	4	6	13
L	0.90	0.99	1.08	1.20	1.27	1.31	0.43	100	2	9.6	510	2.5%	3.2	2.7	12.3	3.05	3.82	4.45	5.09	5.73	6.41	3	4	8
M	0.66	0.73	0.80	0.88	0.94	0.97	0.43	50	1	6.8	475	1.5%	2.4	3.2	10.0	3.29	4.12	4.81	5.50	6.19	6.92	2	3	7
N	1.99	2.19	2.40	2.65	2.81	2.91	0.43	100	2	9.6	975	2.0%	2.8	5.7	15.4	2.78	3.48	4.07	4.65	5.23	5.85	6	8	17
O	0.47	0.52	0.56	0.62	0.66	0.68	0.43	50	1	6.8	575	2.0%	2.8	3.4	10.2	3.27	4.10	4.78	5.47	6.15	6.88	1.5	2	5
P	0.30	0.33	0.36	0.40	0.42	0.44	0.43	50	6	3.8					5.0	4.12	5.17	6.03	6.89	7.75	8.68	1.2	2	4
Q	0.40	0.57	0.77	1.04	1.19	1.32	0.08	260	5	23.9					23.9	2.26	2.82	3.29	3.76	4.23	4.73	1	2	6

JOB NAME: HANNAH RIDGEAT FEATHERGRASS FILING NO. 5, 6 & 7
 JOB NUMBER: 1116.05
 DATE: 10/01/18
 CALCULATED BY: K. CERJAN

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1	A, OS-2	1.91	2.50	14.7	3.55	5.96	7	15	10' Type R Sump
2	F	0.15	0.18	6.8	4.71	7.90	0.7	1.4	5' Type R Sump
3	D, OS-3	2.43	3.29	12.0	3.85	6.47	9	21	15' Type R Sump
4	E	0.41	0.55	8.7	4.34	7.28	2	4	5' Type R Sump
5	OS-4, J	2.55	4.21	15.4	3.48	5.84	9	25	15' Type R Sump
6	K, DP-5 Flowby (75%)	1.76	4.20	15.8	3.44	5.78	6	24	10' Type R Sump
7	L, DP-5 Flowby (25%)	1.06	2.03	15.8	3.44	5.78	4	12	5' Type R Sump
8	M	0.73	0.97	10.0	4.12	6.92	3	7	10' Type R Sump
9	N, OS-5	2.49	3.23	15.4	3.48	5.85	9	19	10' Type R Sump
10	O	0.52	0.68	10.2	4.10	6.88	2	5	5' Type R Sump
E'LY INFLOW TO POND	DP1 - DP4	4.90	6.51	15.5	3.47	5.82	17	38	
W'LY INFLOW TO POND	DP-5 - DP-10	8.83	12.46	16.2	3.40	5.72	30	71	
TOTAL INFLOW TO POND	OS-2, OS-3, OS-4, OS-5, A, D, E, F, J, K, L, M, N, O, Q	See UD-Detention Spreadsheet					44	103	

JOB NAME: HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7
 JOB NUMBER: 1116.05
 DATE: 10/01/18
 CALCULATED BY: K. CERJAN

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
 REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*	Velocity (ft/sec.)
					I(5)	I(100)	Q(5)	Q(100)		
1	DP-1	1.91	2.50	14.7	3.55	5.96	7	15	24" RCP	7.7
2	DP-2, PR-1	2.06	2.68	14.8	3.54	5.94	7	16	24" RCP	11.5
3	DP-3	2.43	3.29	12.0	3.85	6.47	9	21	30" RCP	8.4
4	DP-4, PR-3	2.84	3.83	12.6	3.78	6.35	11	24	30" RCP	16.3
5	PR-2, PR-4	4.90	6.51	15.5	3.47	5.82	17	38	36" RCP	23.6 (Use Class 5 RCP w/ Rstrnts)
6	DP-5 Collected	2.27	1.35	15.4	3.48	5.84	8	8	18" RCP	10.4
7	DP-6, Flow-by from DP-5 (75%)	1.76	4.20	15.8	3.44	5.78	6	24	30" RCP	16.8
8	DP-7, Flow-by from DP-5 (25%)	1.06	2.03	15.8	3.44	5.78	4	12	24" RCP	9.5
9	RP-6, PR-7, PR-8	5.09	7.57	15.9	3.43	5.76	17	44	36" RCP	10.1
10	DP-8, PR-9	5.82	8.54	16.1	3.41	5.73	20	49	36" RCP	10.3
11	DP-10	0.52	0.68	10.3	4.09	6.86	2	5	18" RCP	4.5
12	DP-9, PR-11	3.01	3.92	15.5	3.47	5.83	10	23	36" RCP	6.6
13	PR-10, PR-12	8.83	12.46	16.2	3.40	5.72	30	71	42" RCP	9.5

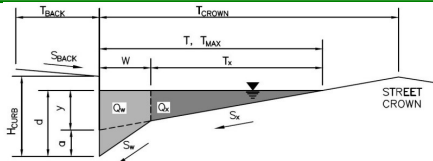
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project:
Inlet ID:

Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

DP-1



Gutter Geometry (Enter data in the blue cells)

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

$T_{BACK} = 7.5$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.013$
 $H_{CURB} = 6.00$ inches
 $T_{CROWN} = 17.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_D = 0.000$ ft/ft
 $n_{STREET} = 0.016$

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

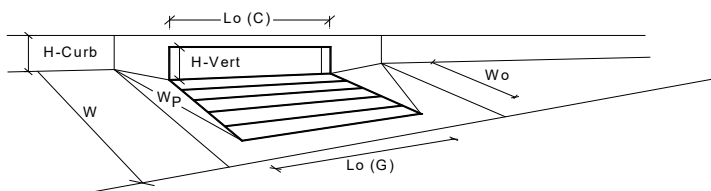
	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

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

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	12.0	inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	8.3	25.5	cfs
Q PEAK REQUIRED =	7.0	15.0	cfs

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

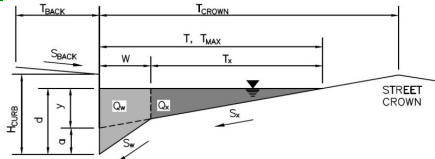
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID:

DP-2



Gutter Geometry (Enter data in the blue cells)

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

$T_{BACK} = 7.5$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.013$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 17.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_D = 0.000$ ft/ft
 $n_{STREET} = 0.016$

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

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

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

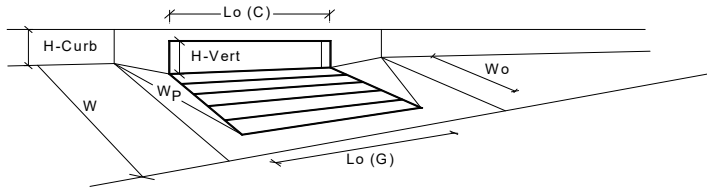
$Q_{allow} =$

Minor Storm	Major Storm
SUMP	SUMP

 cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	12.0	inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	5.4	12.3	cfs
Q PEAK REQUIRED =	0.7	1.4	cfs

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

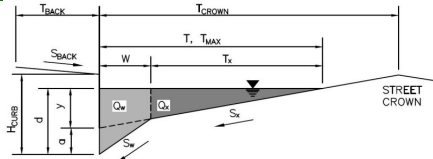
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID:

DP-3



Gutter Geometry (Enter data in the blue cells)

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

$T_{BACK} = 7.5$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.013$
 $H_{CURB} = 6.00$ inches
 $T_{CROWN} = 17.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_D = 0.000$ ft/ft
 $n_{STREET} = 0.016$

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

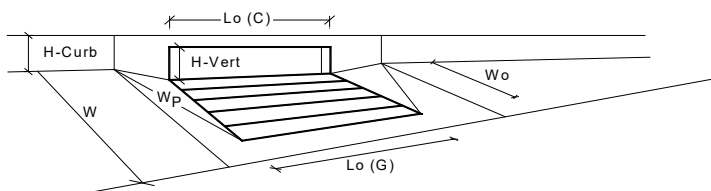
	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

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

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

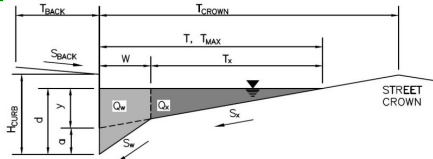


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	12.0	inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	0.79	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	9.7	39.1	cfs
Q PEAK REQUIRED =	9.0	21.0	cfs

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

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

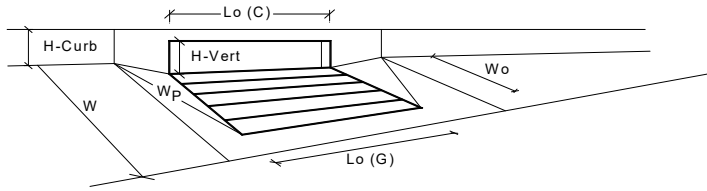
Project: **Hannah Ridge at Feathergrass Filing No. 5, 6 & 7**
 Inlet ID: **DP-4**



Gutter Geometry (Enter data in the blue cells)																	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 7.5$ ft																
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft																
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.013$																
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches																
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft																
Gutter Width	$W = 2.00$ ft																
Street Transverse Slope	$S_X = 0.020$ ft/ft																
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_W = 0.083$ ft/ft																
Street Longitudinal Slope - Enter 0 for sump condition	$S_D = 0.000$ ft/ft																
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$																
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td>$T_{MAX} =$</td> <td>17.0</td> <td>17.0</td> <td>ft</td> </tr> <tr> <td>$d_{MAX} =$</td> <td>6.0</td> <td>12.0</td> <td>inches</td> </tr> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td></td> </tr> </tbody> </table>		Minor Storm	Major Storm		$T_{MAX} =$	17.0	17.0	ft	$d_{MAX} =$	6.0	12.0	inches		<input type="checkbox"/>	<input type="checkbox"/>	
	Minor Storm	Major Storm															
$T_{MAX} =$	17.0	17.0	ft														
$d_{MAX} =$	6.0	12.0	inches														
	<input type="checkbox"/>	<input type="checkbox"/>															
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm																	
Check boxes are not applicable in SUMP conditions																	
MINOR STORM Allowable Capacity is based on Depth Criterion																	
MAJOR STORM Allowable Capacity is based on Depth Criterion																	
$Q_{allow} =$	<table border="1"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td></td> <td>SUMP</td> <td>SUMP</td> <td>cfs</td> </tr> </tbody> </table>		Minor Storm	Major Storm			SUMP	SUMP	cfs								
	Minor Storm	Major Storm															
	SUMP	SUMP	cfs														

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

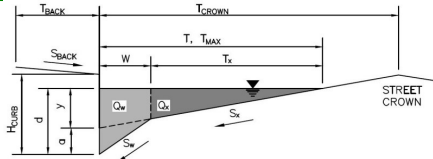


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	12.0	inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	5.4	12.3	cfs
Q PEAK REQUIRED =	2.0	4.0	cfs

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

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

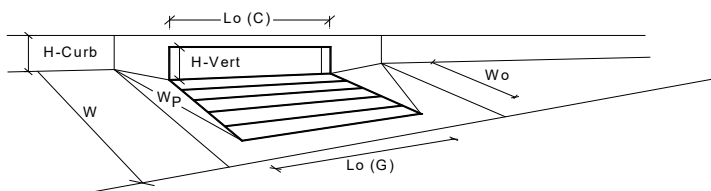
Project: **Hannah Ridge at Feathergrass Filing No. 5, 6 & 7**
 Inlet ID: **DP-5**



Gutter Geometry (Enter data in the blue cells)					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 7.5$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.013$				
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches				
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft				
Gutter Width	$W = 2.00$ ft				
Street Transverse Slope	$S_X = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_W = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_D = 0.000$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$				
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="width: 50%;">Minor Storm</th> <th style="width: 50%;">Major Storm</th> </tr> <tr> <td>$T_{MAX} = 17.0$</td> <td>$T_{MAX} = 17.0$</td> </tr> </table> ft	Minor Storm	Major Storm	$T_{MAX} = 17.0$	$T_{MAX} = 17.0$
Minor Storm	Major Storm				
$T_{MAX} = 17.0$	$T_{MAX} = 17.0$				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="width: 50%;">Minor Storm</th> <th style="width: 50%;">Major Storm</th> </tr> <tr> <td>$d_{MAX} = 6.0$</td> <td>$d_{MAX} = 8.0$</td> </tr> </table> inches	Minor Storm	Major Storm	$d_{MAX} = 6.0$	$d_{MAX} = 8.0$
Minor Storm	Major Storm				
$d_{MAX} = 6.0$	$d_{MAX} = 8.0$				
Check boxes are not applicable in SUMP conditions	<input type="checkbox"/> <input type="checkbox"/>				
MINOR STORM Allowable Capacity is based on Depth Criterion					
MAJOR STORM Allowable Capacity is based on Depth Criterion					
Q_{allow} =	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="width: 50%;">Minor Storm</th> <th style="width: 50%;">Major Storm</th> </tr> <tr> <td style="text-align: center;">SUMP</td> <td style="text-align: center;">SUMP</td> </tr> </table> cfs	Minor Storm	Major Storm	SUMP	SUMP
Minor Storm	Major Storm				
SUMP	SUMP				

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)			
Water Depth at Flowline (outside of local depression)			
Grate Information			
Length of a Unit Grate			
Width of a Unit Grate			
Area Opening Ratio for a Grate (typical values 0.15-0.90)			
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)			
Grate Weir Coefficient (typical value 2.15 - 3.60)			
Grate Orifice Coefficient (typical value 0.60 - 0.80)			
Curb Opening Information			
Length of a Unit Curb Opening			
Height of Vertical Curb Opening in Inches			
Height of Curb Orifice Throat in Inches			
Angle of Throat (see USDCM Figure ST-5)			
Side Width for Depression Pan (typically the gutter width of 2 feet)			
Clogging Factor for a Single Curb Opening (typical value 0.10)			
Curb Opening Weir Coefficient (typical value 2.3-3.7)			
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)			
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth			
Depth for Curb Opening Weir Equation			
Combination Inlet Performance Reduction Factor for Long Inlets			
Curb Opening Performance Reduction Factor for Long Inlets			
Grated Inlet Performance Reduction Factor for Long Inlets			
Total Inlet Interception Capacity (assumes clogged condition)			
WARNING: Inlet Capacity less than Q Peak for Minor and Major Storms			
	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
d_{local} =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	5.6	5.6	inches
	MINOR	MAJOR	<input type="checkbox"/> Override Depths
$L_o(G)$ =	N/A	N/A	feet
W_o =	N/A	N/A	feet
A_{ratio} =	N/A	N/A	
$C_f(G)$ =	N/A	N/A	
$C_w(G)$ =	N/A	N/A	
$C_o(G)$ =	N/A	N/A	
	MINOR	MAJOR	
$L_o(C)$ =	15.00	15.00	feet
H_{vert} =	6.00	6.00	inches
H_{throat} =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W_p =	2.00	2.00	feet
$C_f(C)$ =	0.10	0.10	
$C_w(C)$ =	3.60	3.60	
$C_o(C)$ =	0.67	0.67	
	MINOR	MAJOR	
d_{grate} =	N/A	N/A	ft
d_{curb} =	0.30	0.30	ft
RF _{Combination} =	0.53	0.53	
RF _{Curb} =	0.76	0.76	
RF _{Grate} =	N/A	N/A	
	MINOR	MAJOR	
Q_a =	8.0	8.0	cfs
$Q_{PEAK REQUIRED}$ =	9.0	25.0	cfs

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

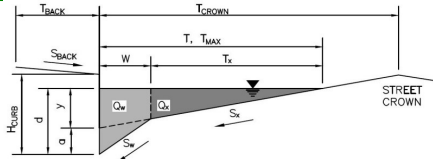
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID:

DP-6



Gutter Geometry (Enter data in the blue cells)

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

T_{BACK} =	8.5	ft
S_{BACK} =	0.020	ft/ft
n_{BACK} =	0.013	
H_{CURB} =	6.00	inches
T_{CROWN} =	17.0	ft
W =	2.00	ft
S_X =	0.020	ft/ft
S_W =	0.083	ft/ft
S_D =	0.000	ft/ft
n_{STREET} =	0.016	
T_{MAX} =	Minor Storm: 17.0 Major Storm: 17.0	ft
d_{MAX} =	Minor Storm: 6.0 Major Storm: 12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>

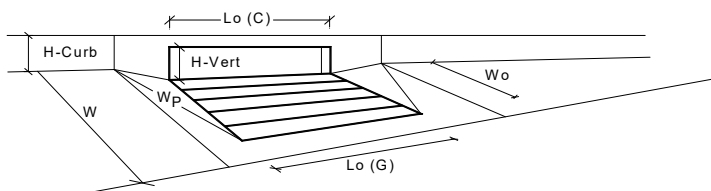
Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

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

Q_{allow} =	Minor Storm: SUMP Major Storm: SUMP	cfs
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INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



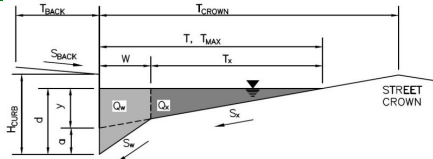
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	12.0	inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
Q_a	8.3	25.5	cfs
Q _{PEAK REQUIRED}	6.0	24.0	cfs

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

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

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

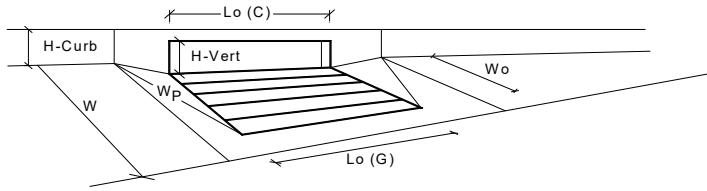
Project: **Hannah Ridge at Feathergrass Filing No. 5, 6 & 7**
 Inlet ID: **DP-7**



Gutter Geometry (Enter data in the blue cells)																	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 7.5$ ft																
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft																
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.013$																
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches																
Distance from Curb Face to Street Crown	$T_{CROWN} = 17.0$ ft																
Gutter Width	$W = 2.00$ ft																
Street Transverse Slope	$S_X = 0.020$ ft/ft																
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_W = 0.083$ ft/ft																
Street Longitudinal Slope - Enter 0 for sump condition	$S_D = 0.000$ ft/ft																
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.016$																
Max. Allowable Spread for Minor & Major Storm	<table border="1"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td>$T_{MAX} =$</td> <td>17.0</td> <td>17.0</td> <td>ft</td> </tr> <tr> <td>$d_{MAX} =$</td> <td>6.0</td> <td>12.0</td> <td>inches</td> </tr> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td></td> </tr> </tbody> </table>		Minor Storm	Major Storm		$T_{MAX} =$	17.0	17.0	ft	$d_{MAX} =$	6.0	12.0	inches		<input type="checkbox"/>	<input type="checkbox"/>	
	Minor Storm	Major Storm															
$T_{MAX} =$	17.0	17.0	ft														
$d_{MAX} =$	6.0	12.0	inches														
	<input type="checkbox"/>	<input type="checkbox"/>															
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm																	
Check boxes are not applicable in SUMP conditions																	
MINOR STORM Allowable Capacity is based on Depth Criterion																	
MAJOR STORM Allowable Capacity is based on Depth Criterion																	
$Q_{allow} =$	<table border="1"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td></td> <td>SUMP</td> <td>SUMP</td> <td>cfs</td> </tr> </tbody> </table>		Minor Storm	Major Storm			SUMP	SUMP	cfs								
	Minor Storm	Major Storm															
	SUMP	SUMP	cfs														

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)			
Water Depth at Flowline (outside of local depression)			
Grate Information			
Length of a Unit Grate			
Width of a Unit Grate			
Area Opening Ratio for a Grate (typical values 0.15-0.90)			
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)			
Grate Weir Coefficient (typical value 2.15 - 3.60)			
Grate Orifice Coefficient (typical value 0.60 - 0.80)			
Curb Opening Information			
Length of a Unit Curb Opening			
Height of Vertical Curb Opening in Inches			
Height of Curb Orifice Throat in Inches			
Angle of Throat (see USDCM Figure ST-5)			
Side Width for Depression Pan (typically the gutter width of 2 feet)			
Clogging Factor for a Single Curb Opening (typical value 0.10)			
Curb Opening Weir Coefficient (typical value 2.3-3.7)			
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)			
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth			
Depth for Curb Opening Weir Equation			
Combination Inlet Performance Reduction Factor for Long Inlets			
Curb Opening Performance Reduction Factor for Long Inlets			
Grated Inlet Performance Reduction Factor for Long Inlets			
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)			
	MINOR	MAJOR	
Type =	CDOT Type R Curb Opening		
a_{local} =	3.00	3.00	inches
No =	1	1	
Ponding Depth =	6.0	12.0	inches
	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
L_o (G) =	N/A	N/A	feet
W_o =	N/A	N/A	feet
A_{ratio} =	N/A	N/A	
C_f (G) =	N/A	N/A	
C_w (G) =	N/A	N/A	
C_o (G) =	N/A	N/A	
	MINOR	MAJOR	
L_o (C) =	5.00	5.00	feet
H_{vert} =	6.00	6.00	inches
H_{throat} =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
W_p =	2.00	2.00	feet
C_f (C) =	0.10	0.10	
C_w (C) =	3.60	3.60	
C_o (C) =	0.67	0.67	
	MINOR	MAJOR	
d_{grate} =	N/A	N/A	ft
d_{curb} =	0.33	0.83	ft
RF _{Combination} =	0.77	1.00	
RF _{Curb} =	1.00	1.00	
RF _{Grate} =	N/A	N/A	
	MINOR	MAJOR	
Q_a =	5.4	12.3	cfs
$Q_{PEAK\ REQUIRED}$ =	4.0	12.0	cfs

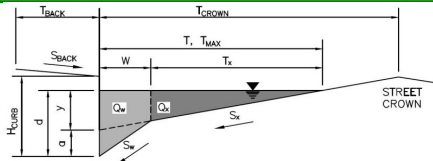
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project:
Inlet ID:

Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

DP-8



Gutter Geometry (Enter data in the blue cells)

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

$T_{BACK} = 7.5$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.013$

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

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

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	8.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

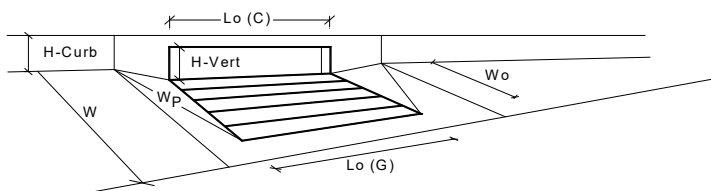
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)			
Water Depth at Flowline (outside of local depression)			
Grate Information			
Length of a Unit Grate			
Width of a Unit Grate			
Area Opening Ratio for a Grate (typical values 0.15-0.90)			
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)			
Grate Weir Coefficient (typical value 2.15 - 3.60)			
Grate Orifice Coefficient (typical value 0.60 - 0.80)			
Curb Opening Information			
Length of a Unit Curb Opening			
Height of Vertical Curb Opening in Inches			
Height of Curb Orifice Throat in Inches			
Angle of Throat (see USDCM Figure ST-5)			
Side Width for Depression Pan (typically the gutter width of 2 feet)			
Clogging Factor for a Single Curb Opening (typical value 0.10)			
Curb Opening Weir Coefficient (typical value 2.3-3.7)			
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)			
Low Head Performance Reduction (Calculated)			
Depth for Grate Midwidth			
Depth for Curb Opening Weir Equation			
Combination Inlet Performance Reduction Factor for Long Inlets			
Curb Opening Performance Reduction Factor for Long Inlets			
Grated Inlet Performance Reduction Factor for Long Inlets			
Total Inlet Interception Capacity (assumes clogged condition)			
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)			
Type	CDOT Type R Curb Opening		
a_{local}	3.00	3.00	inches
No	1	1	
Ponding Depth	6.0	6.0	inches
<input checked="" type="checkbox"/> Override Depths			
$L_o (G)$	N/A	N/A	feet
W_o	N/A	N/A	feet
A_{ratio}	N/A	N/A	
$C_f (G)$	N/A	N/A	
$C_w (G)$	N/A	N/A	
$C_o (G)$	N/A	N/A	
MINOR MAJOR			
$L_o (C)$	10.00	10.00	feet
H_{vert}	6.00	6.00	inches
H_{throat}	6.00	6.00	inches
Theta	63.40	63.40	degrees
W_p	2.00	2.00	feet
$C_f (C)$	0.10	0.10	
$C_w (C)$	3.60	3.60	
$C_o (C)$	0.67	0.67	
MINOR MAJOR			
d_{grate}	N/A	N/A	ft
d_{curb}	0.33	0.33	ft
RF _{Combination}	0.57	0.57	
RF _{Curb}	0.93	0.93	
RF _{Grate}	N/A	N/A	
MINOR MAJOR			
Q_a	8.3	8.3	cfs
Q _{PEAK REQUIRED}	3.0	7.0	cfs

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

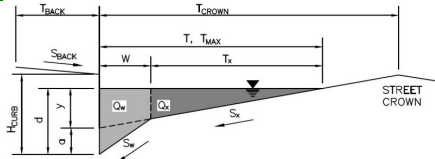
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Hannah Ridge at Feathergrass Filing No. 5, 6 & 7

Inlet ID:

DP-9



Gutter Geometry (Enter data in the blue cells)

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

$T_{BACK} = 7.5$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.013$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 17.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_D = 0.000$ ft/ft
 $n_{STREET} = 0.016$

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

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

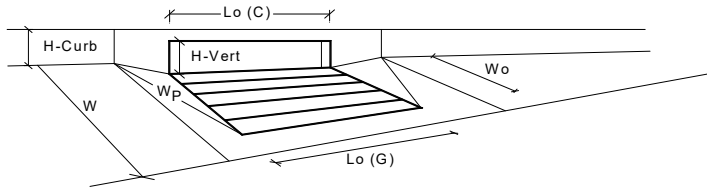
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



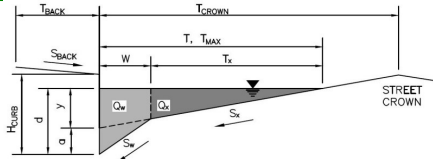
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	12.0	inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
Q_a	8.3	25.5	cfs
Q_{PEAK REQUIRED}	9.0	19.0	cfs

WARNING: Inlet Capacity less than Q Peak for Minor Storm

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

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

Project: **Hannah Ridge at Feathergrass Filing No. 5, 6 & 7**
 Inlet ID: **DP-10**



Gutter Geometry (Enter data in the blue cells)

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

$T_{BACK} = 8.5$ ft
 $S_{BACK} = 0.020$ ft/ft
 $n_{BACK} = 0.013$

$H_{CURB} = 6.00$ inches
 $T_{CROWN} = 17.0$ ft
 $W = 2.00$ ft
 $S_X = 0.020$ ft/ft
 $S_W = 0.083$ ft/ft
 $S_D = 0.000$ ft/ft
 $n_{STREET} = 0.016$

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

	Minor Storm	Major Storm	
$T_{MAX} =$	17.0	17.0	ft
$d_{MAX} =$	6.0	12.0	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

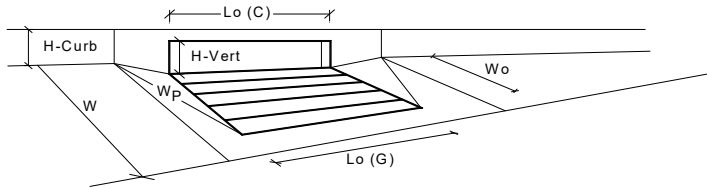
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

Minor Storm	Major Storm	
SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

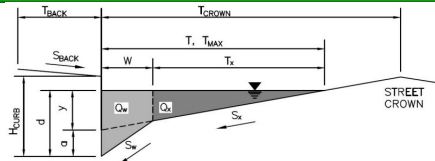


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	12.0	inches
Grate Information	MINOR	MAJOR	<input checked="" type="checkbox"/> Override Depths
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
Curb Opening Information	MINOR	MAJOR	
Length of a Unit Curb Opening	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
Low Head Performance Reduction (Calculated)	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)	MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	5.4	12.3	cfs
Q PEAK REQUIRED =	2.0	5.0	cfs

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

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

Project: **Hannah Ridge at Feathergrass Filing No. 5, 6 & 7**
 Inlet ID: **Street Capacity**



Gutter Geometry (Enter data in the blue cells)

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

T_{BACK}	7.5	ft
S_{BACK}	0.020	ft/ft
n_{BACK}	0.013	
H_{CURB}	6.00	inches
T_{CROWN}	17.0	ft
W	2.00	ft
S_x	0.020	ft/ft
S_w	0.083	ft/ft
S_D	0.015	ft/ft
n_{STREET}	0.016	
	Minor Storm	Major Storm
T_{MAX}	17.0	17.0
d_{MAX}	6.0	12.0
	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		check = yes

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

Maximum Capacity for 1/2 Street based On Allowable Spread

Water Depth without Gutter Depression (Eq. ST-2)
 Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")
 Gutter Depression ($d_c - (W * S_x * 12)$)
 Water Depth at Gutter Flowline
 Allowable Spread for Discharge outside the Gutter Section W (T - W)
 Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
 Discharge outside the Gutter Section W, carried in Section T_x
 Discharge within the Gutter Section W ($Q_T - Q_x$)
 Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)
Maximum Flow Based On Allowable Spread
 Flow Velocity within the Gutter Section
 $V*d$ Product: Flow Velocity times Gutter Flowline Depth

	Minor Storm	Major Storm	
y	4.08	4.08	inches
d_c	2.0	2.0	inches
a	1.51	1.51	inches
d	5.59	5.59	inches
T_x	15.0	15.0	ft
E_o	0.350	0.350	
Q_x	8.6	8.6	cfs
Q_W	4.7	4.7	cfs
Q_{BACK}	0.0	0.0	cfs
Q_T	13.3	13.3	cfs
V	6.1	6.1	fps
$V*d$	2.8	2.8	

Maximum Capacity for 1/2 Street based on Allowable Depth

Theoretical Water Spread
 Theoretical Spread for Discharge outside the Gutter Section W (T - W)
 Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)
 Theoretical Discharge outside the Gutter Section W, carried in Section T_{XTH}
 Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})
 Discharge within the Gutter Section W ($Q_d - Q_x$)
 Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)
 Total Discharge for Major & Minor Storm (Pre-Safety Factor)
 Average Flow Velocity Within the Gutter Section
 $V*d$ Product: Flow Velocity Times Gutter Flowline Depth
 Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm
Max Flow Based on Allowable Depth (Safety Factor Applied)
 Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)
 Resultant Flow Depth at Street Crown (Safety Factor Applied)

	Minor Storm	Major Storm	
T_{TH}	18.7	43.7	ft
T_{XTH}	16.7	41.7	ft
E_o	0.318	0.130	
Q_{XTH}	11.5	132.1	cfs
Q_x	11.5	91.9	cfs
Q_W	5.4	19.8	cfs
Q_{BACK}	0.0	25.5	cfs
Q	16.8	137.2	cfs
V	6.4	10.8	fps
$V*d$	3.2	10.8	
R	1.00	1.00	
Q_d	16.8	137.2	cfs
d	6.00	12.00	inches
d_{CROWN}	0.41	6.41	inches

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

	Minor Storm	Major Storm	
Q_{allow}	13.3	137.2	cfs

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

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.01000 ft/ft
Diameter 2.00 ft
Discharge 15.00 ft³/s

Results

Normal Depth 1.19 ft
Flow Area 1.95 ft²
Wetted Perimeter 3.52 ft
Hydraulic Radius 0.55 ft
Top Width 1.96 ft
Critical Depth 1.40 ft
Percent Full 59.5 %
Critical Slope 0.00632 ft/ft
Velocity 7.70 ft/s
Velocity Head 0.92 ft
Specific Energy 2.11 ft
Froude Number 1.36
Maximum Discharge 24.33 ft³/s
Discharge Full 22.62 ft³/s
Slope Full 0.00440 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 59.50 %
Downstream Velocity Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.02800 ft/ft
Diameter 2.00 ft
Discharge 16.00 ft³/s

Results

Normal Depth 0.91 ft
Flow Area 1.39 ft²
Wetted Perimeter 2.96 ft
Hydraulic Radius 0.47 ft
Top Width 1.99 ft
Critical Depth 1.44 ft
Percent Full 45.4 %
Critical Slope 0.00661 ft/ft
Velocity 11.54 ft/s
Velocity Head 2.07 ft
Specific Energy 2.98 ft
Froude Number 2.44
Maximum Discharge 40.72 ft³/s
Discharge Full 37.85 ft³/s
Slope Full 0.00500 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 45.38 %
Downstream Velocity Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.01000 ft/ft
Diameter	2.50 ft
Discharge	21.00 ft ³ /s

Results

Normal Depth	1.27 ft
Flow Area	2.50 ft ²
Wetted Perimeter	3.96 ft
Hydraulic Radius	0.63 ft
Top Width	2.50 ft
Critical Depth	1.56 ft
Percent Full	50.7 %
Critical Slope	0.00519 ft/ft
Velocity	8.41 ft/s
Velocity Head	1.10 ft
Specific Energy	2.37 ft
Froude Number	1.48
Maximum Discharge	44.12 ft ³ /s
Discharge Full	41.01 ft ³ /s
Slope Full	0.00262 ft/ft
Flow Type	SuperCritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	50.70 %
Downstream Velocity	Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.05500	ft/ft
Diameter	2.50	ft
Discharge	24.00	ft ³ /s

Results

Normal Depth	0.85	ft
Flow Area	1.47	ft ²
Wetted Perimeter	3.11	ft
Hydraulic Radius	0.47	ft
Top Width	2.37	ft
Critical Depth	1.67	ft
Percent Full	34.0	%
Critical Slope	0.00556	ft/ft
Velocity	16.28	ft/s
Velocity Head	4.12	ft
Specific Energy	4.97	ft
Froude Number	3.64	
Maximum Discharge	103.47	ft ³ /s
Discharge Full	96.19	ft ³ /s
Slope Full	0.00342	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	34.04	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.01000 ft/ft
Diameter 3.00 ft
Discharge 38.00 ft³/s

Results

Normal Depth 1.62 ft
Flow Area 3.90 ft²
Wetted Perimeter 4.96 ft
Hydraulic Radius 0.79 ft
Top Width 2.99 ft
Critical Depth 2.01 ft
Percent Full 54.1 %
Critical Slope 0.00524 ft/ft
Velocity 9.74 ft/s
Velocity Head 1.48 ft
Specific Energy 3.10 ft
Froude Number 1.50
Maximum Discharge 71.74 ft³/s
Discharge Full 66.69 ft³/s
Slope Full 0.00325 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 54.07 %
Downstream Velocity Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.03400 ft/ft
Diameter 1.50 ft
Discharge 8.00 ft³/s

Results

Normal Depth 0.67 ft
Flow Area 0.77 ft²
Wetted Perimeter 2.20 ft
Hydraulic Radius 0.35 ft
Top Width 1.49 ft
Critical Depth 1.10 ft
Percent Full 44.8 %
Critical Slope 0.00742 ft/ft
Velocity 10.44 ft/s
Velocity Head 1.69 ft
Specific Energy 2.36 ft
Froude Number 2.57
Maximum Discharge 20.83 ft³/s
Discharge Full 19.37 ft³/s
Slope Full 0.00580 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 44.79 %
Downstream Velocity Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.06000	ft/ft
Diameter	2.50	ft
Discharge	24.00	ft ³ /s

Results

Normal Depth	0.83	ft
Flow Area	1.43	ft ²
Wetted Perimeter	3.07	ft
Hydraulic Radius	0.46	ft
Top Width	2.36	ft
Critical Depth	1.67	ft
Percent Full	33.3	%
Critical Slope	0.00555	ft/ft
Velocity	16.80	ft/s
Velocity Head	4.38	ft
Specific Energy	5.22	ft
Froude Number	3.80	
Maximum Discharge	108.07	ft ³ /s
Discharge Full	100.47	ft ³ /s
Slope Full	0.00342	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	33.27	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.02000 ft/ft
Diameter	2.00 ft
Discharge	12.00 ft ³ /s

Results

Normal Depth	0.85 ft
Flow Area	1.27 ft ²
Wetted Perimeter	2.84 ft
Hydraulic Radius	0.45 ft
Top Width	1.98 ft
Critical Depth	1.24 ft
Percent Full	42.4 %
Critical Slope	0.00558 ft/ft
Velocity	9.46 ft/s
Velocity Head	1.39 ft
Specific Energy	2.24 ft
Froude Number	2.08
Maximum Discharge	34.41 ft ³ /s
Discharge Full	31.99 ft ³ /s
Slope Full	0.00281 ft/ft
Flow Type	SuperCritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	42.43 %
Downstream Velocity	Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.03400 ft/ft
Diameter 2.50 ft
Discharge 24.00 ft³/s

Results

Normal Depth 0.97 ft
Flow Area 1.75 ft²
Wetted Perimeter 3.36 ft
Hydraulic Radius 0.52 ft
Top Width 2.44 ft
Critical Depth 1.67 ft
Percent Full 38.7 %
Critical Slope 0.00556 ft/ft
Velocity 13.68 ft/s
Velocity Head 2.91 ft
Specific Energy 3.87 ft
Froude Number 2.84
Maximum Discharge 81.35 ft³/s
Discharge Full 75.63 ft³/s
Slope Full 0.00342 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 38.71 %
Downstream Velocity Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.01000 ft/ft
Diameter 3.00 ft
Discharge 44.00 ft³/s

Results

Normal Depth 1.78 ft
Flow Area 4.37 ft²
Wetted Perimeter 5.27 ft
Hydraulic Radius 0.83 ft
Top Width 2.95 ft
Critical Depth 2.16 ft
Percent Full 59.3 %
Critical Slope 0.00577 ft/ft
Velocity 10.08 ft/s
Velocity Head 1.58 ft
Specific Energy 3.36 ft
Froude Number 1.46
Maximum Discharge 71.74 ft³/s
Discharge Full 66.69 ft³/s
Slope Full 0.00435 ft/ft
Flow Type SuperCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 59.30 %
Downstream Velocity Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	3.00	ft
Discharge	49.00	ft ³ /s

Results

Normal Depth	1.91	ft
Flow Area	4.75	ft ²
Wetted Perimeter	5.55	ft
Hydraulic Radius	0.86	ft
Top Width	2.89	ft
Critical Depth	2.28	ft
Percent Full	63.7	%
Critical Slope	0.00630	ft/ft
Velocity	10.31	ft/s
Velocity Head	1.65	ft
Specific Energy	3.56	ft
Froude Number	1.42	
Maximum Discharge	71.74	ft ³ /s
Discharge Full	66.69	ft ³ /s
Slope Full	0.00540	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	63.70	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Roughness Coefficient 0.013
Channel Slope 0.00500 ft/ft
Diameter 1.50 ft
Discharge 5.00 ft³/s

Results

Normal Depth 0.90 ft
Flow Area 1.11 ft²
Wetted Perimeter 2.66 ft
Hydraulic Radius 0.42 ft
Top Width 1.47 ft
Critical Depth 0.86 ft
Percent Full 60.1 %
Critical Slope 0.00578 ft/ft
Velocity 4.51 ft/s
Velocity Head 0.32 ft
Specific Energy 1.22 ft
Froude Number 0.91
Maximum Discharge 7.99 ft³/s
Discharge Full 7.43 ft³/s
Slope Full 0.00227 ft/ft
Flow Type SubCritical

GVF Input Data

Downstream Depth 0.00 ft
Length 0.00 ft
Number Of Steps 0

GVF Output Data

Upstream Depth 0.00 ft
Profile Description
Profile Headloss 0.00 ft
Average End Depth Over Rise 0.00 %
Normal Depth Over Rise 60.08 %
Downstream Velocity Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013
Channel Slope	0.00500 ft/ft
Diameter	3.00 ft
Discharge	23.00 ft ³ /s

Results

Normal Depth	1.48 ft
Flow Area	3.47 ft ²
Wetted Perimeter	4.67 ft
Hydraulic Radius	0.74 ft
Top Width	3.00 ft
Critical Depth	1.54 ft
Percent Full	49.3 %
Critical Slope	0.00431 ft/ft
Velocity	6.63 ft/s
Velocity Head	0.68 ft
Specific Energy	2.16 ft
Froude Number	1.09
Maximum Discharge	50.73 ft ³ /s
Discharge Full	47.16 ft ³ /s
Slope Full	0.00119 ft/ft
Flow Type	SuperCritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.00 %
Normal Depth Over Rise	49.27 %
Downstream Velocity	Infinity ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method Manning Formula
 Solve For Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00650	ft/ft
Diameter	3.50	ft
Discharge	71.00	ft ³ /s

Results

Normal Depth	2.54	ft
Flow Area	7.47	ft ²
Wetted Perimeter	7.13	ft
Hydraulic Radius	1.05	ft
Top Width	3.13	ft
Critical Depth	2.64	ft
Percent Full	72.5	%
Critical Slope	0.00591	ft/ft
Velocity	9.50	ft/s
Velocity Head	1.40	ft
Specific Energy	3.94	ft
Froude Number	1.08	
Maximum Discharge	87.25	ft ³ /s
Discharge Full	81.11	ft ³ /s
Slope Full	0.00498	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	72.49	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.11290	ft/ft
Diameter	3.00	ft
Discharge	38.00	ft ³ /s

Results

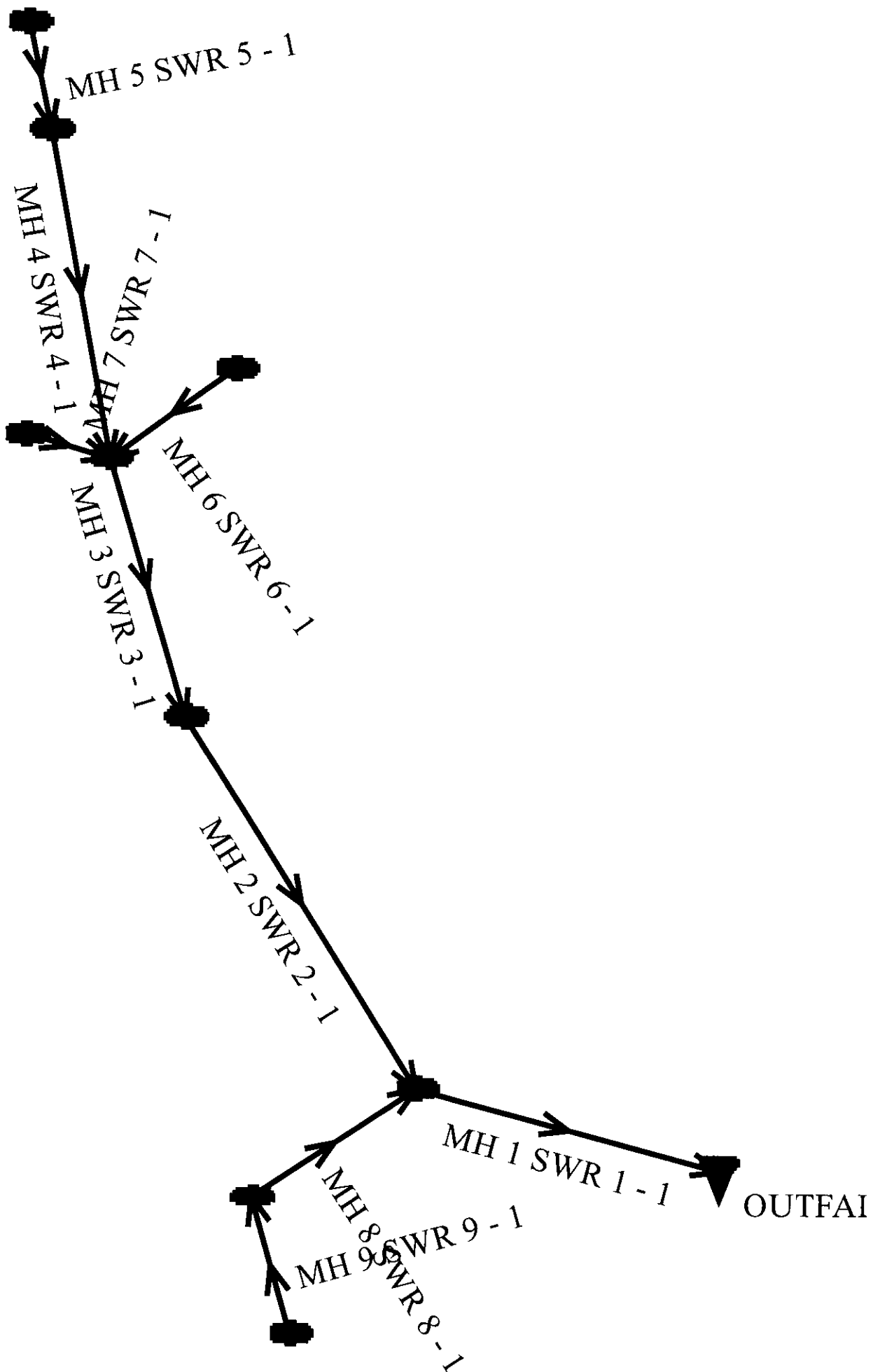
Normal Depth	0.84	ft
Flow Area	1.61	ft ²
Wetted Perimeter	3.34	ft
Hydraulic Radius	0.48	ft
Top Width	2.69	ft
Critical Depth	2.01	ft
Percent Full	27.9	%
Critical Slope	0.00524	ft/ft
Velocity	23.62	ft/s
Velocity Head	8.67	ft
Specific Energy	9.50	ft
Froude Number	5.38	
Maximum Discharge	241.06	ft ³ /s
Discharge Full	224.10	ft ³ /s
Slope Full	0.00325	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	27.86	%
Downstream Velocity	Infinity	ft/s



Westerly Storm Outfall

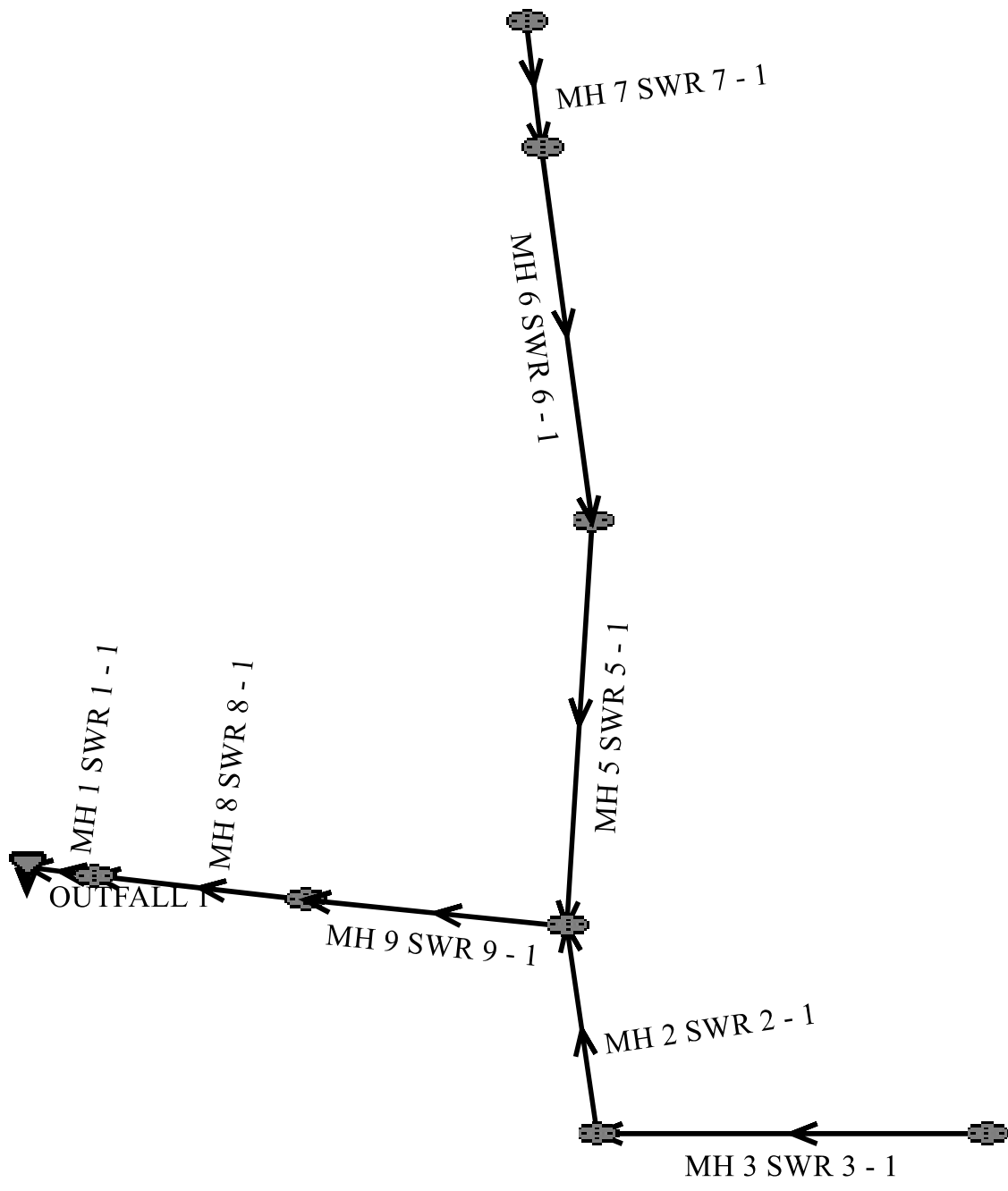
Sewer Input Summary:

Element Name	Sewer Length (ft)	Elevation			Loss Coefficients			Given Dimensions		
		Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Manning's n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	87.66	6464.04	0.6	6464.57	0.013	0.05	1.00	CIRCULAR	42.0 0 in	42.0 0 in
MH 8 SWR 8 - 1	73.59	6465.60	1.2	6466.48	0.013	1.06	0.00	CIRCULAR	36.0 0 in	36.0 0 in
MH 9 SWR 9 - 1	42.21	6467.48	1.5	6468.11	0.013	1.06	0.00	CIRCULAR	18.0 0 in	18.0 0 in
MH 2 SWR 2 - 1	172.08	6465.10	1.0	6466.82	0.013	0.20	1.00	CIRCULAR	36.0 0 in	36.0 0 in
MH 3 SWR 3 - 1	71.52	6467.11	1.0	6467.83	0.013	0.05	1.00	CIRCULAR	36.0 0 in	36.0 0 in
MH 7 SWR 7 - 1	5.00	6468.33	6.0	6468.63	0.013	1.32	0.00	CIRCULAR	30.0 0 in	30.0 0 in
MH 4 SWR 4 - 1	190.00	6468.89	3.4	6475.35	0.013	0.05	1.00	CIRCULAR	18.0 0 in	18.0 0 in
MH 5 SWR 5 - 1	25.08	6475.35	1.0	6475.60	0.013	0.05	1.00	CIRCULAR	18.0 0 in	18.0 0 in
MH 6 SWR 6 - 1	28.62	6468.83	2.0	6469.40	0.013	0.83	0.00	CIRCULAR	24.0 0 in	24.0 0 in

Grade Line Summary:

Tailwater Elevation (ft): 6468.85

Element Name	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
MH 1 SWR 1 - 1	6464.04	6464.57	0.00	0.00	6468.85	6469.28	6469.70	0.43	6470.13
MH 8 SWR 8 - 1	6465.60	6466.48	0.17	0.00	6470.14	6470.23	6470.30	0.09	6470.39
MH 9 SWR 9 - 1	6467.48	6468.11	0.13	0.00	6470.40	6470.49	6470.52	0.10	6470.62
MH 2 SWR 2 - 1	6465.10	6466.82	0.15	0.10	6469.63	6470.56	6470.38	0.92	6471.30
MH 3 SWR 3 - 1	6467.11	6467.83	0.03	0.14	6470.88	6471.18	6471.48	0.31	6471.79
MH 7 SWR 7 - 1	6468.33	6468.63	0.49	0.00	6471.91	6471.92	6472.28	0.02	6472.29
MH 4 SWR 4 - 1	6468.89	6475.35	0.02	0.28	6471.77	6476.45	6472.09	4.88	6476.97
MH 5 SWR 5 - 1	6475.35	6475.60	0.02	0.00	6476.46	6476.70	6476.99	0.22	6477.22
MH 6 SWR 6 - 1	6468.83	6469.40	0.19	0.00	6471.75	6471.83	6471.97	0.08	6472.05



Easterly Storm Outfall

Sewer Input Summary:

Element Name	Sewer Length (ft)	Elevation			Loss Coefficients			Given Dimensions		
		Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Manning's n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1 SWR 1 - 1	14.07	6466.64	1.0	6466.78	0.013	0.03	0.00	CIRCULAR	36.0 0 in	36.0 0 in
MH 8 SWR 8 - 1	28.60	6466.77	11.3	6470.00	0.013	0.06	0.00	CIRCULAR	36.0 0 in	36.0 0 in
MH 9 SWR 9 - 1	56.15	6475.00	1.0	6475.56	0.013	0.05	0.00	CIRCULAR	36.0 0 in	36.0 0 in
MH 2 SWR 2 - 1	116.19	6476.00	1.9	6478.21	0.013	0.83	1.00	CIRCULAR	30.0 0 in	30.0 0 in
MH 3 SWR 3 - 1	121.85	6478.52	5.5	6485.22	0.013	1.32	1.00	CIRCULAR	30.0 0 in	30.0 0 in
MH 4 SWR 4 - 1	35.33	6485.53	1.0	6485.88	0.013	0.05	1.00	CIRCULAR	30.0 0 in	30.0 0 in
MH 5 SWR 5 - 1	161.78	6476.62	5.5	6485.52	0.013	1.32	1.00	CIRCULAR	24.0 0 in	24.0 0 in
MH 6 SWR 6 - 1	168.18	6485.75	2.8	6490.46	0.013	0.05	1.00	CIRCULAR	24.0 0 in	24.0 0 in
MH 7 SWR 7 - 1	35.33	6490.76	1.0	6491.11	0.013	0.05	1.00	CIRCULAR	24.0 0 in	24.0 0 in

Grade Line Summary:

Tailwater Elevation (ft): 6468.85

Element Name	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
MH 1 SWR 1 - 1	6466.64	6466.78	0.00	0.00	6468.85	6469.07	6469.74	0.00	6469.74
MH 8 SWR 8 - 1	6466.77	6470.00	0.03	0.00	6469.10	6475.86	6476.30	0.00	6476.30
MH 9 SWR 9 - 1	6475.00	6475.56	0.02	0.00	6476.62	6477.57	6478.10	0.36	6478.45
MH 2 SWR 2 - 1	6476.00	6478.21	0.31	0.08	6477.95	6479.88	6479.04	1.58	6480.62
MH 3 SWR 3 - 1	6478.52	6485.22	0.49	0.00	6480.37	6486.89	6483.50	4.13	6487.63
MH 4 SWR 4 - 1	6485.53	6485.88	0.01	0.09	6486.99	6487.44	6487.89	0.21	6488.10
MH 5 SWR 5 - 1	6476.62	6485.52	0.53	0.05	6478.14	6486.96	6480.78	6.86	6487.64
MH 6 SWR 6 - 1	6485.75	6490.46	0.02	0.00	6486.98	6491.90	6488.73	3.84	6492.58
MH 7 SWR 7 - 1	6490.76	6491.11	0.02	0.05	6491.97	6492.51	6492.87	0.27	6493.14

SWQ / DETENTION CALCULATIONS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Sheet 1 of 4

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 3, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: EL PASO COUNTY

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) Predominant Watershed NRCS Soil Group</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$ </p>	<p>$I_a =$ <u>60.0</u> %</p> <p>$i =$ <u>0.600</u></p> <p>Area = <u>37.500</u> ac</p> <p>$d_6 =$ <u>0.42</u> in</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"> Choose One <input type="radio"/> Water Quality Capture Volume (WQCV) <input checked="" type="radio"/> Excess Urban Runoff Volume (EURV) </div> <p>$V_{DESIGN} =$ <u>0.738</u> ac-ft</p> <p>$V_{DESIGN\ OTHER} =$ <u>0.721</u> ac-ft</p> <p>$V_{DESIGN\ USER} =$ _____ ac-ft</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"> Choose One <input type="radio"/> A <input checked="" type="radio"/> B <input type="radio"/> C / D </div> <p>EURV = <u>2.448</u> ac-ft</p>
<p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p>	<p>L : W = <u>2.0</u> : 1</p>
<p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>Z = <u>4.00</u> ft / ft</p>
<p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p>	<p>Concrete Forebays</p> <hr/> <hr/> <hr/>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 3, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: EL PASO COUNTY

<p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMIN} =$ <u>3%</u> of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F =$ <u>30</u> inch maximum)</p> <p>D) Forebay Discharge</p> <p style="margin-left: 20px;">i) Undetained 100-year Peak Discharge</p> <p style="margin-left: 20px;">ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p>	<p>$V_{FMIN} =$ <u>0.022</u> ac-ft</p> <p>$V_F =$ <u>0.022</u> ac-ft</p> <p>$D_F =$ <u>12.0</u> in</p> <p>$Q_{100} =$ <u>103.00</u> cfs</p> <p>$Q_F =$ <u>2.06</u> cfs</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> </div> <p>Calculated $D_p =$ <u> </u> in</p> <p>Calculated $W_N =$ <u>9.8</u> in</p>
<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>Choose One</p> <p><input checked="" type="radio"/> Concrete</p> <p><input type="radio"/> Soft Bottom</p> </div> <p>$S =$ <u>0.0100</u> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-feet minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>$D_M =$ <u>2.5</u> ft</p> <p>$A_M =$ <u>190</u> sq ft</p> <div style="border: 1px solid black; padding: 2px; margin: 5px 0;"> <p>Choose One</p> <p><input checked="" type="radio"/> Orifice Plate</p> <p><input type="radio"/> Other (Describe):</p> </div> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <p>$D_{orifice} =$ <u>1.62</u> inches</p> <p>$A_{ot} =$ <u>15.81</u> square inches</p>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 3, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: EL PASO COUNTY

<p>8. Initial Surcharge Volume</p> <p>A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)</p> <p>B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)</p> <p>C) Initial Surcharge Provided Above Micropool</p>	<p>$D_{IS} = 6$ in</p> <p>$V_{IS} = 94.2$ cu ft</p> <p>$V_s = 95.0$ cu ft</p>
<p>9. Trash Rack</p> <p>A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5 * (e^{-0.095D})$</p> <p>B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open area to the total screen area for the material specified.)</p> <p style="padding-left: 40px;">Other (Y/N): N</p> <p>C) Ratio of Total Open Area to Total Area (only for type 'Other')</p> <p>D) Total Water Quality Screen Area (based on screen type)</p> <p>E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)</p> <p>F) Height of Water Quality Screen (H_{TR})</p> <p>G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)</p>	<p>$A_t = 522$ square inches</p> <p><u>Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.</u></p> <hr/> <hr/> <p>User Ratio =</p> <p>$A_{total} = 735$ sq. in.</p> <p>$H = 5.75$ feet</p> <p>$H_{TR} = 97$ inches</p> <p>$W_{opening} = 12.0$ inches</p>

Design Procedure Form: Extended Detention Basin (EDB)

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Date: October 3, 2018
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Location: EL PASO COUNTY

<p>10. Overflow Embankment</p> <p>A) Describe embankment protection for 100-year and greater overtopping:</p> <p>B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p><u>Weir with rip-rap</u></p> <p><u>4.00</u></p>
<p>11. Vegetation</p>	<p>Choose One</p> <p><input type="radio"/> Irrigated</p> <p><input checked="" type="radio"/> Not Irrigated</p>
<p>12. Access</p> <p>A) Describe Sediment Removal Procedures</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Notes: _____</p> <p>_____</p> <p>_____</p>	

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Sheet 1 of 4

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 2, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: Westerly Pond Inflow

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) Predominant Watershed NRCS Soil Group</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$ </p>	<p>$I_a =$ <u>60.0</u> %</p> <p>$i =$ <u>0.600</u></p> <p>Area = <u>22.960</u> ac</p> <p>$d_6 =$ <u>0.42</u> in</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Choose One</p> <p><input type="radio"/> Water Quality Capture Volume (WQCV)</p> <p><input checked="" type="radio"/> Excess Urban Runoff Volume (EURV)</p> </div> <p>$V_{DESIGN} =$ <u>0.452</u> ac-ft</p> <p>$V_{DESIGN\ OTHER} =$ <u>0.441</u> ac-ft</p> <p>$V_{DESIGN\ USER} =$ _____ ac-ft</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Choose One</p> <p><input type="radio"/> A</p> <p><input checked="" type="radio"/> B</p> <p><input type="radio"/> C / D</p> </div> <p>EURV = <u>1.499</u> ac-ft</p>
<p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p>	<p>L : W = <u>2.0</u> : 1</p>
<p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>Z = <u>4.00</u> ft / ft</p>
<p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p>	<p>Concrete Forebays</p> <hr/> <hr/> <hr/>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 2, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: Westerly Pond Inflow

<p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMIN} =$ <u>3%</u> of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F =$ <u>18</u> inch maximum)</p> <p>D) Forebay Discharge</p> <p style="margin-left: 20px;">i) Undetained 100-year Peak Discharge</p> <p style="margin-left: 20px;">ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p>	<p>$V_{FMIN} =$ <u>0.013</u> ac-ft</p> <p>$V_F =$ <u>0.013</u> ac-ft</p> <p>$D_F =$ <u>18.0</u> in</p> <p>$Q_{100} =$ <u>71.00</u> cfs</p> <p>$Q_F =$ <u>1.42</u> cfs</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> </div> <p align="right" style="color: blue;">(flow too small for berm w/ pipe)</p> <p>Calculated $D_p =$ <u> </u> in</p> <p>Calculated $W_N =$ <u>6.4</u> in</p>
<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input checked="" type="radio"/> Concrete</p> <p><input type="radio"/> Soft Bottom</p> </div> <p>$S =$ <u>0.0100</u> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-feet minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>$D_M =$ _____ ft</p> <p>$A_M =$ _____ sq ft</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input checked="" type="radio"/> Orifice Plate</p> <p><input type="radio"/> Other (Describe):</p> </div> <p>_____</p> <p>_____</p> <p>$D_{orifice} =$ _____ inches</p> <p>$A_{ot} =$ _____ square inches</p>

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Sheet 1 of 4

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 3, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: Easterly Pond Inflow

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, I_a</p> <p>B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) Predominant Watershed NRCS Soil Group</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$ </p>	<p>$I_a =$ <u>60.0</u> %</p> <p>$i =$ <u>0.600</u></p> <p>Area = <u>11.340</u> ac</p> <p>$d_6 =$ <u>0.42</u> in</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"> Choose One <input type="radio"/> Water Quality Capture Volume (WQCV) <input checked="" type="radio"/> Excess Urban Runoff Volume (EURV) </div> <p>$V_{DESIGN} =$ <u>0.223</u> ac-ft</p> <p>$V_{DESIGN\ OTHER} =$ <u>0.218</u> ac-ft</p> <p>$V_{DESIGN\ USER} =$ _____ ac-ft</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;"> Choose One <input type="radio"/> A <input checked="" type="radio"/> B <input type="radio"/> C / D </div> <p>EURV = <u>0.740</u> ac-ft</p>
<p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p>	<p>L : W = <u>2.0</u> : 1</p>
<p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>Z = <u>4.00</u> ft / ft</p>
<p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p>	<p>Concrete Forebays</p> <hr/> <hr/> <hr/>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: October 3, 2018
Project: HANNAH RIDGE AT FEATHERGRASS FILINGS 5-7
Location: Easterly Pond Inflow

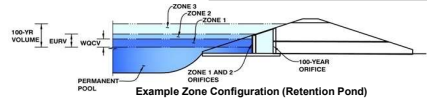
<p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMIN} =$ <u>3%</u> of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F =$ <u>18</u> inch maximum)</p> <p>D) Forebay Discharge</p> <p style="margin-left: 20px;">i) Undetained 100-year Peak Discharge</p> <p style="margin-left: 20px;">ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p>	<p>$V_{FMIN} =$ <u>0.007</u> ac-ft</p> <p>$V_F =$ <u>0.007</u> ac-ft</p> <p>$D_F =$ <u>12.0</u> in</p> <p>$Q_{100} =$ <u>38.00</u> cfs</p> <p>$Q_F =$ <u>0.76</u> cfs</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> </div> <p align="right" style="color: blue; font-size: small;">(flow too small for berm w/ pipe)</p> <p>Calculated $D_p =$ <u> </u> in</p> <p>Calculated $W_N =$ <u>5.1</u> in</p>
<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input checked="" type="radio"/> Concrete</p> <p><input type="radio"/> Soft Bottom</p> </div> <p>$S =$ <u>0.0100</u> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-feet minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>$D_M =$ <u> </u> ft</p> <p>$A_M =$ <u> </u> sq ft</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input checked="" type="radio"/> Orifice Plate</p> <p><input type="radio"/> Other (Describe):</p> </div> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <hr style="border: 0; border-top: 1px solid black; margin: 5px 0;"/> <p>$D_{orifice} =$ <u> </u> inches</p> <p>$A_{ot} =$ <u> </u> square inches</p>

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7

Basin ID: POND



Required Volume Calculation

Selected BMP Type =	EDB
Watershed Area =	37.50 acres
Watershed Length =	1,700 ft
Watershed Slope =	0.015 %/ft
Watershed Imperviousness =	60.00% percent
Percentage Hydrologic Soil Group A =	0.0% percent
Percentage Hydrologic Soil Group B =	100.0% percent
Percentage Hydrologic Soil Groups C/D =	0.0% percent
Desired WQCV Drain Time =	40.0 hours
Location for 1-hr Rainfall Depths =	User Input
Water Quality Capture Volume (WQCV) =	0.738 acre-feet
Excess Urban Runoff Volume (EURV) =	2.441 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.004 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	2.697 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	3.518 acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	4.635 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	5.434 acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	6.483 acre-feet
500-yr Runoff Volume (P1 = 3.85 in.) =	10.626 acre-feet
Approximate 2-yr Detention Volume =	1.877 acre-feet
Approximate 5-yr Detention Volume =	2.533 acre-feet
Approximate 10-yr Detention Volume =	3.265 acre-feet
Approximate 25-yr Detention Volume =	3.531 acre-feet
Approximate 50-yr Detention Volume =	3.681 acre-feet
Approximate 100-yr Detention Volume =	4.019 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
3.85 inches

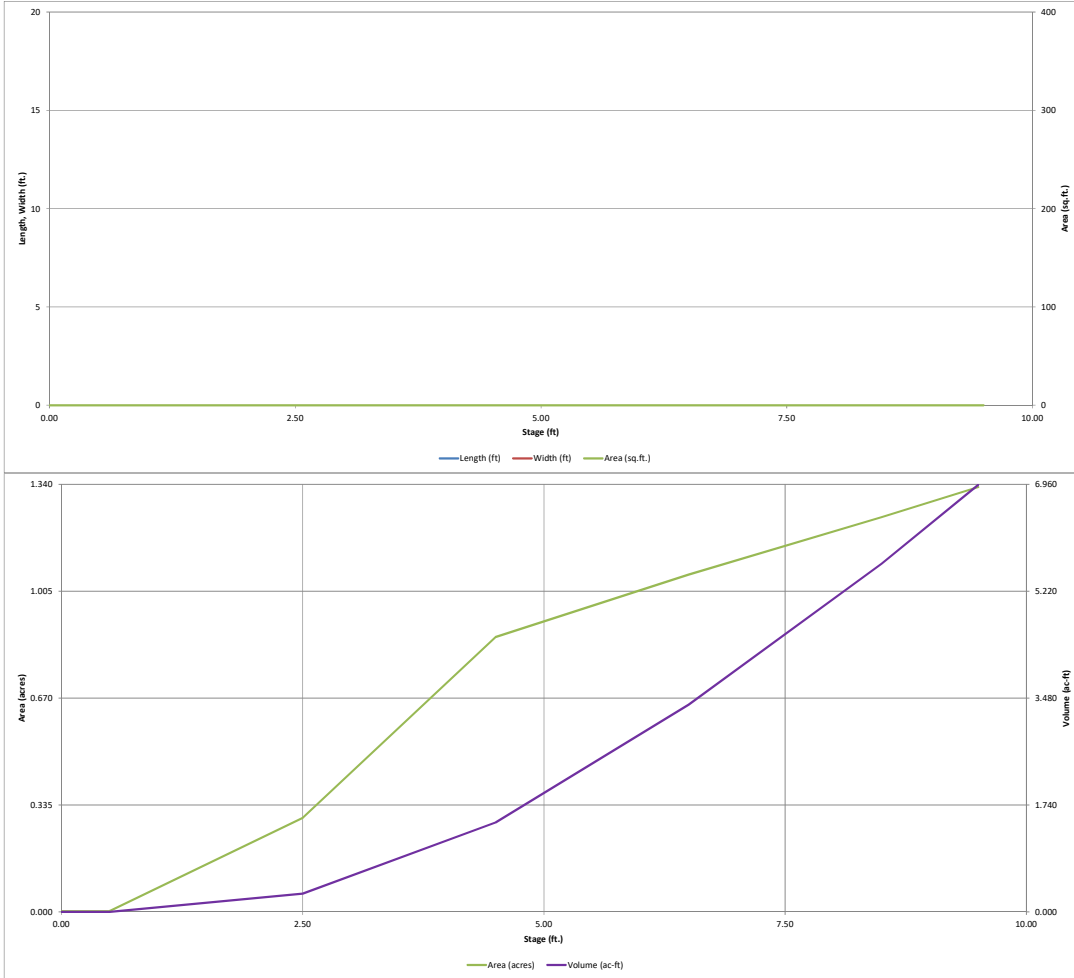
Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.738	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.703	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.578	acre-feet
Total Detention Basin Volume =	4.019	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 _{basin}) =	user	
Initial Surcharge Area (A _{sur}) =	user	ft ²
Surcharge Volume Length (L _{sur}) =	user	ft
Surcharge Volume Width (W _{sur}) =	user	ft
Depth of Basin Floor (H _{f,100yr}) =	user	ft
Length of Basin Floor (L _{f,100yr}) =	user	ft
Width of Basin Floor (W _{f,100yr}) =	user	ft
Area of Basin Floor (A _{f,100yr}) =	user	ft ²
Volume of Basin Floor (V _{f,100yr}) =	user	ft ³
Depth of Main Basin (H _{main}) =	user	ft
Length of Main Basin (L _{main}) =	user	ft
Width of Main Basin (W _{main}) =	user	ft
Area of Main Basin (A _{main}) =	user	ft ²
Volume of Main Basin (V _{main}) =	user	ft ³
Calculated Total Basin Volume (V _{total}) =	user	acre-feet

Depth Increment = 1 ft									
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Optional Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002	49	0.001
6462	--	0.50	--	--	--	100	0.002	49	0.001
6464	--	2.50	--	--	--	12,825	0.294	12,975	0.298
6466	--	4.50	--	--	--	37,534	0.862	63,334	1.454
6468	--	6.50	--	--	--	46,042	1.057	146,910	3.373
6470	--	8.50	--	--	--	53,898	1.237	246,850	5.667
6471	--	9.50	--	--	--	58,000	1.331	302,799	6.951
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

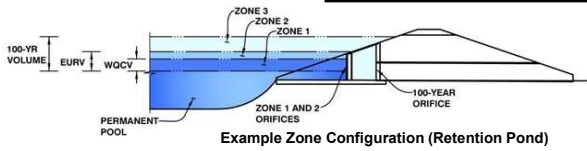


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 & 7

Basin ID: POND



	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.51	0.738	Orifice Plate
Zone 2 (EURV)	5.58	1.703	Orifice Plate
Zone 3 (100-year)	7.10	1.578	Weir&Pipe (Restrict)
		4.019	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 =	5.75	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	13.80	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	1.20	2.40	3.60	4.80			
Orifice Area (sq. inches)	2.43	2.43	2.05	4.45	4.45			
	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 =	5.75	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	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 _g =	6.75	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.91	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	18.55	N/A	ft ²
Overflow Grate Open Area w/ Debris =	9.28	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 =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.14	N/A	ft ²
Outlet Orifice Centroid =	1.00	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 =	7.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	40.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

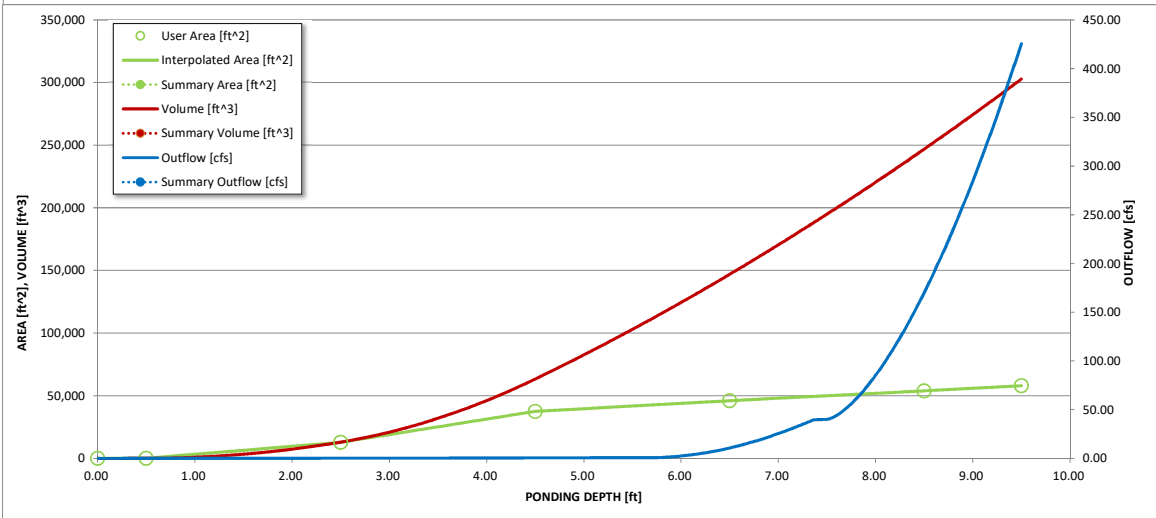
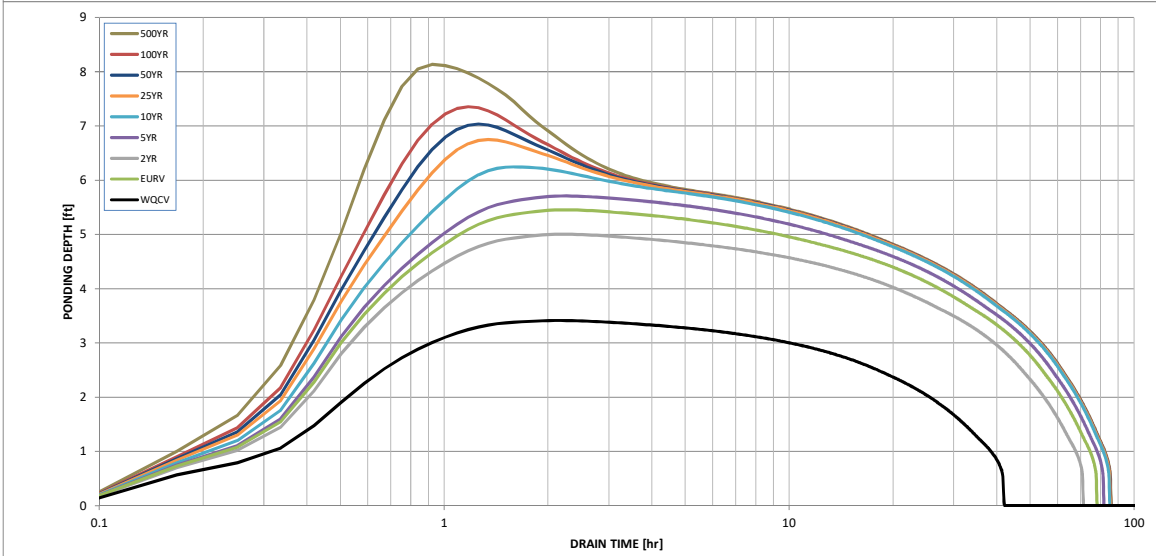
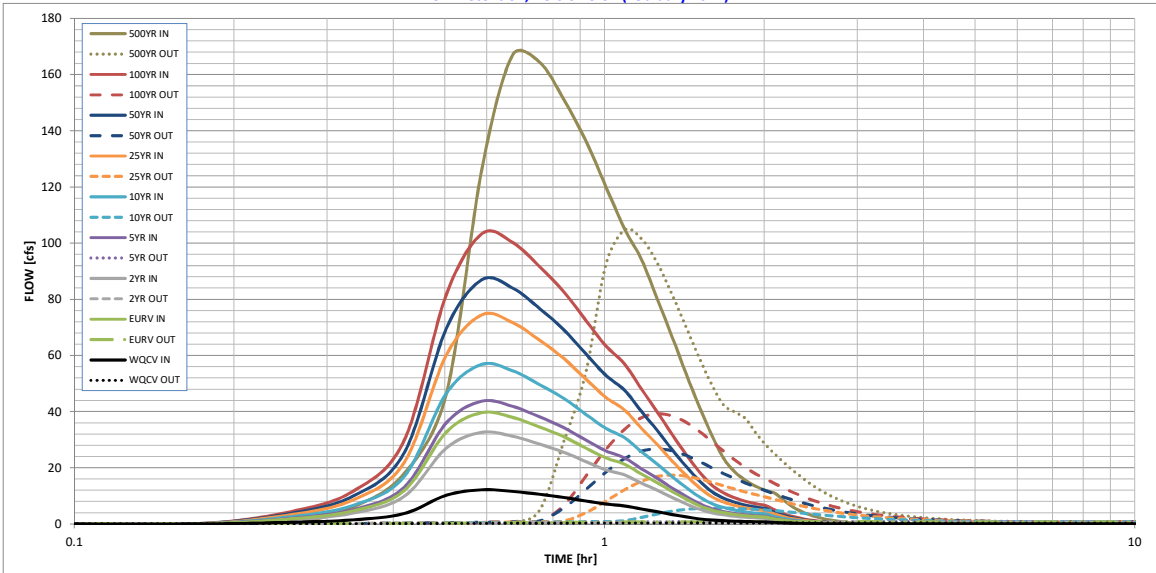
Spillway Design Flow Depth =	0.87	feet
Stage at Top of Freeboard =	9.37	feet
Basin Area at Top of Freeboard =	1.32	acres

Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.738	2.441	2.004	2.697	3.518	4.635	5.434	6.483	10.626
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.737	2.438	2.002	2.694	3.515	4.631	5.428	6.478	10.618
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.66	0.91	1.23	2.23
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	0.777	7.5	24.8	34.3	46.1	83.6
Peak Inflow Q (cfs) =	12.1	39.6	32.6	43.7	56.8	74.4	86.9	103.3	166.9
Peak Outflow Q (cfs) =	0.3	0.8	0.7	0.849	5.6	17.4	26.7	39.2	104.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	0.8	0.7	0.8	0.8	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Gate 1	Overflow Gate 1	Overflow Gate 1	Overflow Gate 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	0.9	1.4	2.0	2.2
Max Velocity through Gate 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	69	63	72	73	71	70	68	61
Time to Drain 99% of Inflow Volume (hours) =	41	74	68	77	79	79	78	77	74
Maximum Ponding Depth (ft) =	3.41	5.45	5.00	5.71	6.25	6.75	7.04	7.35	8.13
Area at Maximum Ponding Depth (acres) =	0.55	0.95	0.91	0.98	1.03	1.08	1.10	1.13	1.20
Maximum Volume Stored (acre-ft) =	0.683	2.317	1.897	2.558	3.101	3.640	3.945	4.304	5.215

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



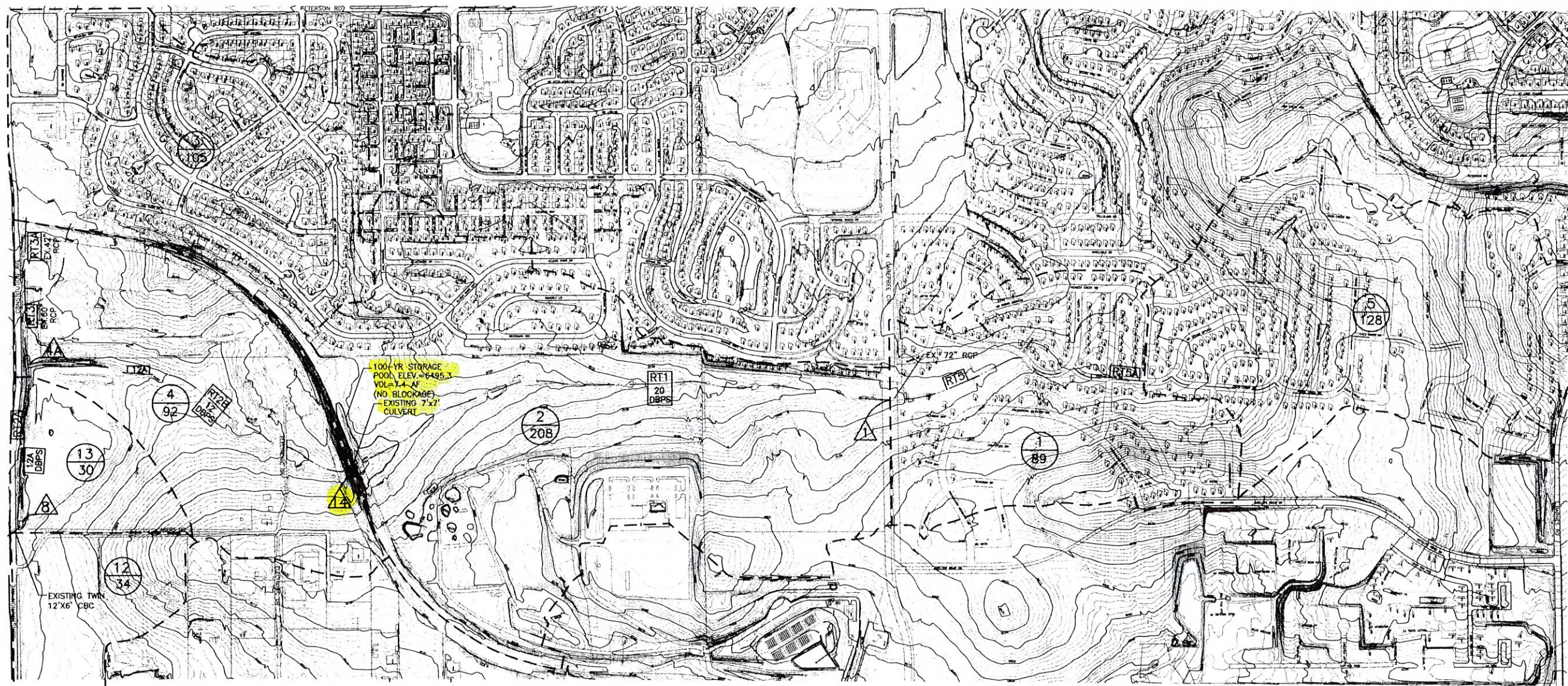
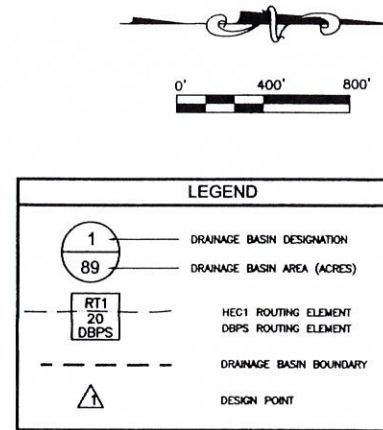
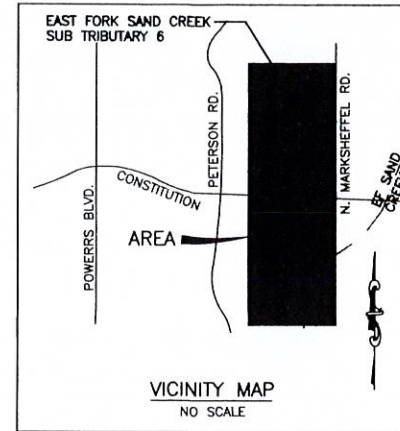
S-A-V-D Chart Axis Override

	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DRAINAGE MAPS

SUMMARY OF DISCHARGES		
DESIGN POINT LOCATION	DRAINAGE AREA (SM)	Q_{100}/Q_{10} (cfs)
1 AT N, CAREFREE CIR.	0.34	551/255
14 AT RAILROAD GRADE (INFLOW)	0.66	915/374
14 AT RAILROAD GRADE (OUTFLOW)	0.66	640/360
8 AT CONSTITUTION	1.07	1076/457
8A AT CONFLUENCE WITH EF SAND CREEK	1.91	2088/925

SUMMARY OF ROUTING ELEMENTS		
ROUTING ELEMENT	LOCATION	DESCRIPTION
RT-8	DP 7 TO DP 8A	45' BW, 3:1 SS, S = 0.7% RIPRAP CHANNEL
RT-7	DP 6 TO DP 7	45' BW, 3:1 SS, S = 0.7% RIPRAP CHANNEL
RT-6/6A	DP 8 TO D 6	30' BW, 3:1 SS, S = 0.7% RIPRAP CHANNEL
RT-2A	DP 4A TO DP 8	30' BW, 3:1 SS, S = 1.0% RIPRAP CHANNEL
RT-2B	DP 14 TO DP 4A	16' BW, 3:1 SS, S = 0.5% RIPRAP CHANNEL
RT 3 - RT 3A	SB 3 TO DP4A	60" RCP TO 42" RCP
RT-1	DP 1 TO DP14	NATURAL CHANNEL, S = 3.0%
RT-5	SB 5 TO DP1	NATURAL CHANNEL, S = 3.0%



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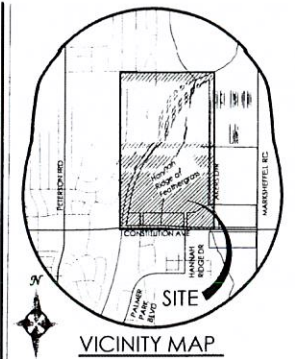
EAST FORK SAND CREEK
SUBTRIBUTARY HYDROLOGIC ANALYSIS
HYDROLOGIC BASIN MAP
EL PASO COUNTY, COLORADO

Project No.: 06040
Date: AUG 2006
Design: RNW
Drawn: MFA
Check: RNW
Revisions:

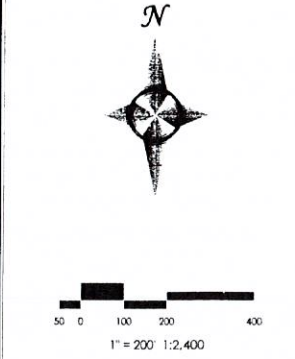
Fig. 4.2



* NOTE: MAIN CHANNEL MINOR STORM FLOW RATES ARE 10-YEAR IN ACCORDANCE WITH DRAINAGE BASIN PLANNING STUDY



BENCHMARK
 THE BENCHMARK FOR THESE PLANS IS THE TOP OF #4 REBAR, PANEL POINT NO. 1, LOCATED ON THE SOUTH EDGE OF CONSTITUTION AVE AND THE WEST EDGE OF THE ROCK ISLAND TRAIL, 535 FEET WEST OF THE CENTERLINE OF SHAWNEE DR. ELEVATION = 6486.63. (EPC DATUM ELEVATION = 6485.29)



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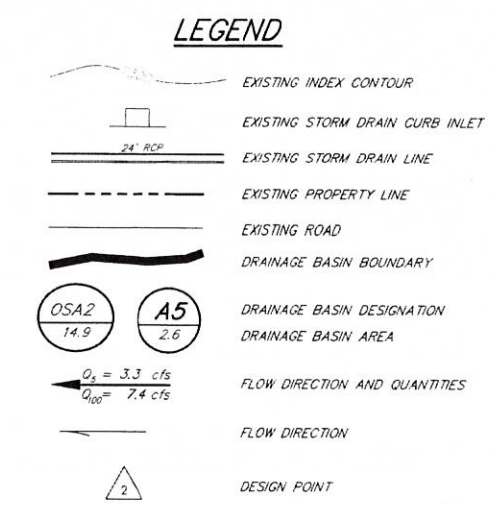
REVISIONS

DESIGNED BY DRG August 21, 2013
 DRAWN BY TJW August 21, 2013
 CHECKED BY _____
 AS-BUILTS BY _____
 CHECKED BY _____

Hannah Ridge at Feathergrass
EXISTING DRAINAGE MAP

MVE PROJECT **60970**
 MVE DRAWING **60970109**

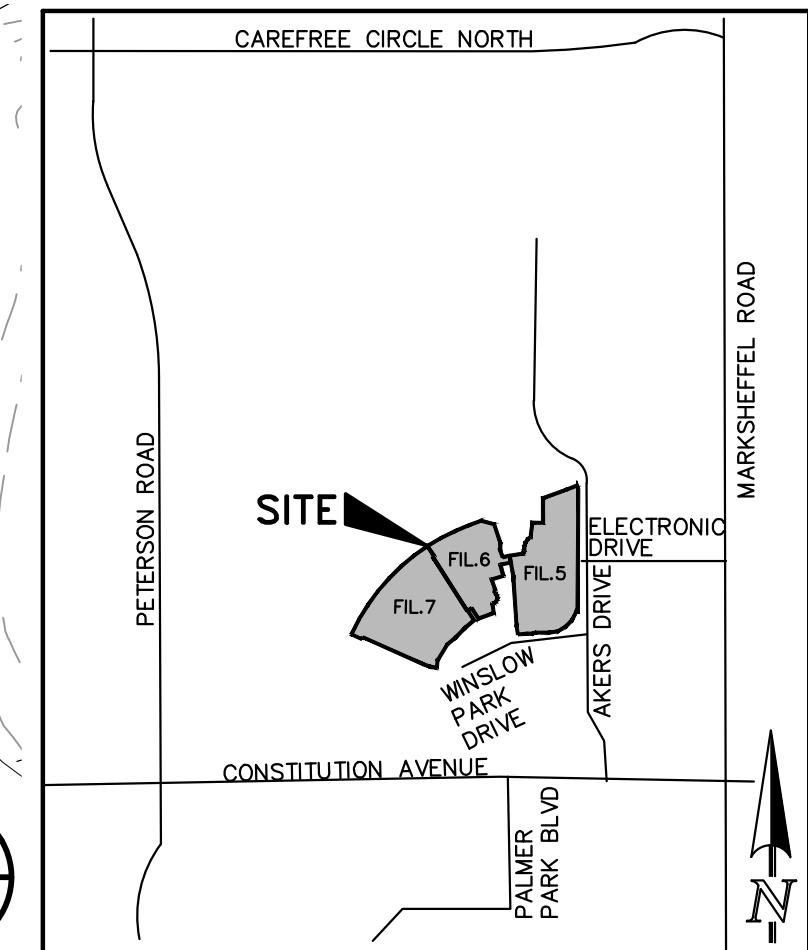
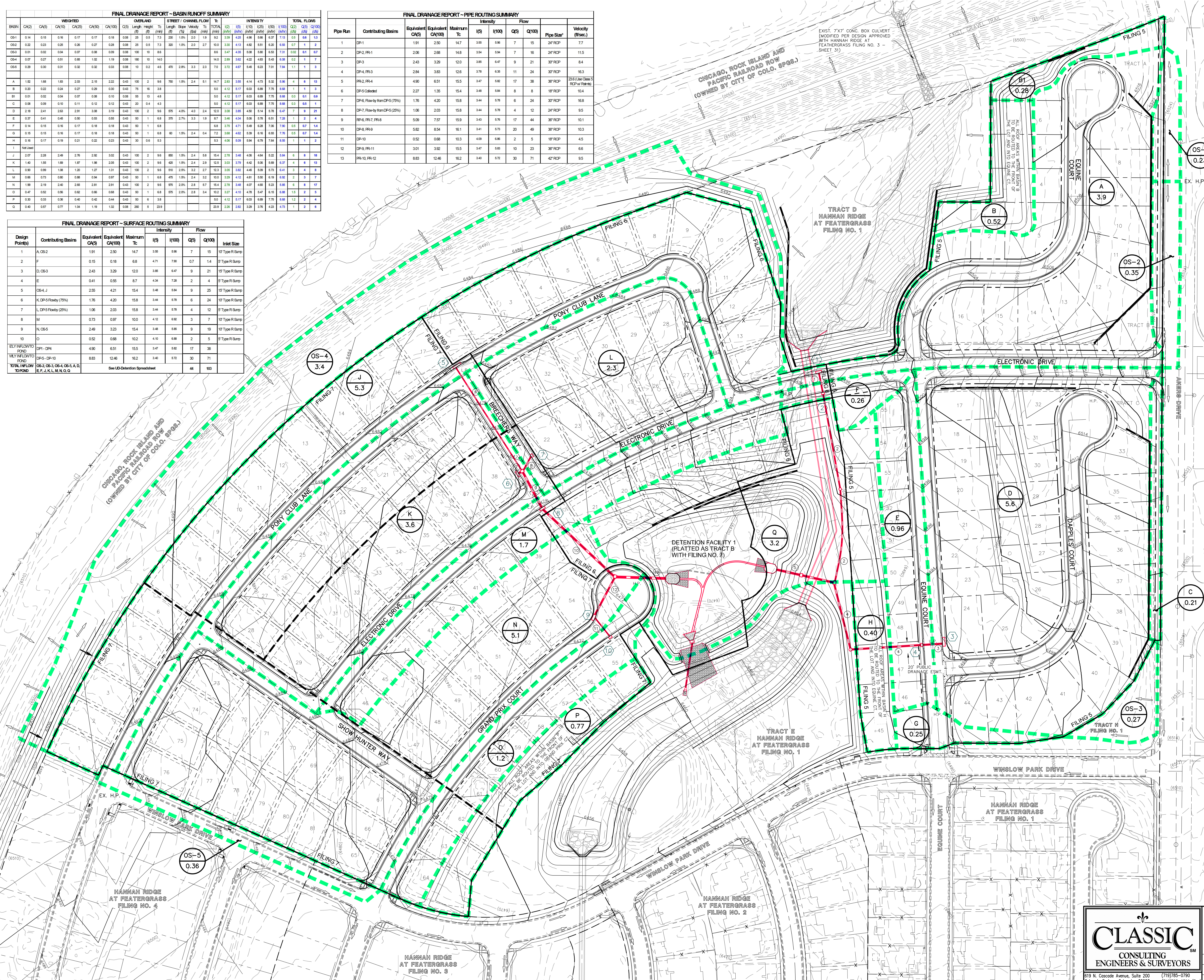
December 12, 2013



BSIN	CA(2)	CA(3)	CA(10)	CA(25)	CA(50)	CA(100)	OVERLAND		STREET / CHANNEL FLOW		TOTAL		TOTAL FLOWS											
							Length (ft)	Height (ft)	Length (ft)	Velocity (ft/s)	Q(2)	Q(5)	Q(10)	Q(25)	Q(50)	Q(100)								
OS1	0.14	0.15	0.16	0.17	0.17	0.18	0.08	25	0.3	7.3	200	10%	3.0	1.9	92	3.38	4.35	4.96	5.66	6.37	7.13	7.95	8.6	13
OS2	0.22	0.23	0.25	0.26	0.27	0.28	0.08	25	0.3	7.3	200	10%	3.0	1.9	92	3.38	4.35	4.96	5.66	6.37	7.13	7.95	8.6	13
OS3	0.27	0.27	0.31	0.32	0.33	0.34	0.08	100	10	8.6	86	3.47	4.35	5.08	5.80	6.37	7.13	7.95	8.6	9.2	10.0	10.8	11.6	17
OS4	0.27	0.27	0.31	0.32	0.33	0.34	0.08	100	10	8.6	86	3.47	4.35	5.08	5.80	6.37	7.13	7.95	8.6	9.2	10.0	10.8	11.6	17
OS5	0.28	0.30	0.31	0.32	0.33	0.34	0.08	100	10	8.6	86	3.47	4.35	5.08	5.80	6.37	7.13	7.95	8.6	9.2	10.0	10.8	11.6	17

Pipe Run	Contributing Basins	Equivalent CA(2)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size	Velocity (ft/sec)
					(2)	(100)	Q(2)	Q(100)		
1	DP-1	1.91	2.50	147	3.05	9.96	7	15	24" RCP	7.7
2	DP-2, PR-1	2.06	2.68	148	3.04	9.94	7	16	24" RCP	11.5
3	DP-3	2.43	3.29	120	3.85	6.47	9	21	30" RCP	8.4
4	DP-4, PR-3	2.84	3.83	126	3.78	6.38	11	24	30" RCP	16.3
5	PR-2, PR-4	4.90	6.51	155	3.47	9.82	17	38	36" RCP	20.6 (Use Class 5 RCP w/ Riser)
6	DP-5 Collected	2.27	1.35	154	3.48	5.84	6	8	18" RCP	10.4
7	DP-6, Rowley from DP-5 (75%)	1.76	4.20	158	3.44	5.78	6	24	30" RCP	16.8
8	DP-7, Rowley from DP-5 (25%)	1.00	2.03	158	3.44	5.78	4	12	24" RCP	9.5
9	PR-6, PR-7, PR-8	5.09	7.57	159	3.43	5.76	17	44	36" RCP	10.1
10	DP-8, PR-9	5.82	8.54	161	3.41	5.73	20	49	36" RCP	10.3
11	DP-10	0.52	0.68	103	4.08	6.86	2	5	18" RCP	4.5
12	DP-9, PR-11	3.01	3.92	155	3.47	6.03	10	23	30" RCP	6.6
13	PR-10, PR-12	6.83	12.46	162	3.40	6.72	30	71	42" RCP	9.5

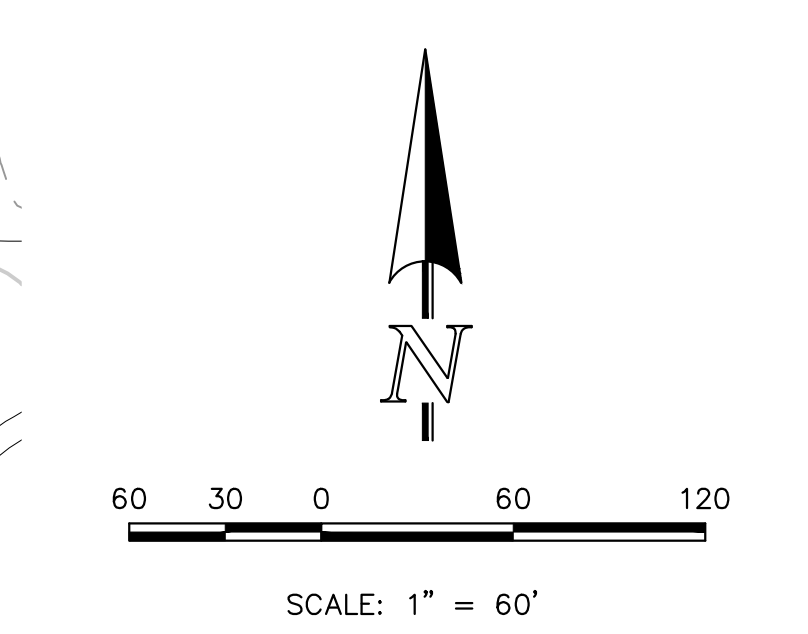
Design Point	Contributing Basins	Equivalent CA(2)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					(2)	(100)	Q(2)	Q(100)	
1	A, OS-2	1.91	2.50	147	3.05	9.96	7	15	10" Type R Sump
2	F	0.15	0.18	6.8	4.71	7.90	0.7	1.4	8" Type R Sump
3	D, OS-3	2.43	3.29	120	3.85	6.47	9	21	15" Type R Sump
4	E	0.41	0.55	8.7	4.34	7.28	2	4	8" Type R Sump
5	OS-4, J	2.55	4.21	154	3.46	5.94	5	25	15" Type R Sump
6	K, DP-5 Rowley (75%)	1.76	4.20	158	3.44	5.78	6	24	10" Type R Sump
7	L, DP-5 Rowley (25%)	1.06	2.03	158	3.44	5.78	4	12	8" Type R Sump
8	M	0.73	0.97	10.0	4.12	6.92	3	7	10" Type R Sump
9	N, OS-5	2.49	3.23	154	3.46	5.86	5	19	10" Type R Sump
10	O	0.52	0.68	10.2	4.10	6.88	2	5	8" Type R Sump
ELV INFLOW TO POND	DP-1, DP-4	4.90	6.51	155	3.47	5.80	17	38	
VEL INFLOW TO POND	DP-5, DP-10	8.83	12.46	162	3.40	6.72	30	71	
TOTAL INFLOW TO POND	OS-2, OS-3, OS-4, OS-5, A, B, E, F, J, K, L, M, N, O, Q						41	93	



FLOOD PLAIN STATEMENT:
 NO PORTION OF THIS SITE IS LOCATED WITHIN A FEMA FLOODPLAIN AS DETERMINED BY THE FLOOD INSURANCE RATE MAPS (F.I.R.M.) MAP NUMBERS 08041C 0752F, WITH EFFECTIVE DATES OF MARCH 17, 1997 (SEE APPENDIX).

NOTES:
 THIS MAP IS FOR DRAINAGE PURPOSES ONLY. SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.

POND DESIGN DATA:
 TRIBUTARY ACREAGE = 37.5 AC. @ 60% IMP
 WQCY REQ. = 0.74 AC-FT
 EURV REQ. = 2.44 AC-FT
 RELEASE:
 Q5 = 0.85 cfs @ WSE = 6467.21 (2.6 AC-FT)
 Q100 = 38 cfs @ WSE = 6468.90 (4.4 AC-FT)
 EMERGENCY SPILLWAY ELEV. = 6469.00
 EMERGENCY OVERFLOW ELEV. = 6469.87



EXISTING GROUND CONTOUR	6650
PROPOSED FINISHED CONTOUR	6650
SUBDIVISION BOUNDARY	---
LOT LINE	---
PROPOSED BASIN BOUNDARY	---
EXISTING FLOW DIRECTION	→
DIRECTION OF DRAINAGE	→
EXISTING STORM SEWER	---
EXISTING STORM INLET	□
PROPOSED STORM SEWER	---
PROPOSED STORM INLET	□
LOW POINT/HIGH POINT	LP/HP
BASIN IDENTIFIER	DD
AREA IN ACRES	1.41
PIPE RUN	①
DESIGN POINT	③

CLASSIC CONSULTING ENGINEERS & SURVEYORS
 HANNAH RIDGE AT FEATHERGRASS FILING NO. 5, 6 AND 7 FINAL DRAINAGE REPORT PROPOSED CONDITIONS DRAINAGE MAP
 DESIGNED BY MAW SCALE DATE 08/27/18
 DRAWN BY KC (H) 1" = 60' SHEET 1 OF 1
 CHECKED BY (V) 1" = N/A JOB NO. 1116.05

N:\116605\DRAINAGE\116605-FDR.dwg, 12/20/2018 1:31:15 PM, 1:1

Markup Summary

Steve Kuehster (4)

submitting and address of the applicant. To date, these improvements have
not been developed or filed with the Department of Public Works. The
owner of the improvements and is intended to accept the
responsibility and maintenance responsibility for the structure and associated
improvements. Colorado: the contractor and the
owner of the Box Culvert, The City of Colorado Springs
has accepted the improvements to the
structure.
and submit a FEMA Application as described by the Flood Insurance Rate
Manual (FIRM) with reference to March 17, 1997 (See Appendix).
MS
Specify an Erosion Control Plan and associated cost estimate to be submitted
to the Department of Public Works. We respectfully request that the Erosion Control Plan and cost estimate be

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Author: Steve Kuehster
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Mostly Resolved, However, the comment that the owner of the Box Culvert, The City of Colorado Springs has in writing accepted the improvements is still outstanding.

a FEMA floodpla

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Author: Steve Kuehster
Date: 1/16/2019 7:34:57 AM
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A Private Maintenance Agreement for all Filings that
identify the detention facility and outfall channel
that are located on the other filings (5, 6 & 7).

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Author: Steve Kuehster
Date: 1/17/2019 11:47:51 AM
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A Private Maintenance Agreement for all Filings that identifies the detention facility and outfall channel that are located on the other filings (5,6 & 7).

This document should confirm that the Hannah Ridge HOA will own and maintain these facilities.

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Date: 1/17/2019 11:50:59 AM
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This document should confirm that the Hannah Ridge HOA will own and maintain these facilities.