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**PRELIMINARY/FINAL DRAINAGE REPORT**

**MIDTOWN COLLECTION AT HANNAH RIDGE**

**FILING No. 3**

**(A Replat of Tract CC, Hannah Ridge at  
Feathergrass Subdivision Filing No. 1)**

PUDSP-20 -007

**AUGUST 2020**

Engineering Review

09/29/2020 12:07:36 PM

*dsdrice*

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EPC Planning & Community  
Development Department

**See comment letter also**

Prepared for:

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**PRELIMINARY/FINAL DRAINAGE REPORT FOR MIDTOWN COLLECTION AT HANNAH RIDGE FILING NO. 3 (A Replat of Tract CC, Hannah Ridge at Feathergrass Subdivision Filing No. 1)**

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

\_\_\_\_\_  
Kyle R. Campbell, Colorado P.E. #29794

\_\_\_\_\_  
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: Elite Properties of America, Inc.

\_\_\_\_\_  
Date

Title: \_\_\_\_\_

Address: 2138 Flying Horse Club Drive

Colorado Springs, CO 80921

**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:



**PRELIMINARY/FINAL DRAINAGE REPORT FOR MIDTOWN COLLECTION AT HANNAH RIDGE FILING NO. 3 (A Replat of Tract CC, Hannah Ridge at Feathergrass Subdivision Filing No. 1)**

**TABLE OF CONTENTS:**

PURPOSE	Page 4
GENERAL DESCRIPTION	Page 4
EXISTING DRAINAGE CONDITIONS	Page 5
DEVELOPED DRAINAGE CONDITIONS	Page 5
HYDROLOGIC CALCULATIONS	Page 8
FLOODPLAIN STATEMENT	Page 9
EROSION CONTROL PLAN	Page 10
DRAINAGE FACILITY COST OPINION	Page 10
DRAINAGE AND BRIDGE FEES	Page 10
SUMMARY	Page 13
REFERENCES	Page 14

**APPENDICES**

VICINITY MAP  
SOILS MAP (S.C.S. SURVEY)  
F.E.M.A. MAP  
REFERENCE MATERIAL FROM ADJACENT STUDIES  
HYDROLOGIC / HYDRAULIC CALCULATIONS  
SWQ / FULL SPECTRUM DETENTION CALCULATIONS  
DRAINAGE MAPS



**PRELIMINARY/FINAL DRAINAGE REPORT FOR MIDTOWN COLLECTION AT HANNAH RIDGE FILING NO. 3 (A Replat of Tract CC, Hannah Ridge at Feathergrass Subdivision Filing No. 1)**

**PURPOSE**

This document is the Preliminary and Final Drainage Report for Midtown Collection at Hannah Ridge Filing No. 3. 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 3 and discuss the construction details, and more specifically, the design details of the proposed sub-regional public detention/water quality facility located within Filing 3 that will handle the treatment for this site as well as Hannah Ridge at Feathergrass Filings No. 1 & 2. Design information for the Filing No. 3 detention/water quality facility is included in this report.

It is anticipated that an amendment to this report will be provided when the Final Plat and Construction Drawings details are processed for review.

**GENERAL DESCRIPTION**

The overall 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 6<sup>th</sup> 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 development includes a total of 345 single-family residences that will be developed in seven filings, as well as two small lot PUD single family developments and one commercial parcel, Tract CC. Tract CC is now proposed for a small lot PUD single family development which is prompting the PUD rezone and PUD site plan applications. Midtown Collection at Hannah Ridge Filing No. 3 (Tract CC) is 7.44 acres in size and contains 42 small lot, single-family detached lots.

proposed



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 far southeast portion of the overall Hannah Ridge at Feathergrass development. This site was previously studied in the "Final Drainage Report for Hannah Ridge at Feathergrass Subdivision Filing No. 1", by MVE, Inc. dated January 2014 this proposed residential filing is located in Basin D9, D11 and G1 from the Filing No. 1 report as shown on the developed drainage map provided by MVE, Inc. (See Appendix). Existing Hannah Ridge Drive along the west edge of the development serves as the westerly basin boundary and Hunter Jumper Drive to the north as the northerly basin boundary. The construction of Hannah Ridge at Feathergrass Filing 1 and 2 improvements included the public storm under Hunter Jumper Drive and Hannah Ridge Drive out-falling into the existing drainageway that runs parallel to Constitution. The 84" RCP public storm from Hunter Jumper Drive to Hannah Ridge Drive was previously constructed. The on-site pre-development drainage patterns are generally sheet flowing towards Constitution Avenue where existing inlets intercept the flows and transfer them to an existing stormwater quality only facility located on the east side of Hannah Ridge Drive also constructed with Filing No. 1 and Filing No. 2. Filing No. 1 existing flows generally drain as street flow in a westerly direction towards the existing public drainage facilities within Hannah Ridge Drive. The prior report anticipated released of fully developed flows downstream into the dual cell box culverts under Constitution Avenue.

### **DEVELOPED DRAINAGE CONDITIONS**

Based upon City/County Drainage Criteria, the drainage approach for this development now reflects current criteria for stormwater quality and Full Spectrum Detention requirements. The existing pond on the site will be redesigned as a Full Spectrum facility to accommodate the development of this site and all of northerly Hannah Ridge at Feathergrass Filing 1 and portions of Filing No. 2 This will include the design of concrete forebays, concrete trickle channels, concrete micro-pool and an outlet structure



Verify name

designed to release flows based on full spectrum criteria. The attached developed conditions drainage map contains the design points related to proposed sump conditions. All public and private Type R inlets have been designed at these various locations to accept both the 5-yr. and 100-yr. developed flows.

Plan shows public storm through HOA property to the proposed FSD

All proposed storm facilities within the public Right-of-way will be public with ownership and maintenance by El Paso County. All other proposed storm facilities are within easements or tracts and the proposed modified Pond 1 will be owned and maintained by the Hannah Ridge HOA. All existing public storm facilities are located within existing easements as reflected on the drainage map.

**Design Point 1** ( $Q_5 = 1.9$  cfs and  $Q_{100} = 4.1$  cfs) is comprised of developed and on-site flows from Basin A. These single-family lots and private street flows travel west to the proposed intersection at Equine Court. The flows are intercepted by a 6' cross pan and routed south into Basin B.

**Design Point 2** ( $Q_5 = 5.0$  cfs and  $Q_{100} = 11.3$  cfs) collect developed flows from Basin Band the flows from Design Point 1. 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 will then be conveyed via a 24" RCP public storm sewer in a northerly direction towards the Tract A Pond. The total flow within the pipe at this location is given by **Pipe Run 1 ( $Q_5 = 5$  cfs and  $Q_{100} = 11.3$  cfs)**. The emergency overflow route at this location is in the southerly direction directly into the southerly drainage tract that will route the flows east towards Constitution Avenue.

← south?

**Design Point 3** ( $Q_5 = 3.9$  cfs and  $Q_{100} = 8.7$  cfs) is developed flows from Basins D & E. At this sump condition, 10' Type R private 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 then be conveyed via an 18" RCP private storm sewer towards the Tract A Pond. The total flow within the pipe at this location is given by **Pipe Run 4 ( $Q_5 = 3.9$  cfs and  $Q_{100} = 8.7$  cfs)**. The emergency overflow route at this location is south directly into the proposed expanded Pond. **Pipe Run 5 ( $Q_5 = 30.1$  cfs and  $Q_{100} =$**



**50.2 cfs**) represents the combined pipe flows from Design Points 3 and all northerly off-site developed flows. A 48" RCP storm sewer will route these combined developed flows directly into the Pond.

**Design Point 4** ( $Q_5 = 1.7$  cfs and  $Q_{100} = 3.5$  cfs) collects developed flows from Basin C. At this sump condition, a 5' private Type R sump inlet will be installed to completely collect both the 5-year and 100-year developed flows. These flows being collected have a maximum ponding depth of 6 inches and then be conveyed via a private 18" RCP storm sewer towards Pipe Run 5. The total flow within the pipe at this location is given by **Pipe Run 5** ( $Q_5 = 6.3$  cfs and  $Q_{100} = 13.9$  cfs). The emergency overflow route at this location is via Tract A directly into the pond in a 24" RCP public storm system. This 24" RCP storm sewer will route these combined developed flows directly into the Pond. **3**

Clarify these sentences

Runoff from Basin F (0.89 Acres) and Basin G (1.46 Acres) flow directly into the proposed expanded pond or into the southerly drainage channel.

**Basin H** ( $Q_5 = 0.2$  cfs and  $Q_{100} = 1.3$  cfs) is a small 0.40-acre landscape parcel at the southeast corner of the site that street flows directly into Akers Drive and Constitution avenue.

See redlines on basin line.

**The total inflow into the expanded Pond is  $Q_5 = 6.3$  cfs and  $Q_{100} = 13.9$  cfs from the east and  $Q_5 = 30.1$  and  $Q_{100} = 59.2$  cfs from the west.** The existing facility will be expanded with the proposed Filing 3 development. This facility will have two inflow point. both inflow points will outfall into a concrete forebay. This facility will have two inflow points. The west inflow will be from a proposed 48" RCP into a proposed concrete forebay with a required size of .010 ac-ft based on 3% of the WQCV from this inflow. The forebay is designed with 12" high walls, 6.7" notch and a 30" wide concrete trickle channel routing the flows towards the pond outlet. The east inflow will be from a proposed 24" RCP into a proposed concrete forebay with a required size of .010 ac-ft based on 3% of the WQCV from this inflow. The forebay is designed with 12" high walls, 4.7" notch and a 30" wide concrete trickle channel routing the flows toward the pond outlet. The outlet structure consists of a 6'x5' concrete box with an integral 100 Square Foot micro-pool allowing for 6" initial surcharge depth. The micro-pool total depth of 3.0' provides the required 0.3% of the WQCV. The outlet box will have a height of 4.0'



above the micro-pool water elevation. (see UD-BMP Spreadsheets in the Appendix). The orifice plate on the front of the outlet box consists of a series of 3 – 1 5/8” holes, 16” 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:

- 0.346 Ac.-ft. WQCV required
- 0.666 Ac.-ft. EURV required
- 1.861 Ac.-ft. 100-year storage required

Verify name

Pond Design Release:  $Q_5 = 0.346$  cfs,  $Q_{100} = 34.1$  cfs  
Pre-development Release:  $Q_5 = 0.579$  cfs,  $Q_{100} = 33.60$  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 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 and ultimately released into a proposed stabilized drainage channel.
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.

#### **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 Number 08041C0752G, with effective dates of December 7, 2018 (See Appendix).

and 756G



## 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. Early grading is not being requested with these applications.

### Midtown Collection at Hannah Ridge Filing No. 3 Drainage Improvement Costs (Non-Reimbursable)

ITEM	DESCRIPTION	QUANTITY	UNIT COST	COST
1.	5' Type R Inlet	1 EACH	\$3,791/EA	\$ 3,791.00
2.	10' Type R Inlet	2 EACH	\$5,950/EA	\$ 11,900.00
3.	18" RCP Storm Drain	105 LF	\$69/LF	\$ 7,245.00
4.	24" RCP Storm Drain	380 LF	\$84/LF	\$ 31,920.00
5.	48" RCP Storm Drain	75 LF	\$122/LF	\$ 9,150.00
6.	Type I MH	1 EACH	\$8,592/EA	\$ 8,592.00
7.	Type II MH	4EACH	\$4,575/EA	\$ 18,300.00
8.	Pond 1 FSD	1 EACH	\$83,000/EA	\$ 83,000.00
SUB-TOTAL				\$ 173,898.00
10% ENGINEERING				\$ 17,389.80
5% CONTINGENCIES				\$ 8,694.90
<b>GRAND-TOTAL</b>				<b><u>\$ 199,982.70</u></b>

Classic Consulting Engineers & Surveyors cannot and does not guarantee that the construction cost will not vary from these opinions of probable construction costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular.

## 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. Filing No. 3 is a re-plat of previously platted Tract CC within Filing 1. However, Tract CC was 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 acreage:

Filing 3: 7.44 ac.

The total development area is broken into different residential uses:

PUD zone (1/8 acre or less SF lots – 65% Impervious)

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

The following calculations are based on the 2020 drainage/bridge fees for the Sand Creek Basin:

**FILING 3:**

**2158 SF avg. lots (1/8 acre or less)**

(Per El Paso County Percent Impervious Chart for 1/8 acre or less SF lots: 65%)

$$7.44 \text{ Ac.} \times 65\% = 4.84 \text{ Impervious Ac.}$$

**Open Space Tracts**

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

$$2.60 \text{ Ac.} \times 2\% = 0.05 \text{ Impervious Ac.}$$

**Total Impervious Acreage: 4.89 Imp. Ac.**

**\$8,057** — **FILING 3 FEE TOTALS:** — **4.89**

**Bridge Fees** — **4.89**

$\$ 5,559.00 \times 4.84 \text{ Impervious Ac.} = \$ 27,183.51$

**Drainage Fees** — **4.89**

$\$ 18,940.00 \times 4.84 \text{ Impervious Ac.} = \$ 92,616.60$

These Drainage Fees will be paid by developer in the form of cash and/or credits.

**\$19,698** — **\$96,323?**

**\$39,399?**

(the fees above depend on plat being submitted prior to any updates)



## **SUMMARY**

This proposed development remains consistent with the previously approved MDDP and Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 1. The existing storm facilities continue to adequately handle both the 5-yr. and 100-yr. developed flows. The proposed detention facility meets current criteria and provides full spectrum design. The proposed development will not adversely impact surrounding developments.

A future Final Plat application will include Construction Drawings and amendment to this report to provide further Final Design details associated with the more detailed design.

PREPARED BY:  
**Classic Consulting**

Kyle R. Campbell, P.E.  
Division Manager

db/111635/REPORTS/PDRdoc



## 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. "Final Drainage Report for Hannah Ridge at Feathergrass Subdivision Filing No. 1", by MVE, Inc. January 2014.
5. Drainage Criteria Manual (Volume 3) latest revision April 2008, Urban Drainage and Flood Criteria District.
6. "Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 3", by MVE, Inc. October 2017.
7. "Final Drainage Report for Hannah Ridge at Feathergrass Filing No. 4", by MVE, Inc. October 2017.

EPC Board Resolution No. 15-042 (El Paso County adoption of Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014, hydrology and full-spectrum detention)

ECM updated 2019 to include County MS4 permit updates

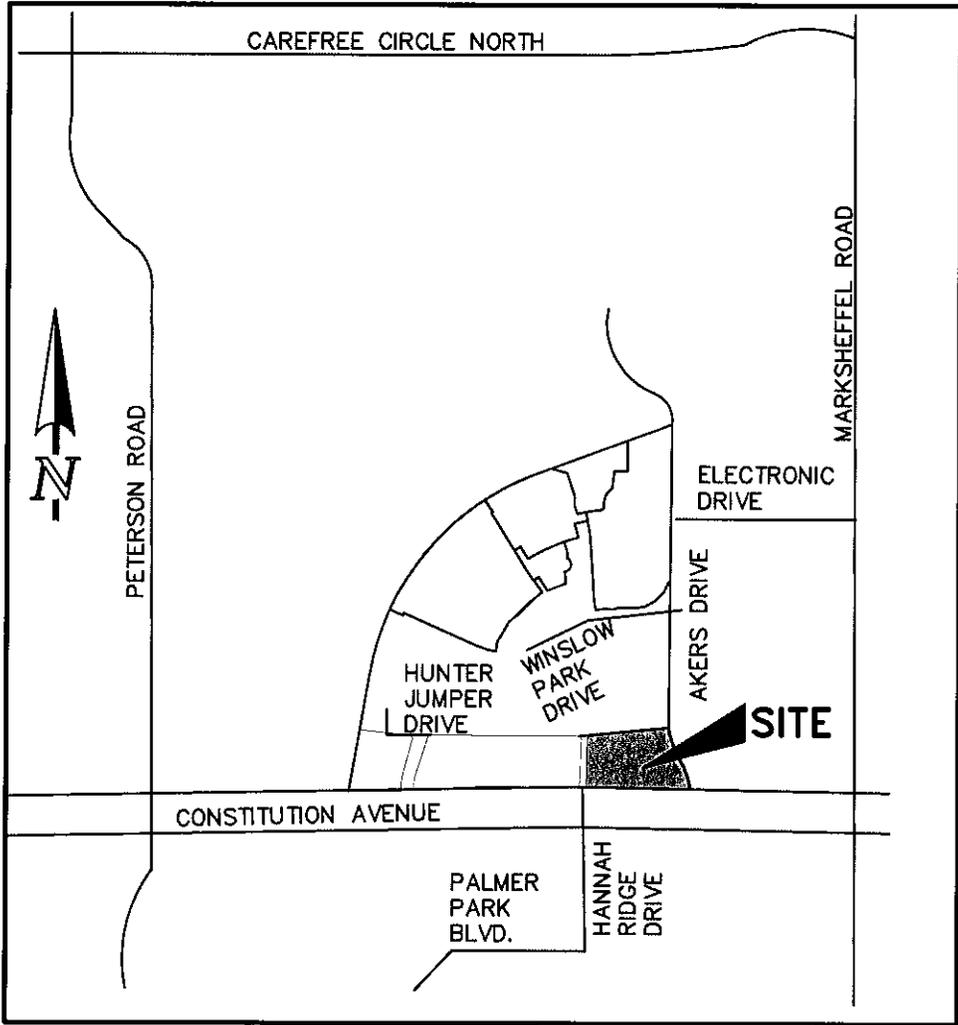


**APPENDIX**



**VICINITY MAP**





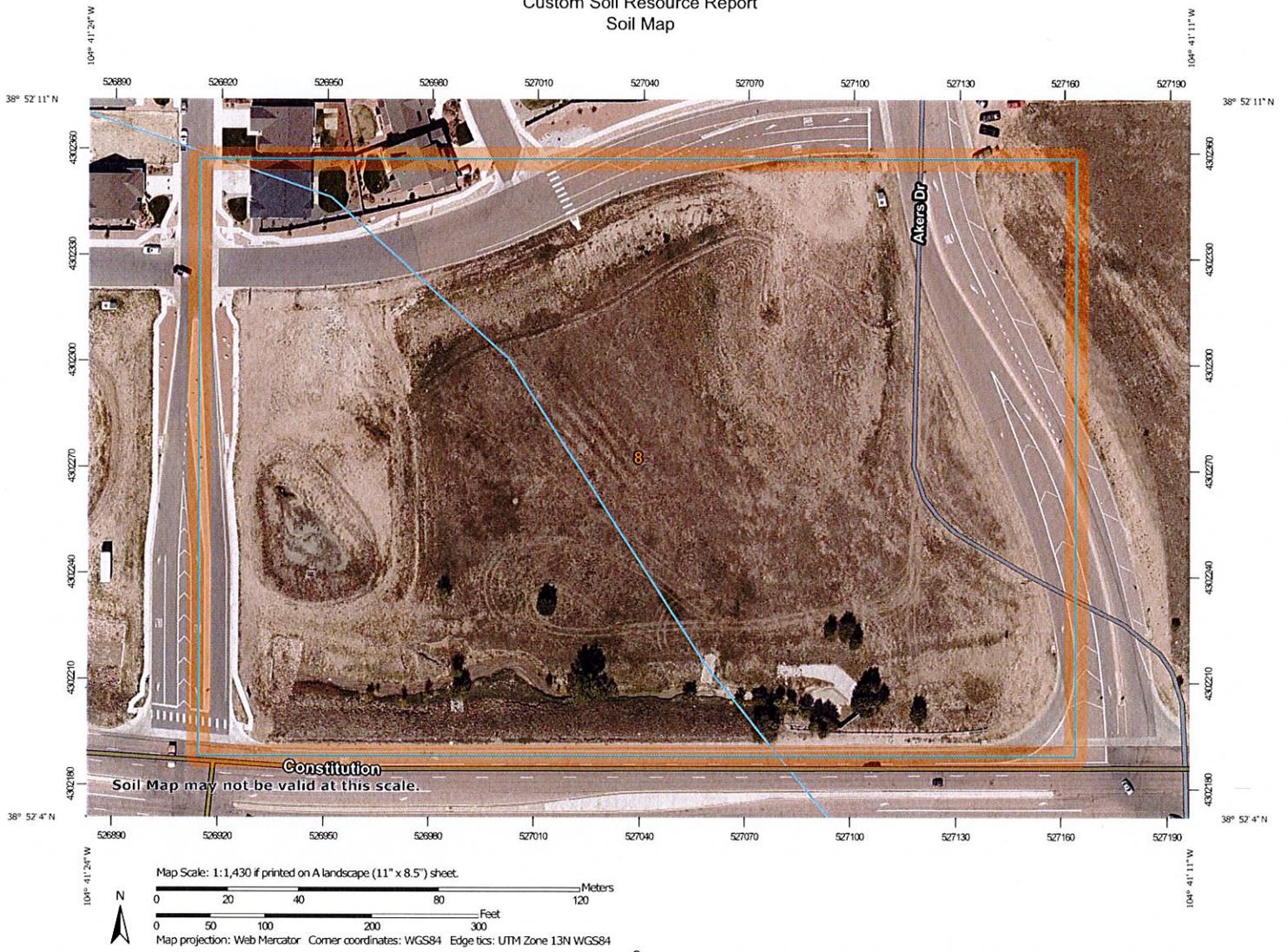
VICINITY MAP

N.T.S.

**SOILS MAP (S.C.S SURVEY)**



Custom Soil Resource Report  
Soil Map



## Custom Soil Resource Report

### MAP LEGEND

<b>Area of Interest (AOI)</b>		 Spoil Area	
	Area of Interest (AOI)	 Stony Spot	
<b>Soils</b>		 Very Stony Spot	
	Soil Map Unit Polygons	 Wet Spot	
	Soil Map Unit Lines	 Other	
	Soil Map Unit Points	 Special Line Features	
<b>Special Point Features</b>		<b>Water Features</b>	
	Blowout	 Streams and Canals	
	Borrow Pit	<b>Transportation</b>	
	Clay Spot	 Rails	
	Closed Depression	 Interstate Highways	
	Gravel Pit	 US Routes	
	Gravelly Spot	 Major Roads	
	Landfill	 Local Roads	
	Lava Flow	<b>Background</b>	
	Marsh or swamp	 Aerial Photography	
	Mine or Quarry		
	Miscellaneous Water		
	Perennial Water		
	Rock Outcrop		
	Saline Spot		
	Sandy Spot		
	Severely Eroded Spot		
	Sinkhole		
	Slide or Slip		
	Sodic Spot		

### 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 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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	10.5	100.0%
<b>Totals for Area of Interest</b>		<b>10.5</b>	<b>100.0%</b>

## Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

## Custom Soil Resource Report

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

## 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:* 98 percent  
*Minor components:* 2 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 (R049XB210CO)  
*Hydric soil rating:* No

The FSD calculations need to be for this soil type.

#### Minor Components

##### Pleasant

*Percent of map unit:* 1 percent

Custom Soil Resource Report

*Landform: Depressions*  
*Hydric soil rating: Yes*

**Other soils**

*Percent of map unit: 1 percent*  
*Hydric soil rating: No*

**F.E.M.A. MAP**



# National Flood Hazard Layer FIRMette

104°41'36"W 38°52'22"N



SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

## Legend

**SPECIAL FLOOD HAZARD AREAS**

- Without Base Flood Elevation (BFE)  
Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

**OTHER AREAS OF FLOOD HAZARD**

- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile (Zone X)
- Future Conditions 1% Annual Chance Flood Hazard (Zone X)
- Area with Reduced Flood Risk due to Levee. See Notes, Zone X
- Area with Flood Risk due to Levee (Zone D)

**OTHER AREAS**

- NO SCREEN
- Area of Minimal Flood Hazard (Zone X)
- Effective LOMRs
- Area of Undetermined Flood Hazard (Zone X)

**GENERAL STRUCTURES**

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

**OTHER FEATURES**

- 20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
- 17.5 Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

**MAP PANELS**

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/3/2020 at 6:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



USGS The National Map: Orthoimagery. Data refreshed April 2020.

104°40'59"W 38°51'54"N

Feet

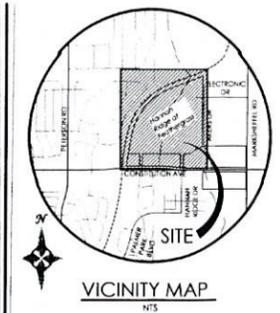
0 250 500 1,000 1,500 2,000 1:6,000

**REFERENCE MATERIAL FROM ADJACENT STUDIES**

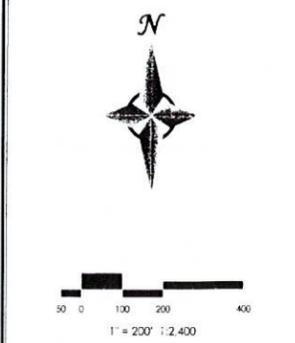


**LEGEND**

- EXISTING INDEX CONTOUR
- EXISTING STORM DRAIN CURB INLET
- EXISTING STORM DRAIN LINE
- EXISTING PROPERTY LINE
- EXISTING ROAD
- DRAINAGE BASIN BOUNDARY
- DRAINAGE BASIN DESIGNATION
- DRAINAGE BASIN AREA
- FLOW DIRECTION AND QUANTITIES
- FLOW DIRECTION
- DESIGN POINT



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 = 6485.53. (EPC DATUM ELEVATION = 6485.29).



DESIGNED BY DRG August 21, 2013  
 DRAWN BY DRG August 21, 2013  
 CHECKED BY \_\_\_\_\_  
 AS-BUILTS BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_

**Hannah Ridge at Feathergrass**

**DEVELOPED Drainage Map**

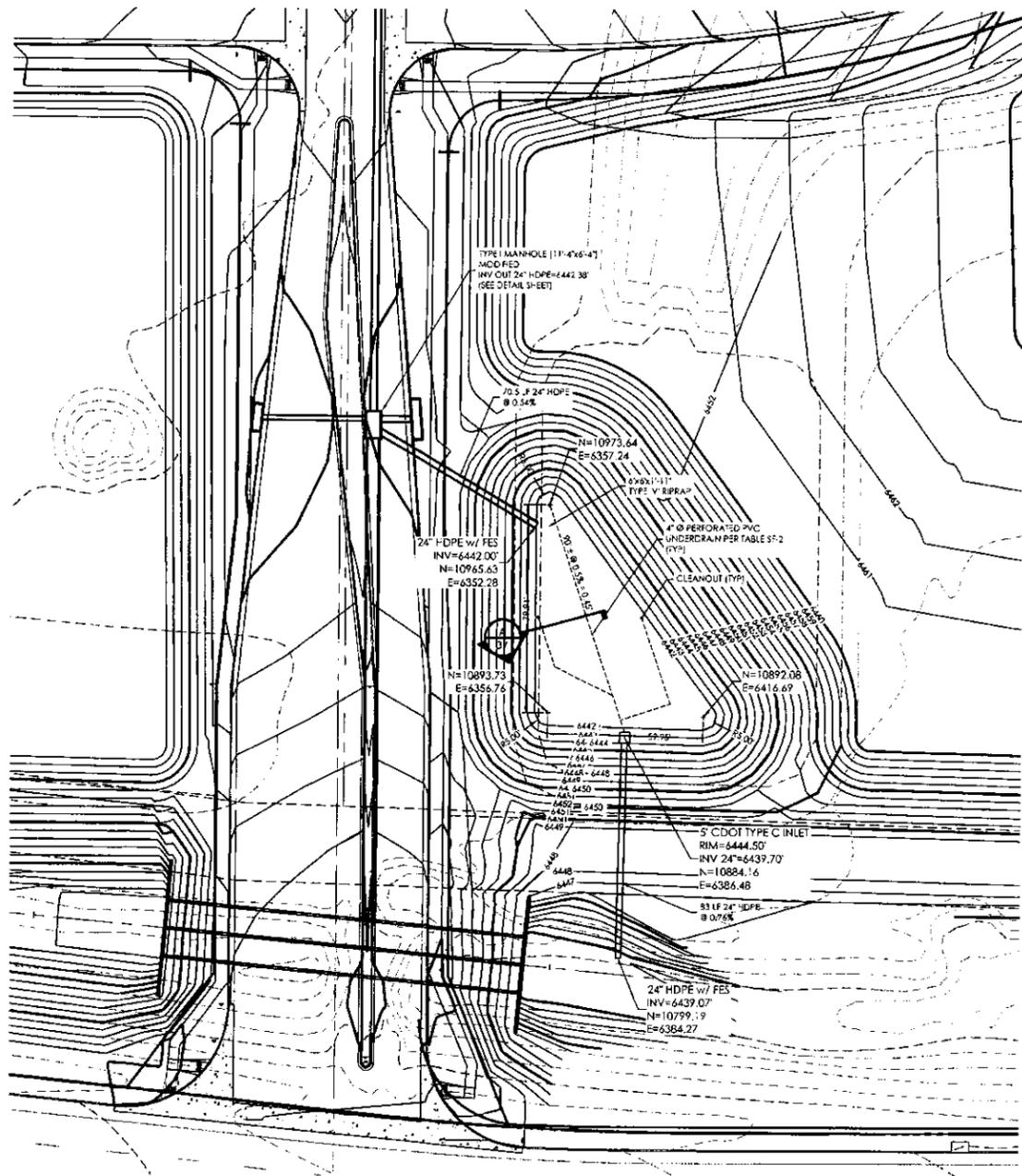
MVE PROJECT 60970  
 MVE DRAWING 60970110

**December 12, 2013 SHEET 1 OF 1**

DEVELOPED SUMMARY RUNOFF TABLE					
BASIN or DESIGN POINT	CONTRIBUTING BASINS	CONTRIBUTING AREA [AC]	5-YR(Q5) RUNOFF [CFS]*	100-YR (Q100) RUNOFF [CFS]	DESCRIPTION
OSA1 (IN)		425	374 *	915 (IN)	
1 (OUT)	OSA1	425	360 *	640 (OUT)	EX 7x7 CBC
2	OSA1, OSA2, A6	430.8	360 *	640 *	12'Wx6'H CBC
3	A1, A2, OSA3, A3	4.2	9.4	18.8	CROSS PAN
4	A1, A2, OSA3, A3, A4	4.4	9.7	19.2	10' TYPE R INLET (SUMP)
5	A5	0.2	0.7	1.3	5' TYPE R INLET (SUMP)
6	OSB1, B1, B2, B3, B4, B5, B6	8.2	19.5	38.5	CROSS PAN
7	OSB1, B1, B2, B3, B4, B5, B6, B7	8.9	20.4	40.1	15' TYPE R (SUMP), 15' TYPE R INLETS
8	OSCI, C1	8.6	15.0	31.1	10' TYPE R (SUMP), 10' TYPE R INLETS
9	C3, C5	3.6	8.9	17.8	15' TYPE R INLET (SUMP)
10	C2, C4	2.3	5.5	10.9	10' TYPE R INLET (SUMP)
11	C7, C8, C9, C11	6.1	13.4	26.6	15' TYPE R INLET (SUMP)
12	C6, C10	3.2	6.6	14.1	10' TYPE R INLET (SUMP)
13	C12	1.5	3.7	7.4	5' TYPE R INLET (SUMP)
14	OSA1, A6, OSB1-B9, OSCI-C12	476	360 *	640 *	10'Wx6'H CBC & 90' RCP
15	D1, D2, D3, D4, D5, D6	7.8	19.2	38.0	CROSS PAN
16	D1, D2, D3, D4, D5, D6, D7	11.7	26.6	52.8	10' TYPE R & 15' TYPE R INLETS
17	D1, D7, D9, D11	13.9	29.6	59.0	15' TYPE R INLET (SUMP)
18	D8, D10, D12	4.0	8.7	17.1	10' TYPE R INLET (SUMP)
19	E1, E2, E3	5.0	11.9	23.7	15' TYPE R INLET
20	E1, E2, E3, E4, E5, E7	11.0	23.4	48.4	15' TYPE R (SUMP), TYPE C INLETS
21	E6	1.8	4.5	9.0	5' TYPE R INLET (SUMP)
22	E8	0.7	1.8	3.6	5' TYPE R INLET (SUMP)
23	OSF1, F1, F2, F3	7.4	16.2	32.5	CROSS PAN
24	OSF1, F1, F2, F3, F5	11.0	23.4	48.4	15' TYPE R (SUMP), TYPE C INLETS
25	F4	0.3	0.9	1.9	5' TYPE R INLET (SUMP)
26	OSF2	4.9	4.2	9.6	TYPE D INLET (SUMP)
27	OSA1, A6, OSB1-B9, OSCI-C12, E1-E9, OSF1-OSF3, F1-F5	619	428 *	991 *	OPEN CHANNEL
28	OSA1, A6, OSB1-B9, OSCI-C12, E1-E9, OSF1-OSF3, F1-F5, D1-D12	647	428 *	991 *	DBL 10'Wx6'H CBC
29	OSA1, A6, OSB1-B9, OSCI-C12, E1-E9, OSF1-OSF3, F1-F5, D1-D12, G1	685	457 *	1075 *	EXISTING DBL 12'Wx6'H CBC

\* NOTE: MAIN CHANNEL MINOR STORM FLOW RATES ARE 10-YEAR IN ACCORDANCE WITH DRAINAGE BASIN PLANNING STD.Y

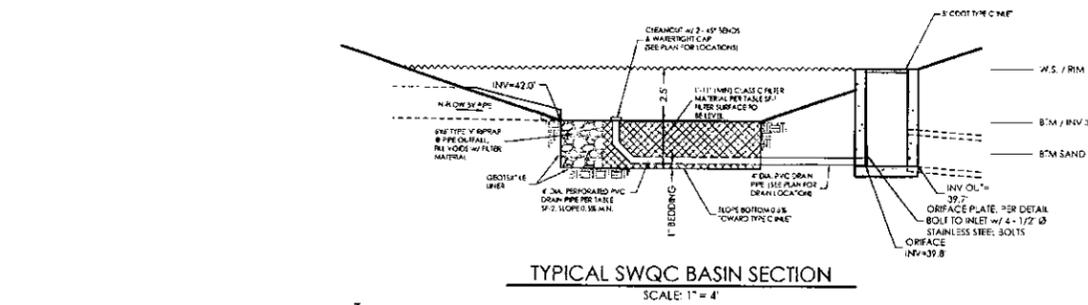




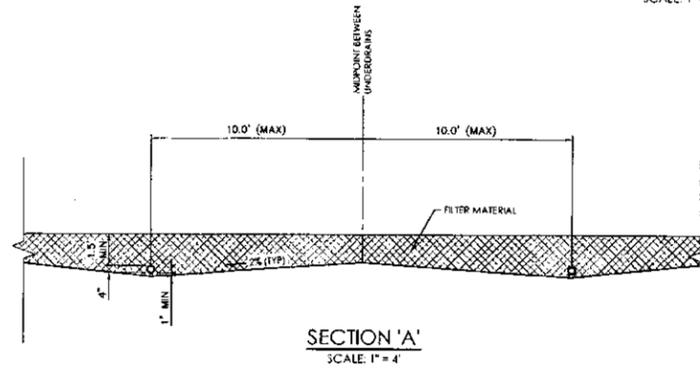
SWQC BASIN "D"  
SCALE: 1" = 30'



KEYMAP  
NOT TO SCALE



TYPICAL SWQC BASIN SECTION  
SCALE: 1" = 4'



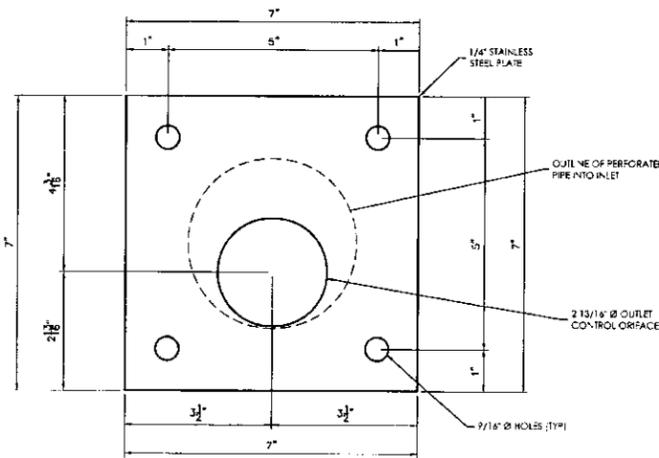
SECTION 'A'  
SCALE: 1" = 4'

TABLE SF-1 (CLASS C FILTER MATERIAL)

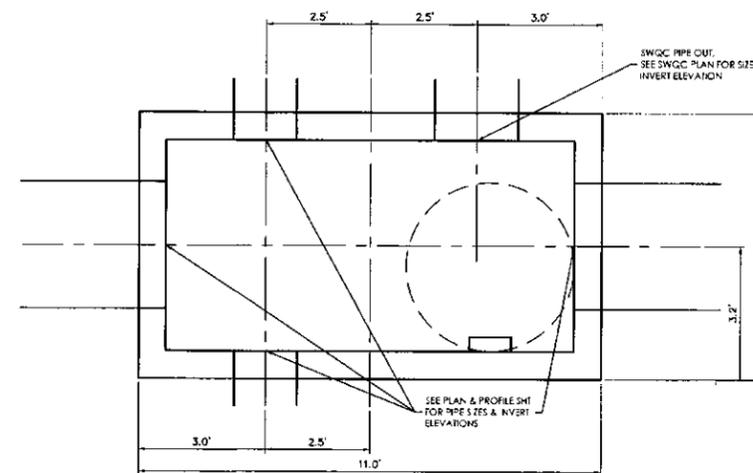
SEIVE SIZE	% PASSING
3/4"	100
NO 4	60-100
NO 50	10-30
NO 100	0-10
NO 200	0-3

TABLE SF-2 (PERFORATED PIPE DIMENSIONS)

PIPE Ø	SLOT LENGTH	SLOT WIDTH	SLOT CENTERS	OPEN AREA (PER SF)
4"	1-1/16"	0.032"	0.413"	1.90 SQ. IN.

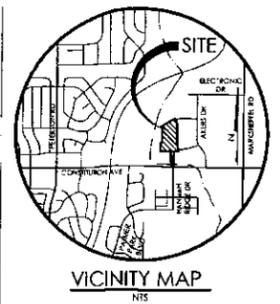


ORIFACE PLATE DETAIL  
SCALE: 1" = 2'



MODIFIED TYPE I MANHOLE  
SCALE: 1" = 2'-0"

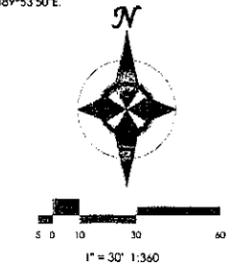
NOTE: REFERENCE SPC TYPE I MANHOLE STANDARDS FOR ALL OTHER INFORMATION



VICINITY MAP  
NTS

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).

BASIS OF BEARINGS  
BEARING REFERRED TO HEREIN ARE BASED ON THE SOUTH LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 32, TOWNSHIP 13 SOUTH, RANGE 65 WEST OF THE 6TH P.M. ASSUMED TO BEAR N89°53'50"E.



**MVE, INC.**  
ENGINEERS & SURVEYORS  
**MVE**  
1903 Sidney Street, Suite 200, Cedar Rapids, IA 52403  
Phone: 319.244.8000 Fax: 319.244.8001

REVISIONS

DESIGNED BY DRG  
DRAWN BY JW  
CHECKED BY  
AS-BUILTS BY  
CHECKED BY

Hannah Ridge  
at Feathergrass

STORM WATER  
QUALITY BASIN 'D'  
PLAN & DETAILS

MVE PROJECT **60970**  
MVE DRAWING 60970106-F2

**AUGUST 24, 2015**  
SHEET 37 OF

BOX CULVERT CENTERLINE DATA:  
 STA=0+00.00  
 N: 10819.64  
 E: 6109.02  
 S 84°24'54" E, 100.00'

STA=1+00.00  
 N: 10809.91  
 E: 6208.54  
 S 84°24'54" E, 140.00'

STA=2+40.00  
 N: 10796.29  
 E: 6347.88  
 S 84°24'54" E, 100.00'

STA=3+40.00  
 N: 10786.56  
 E: 6447.40

**LOAD DATA**

LIVE LOAD = AASHTO LRFD HL 93 TRUCK, HL 93 (AND/OR COLORADO PERMIT TRUCK)  
 DEAD LOAD CASE 1: VERTICAL EARTH LOAD = 120 LBS./C.F. FT. HORIZONTAL EARTH LOAD = 30 LBS./C.F. FT.  
 DEAD LOAD CASE 2: VERTICAL EARTH LOAD = 20 LBS./C.F. FT. HORIZONTAL EARTH LOAD = 60 LBS./C.F. FT.  
 FUTURE HMA OVERLAY = 48 LBS./SQ. FT. BASED ON 4 IN THICKNESS  
 LIVE LOAD SURCHARGE ON EXTERIOR WALLS = 2' OF EARTH

**GENERAL NOTES**

1. ALL CONCRETE SHALL BE CLASS D (BOX CULVERT).
2. CONSTRUCTION JOINTS ARE NOT SHOWN ON THESE PLANS. CONTRACTOR SHALL PROVIDE A PLAN SHOWING LOCATION OF CONTRACTOR'S PROPOSED CONSTRUCTION JOINTS FOR STAGED CONSTRUCTION PRIOR TO THE BEGINNING OF ANY BOX CULVERT FORMING. THE CONSTRUCTION JOINT DETAIL FOR STAGED CONSTRUCTION SHALL BE AS SHOWN IN SECTION C-C AS DEPICTED ON THESE PLANS.
3. ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE FRESH CONCRETE IS PLACED.
4. THE CONTRACTOR SHALL MAINTAIN THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH CDOT STANDARD M-204.
5. BACKFILL SHALL NOT BEGIN UNTIL TOP SLAB HAS REACHED DESIGN STRENGTH = F<sub>c</sub>.
6. REINFORCING STEEL SHALL BE GRADE 40 UNCOATED.
7. ALL DIMENSIONS ARE PERPENDICULAR TO THE CENTERLINE OF THE BOX.
8. ALL TRANSVERSE REINFORCING SHALL BE NORMAL TO THE CENTERLINE OF THE BOX.
9. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 1/4 IN.
10. STANDARD PLANS REFERENCED ARE COLORADO DEPARTMENT OF TRANSPORTATION (AS STANDARD PLANS, THEY ARE M-204-1, M-40-1, M-44-2, AND M-501-20, DATED 7/4/2012).
11. WINGWALL FOOTINGS AND FLOOR OF BOX CULVERT SHALL BE PLACED MONOLITHICALLY.
12. WINGWALL AND APRON CONCRETE SHALL BE CONCRETE CLASS B, OR D (BOX CULVERT) FOR CBC'S.
13. AN ALTERNATE "REGAS" CONCRETE BOX CULVERT MAY BE USED FOR THIS PROJECT IN ACCORDANCE WITH STANDARD PLAN NO. M-603-3 DATED JULY 04, 2012. (APPROPRIATE BEHIND FORMED AND CONSTRUCTED ON SITE).

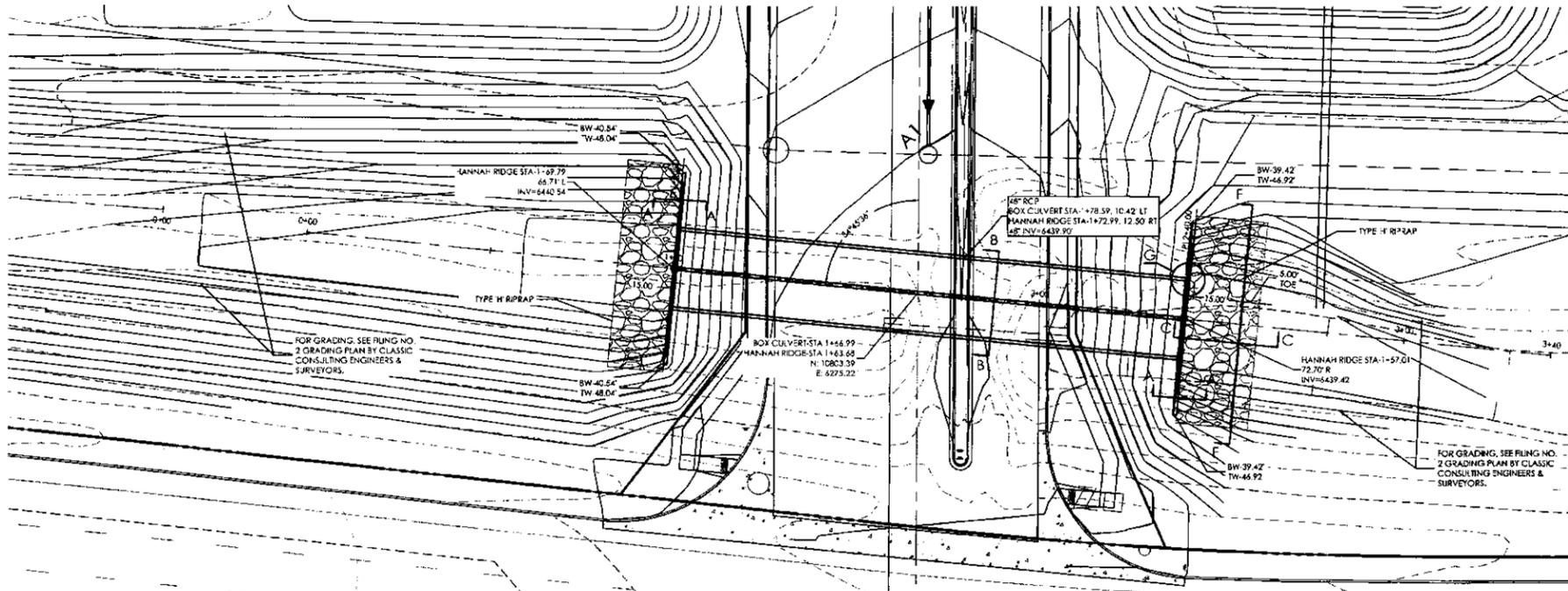
**DESIGN DATA**

WING WALLS:  
 UNIT STRESS: f<sub>c</sub> = 24,000 PSI  
 f<sub>t</sub> = 1,200 PSI  
 N = 9  
 EQUIVALENT FLUID PRESSURE = 34 LBS./C.F. FT.  
 MAXIMUM TOE PRESSURE = 1 TONS/CSQ. FT.  
 BOX CULVERT:  
 AASHTO LRFD, 6TH ED (2012)  
 UNIT STRESS: f<sub>c</sub> = 40,300 PSI  
 f<sub>t</sub> = 4,500 PSI



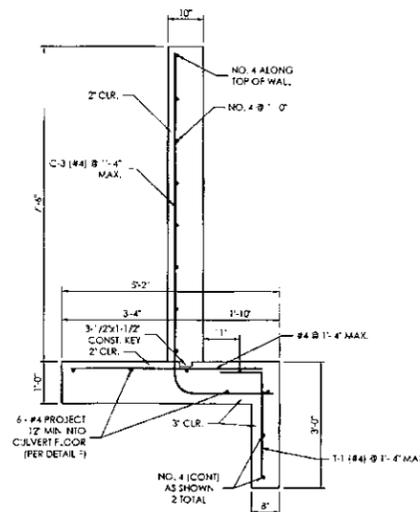
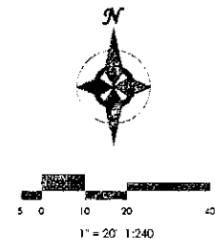
**VICINITY MAP**

BENCHMARK



**DOUBLE 6' X 10' BOX CULVERT PLAN**

SCALE 1" = 20'-0"



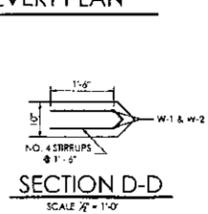
**SECTION A-A**

SCALE 1/2" = 1'-0"



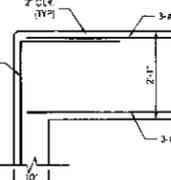
**STORM DRAIN TO CBC CONNECTION DETAIL**

NOT TO SCALE



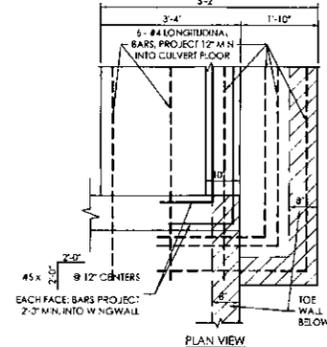
**SECTION D-D**

SCALE 1/2" = 1'-0"



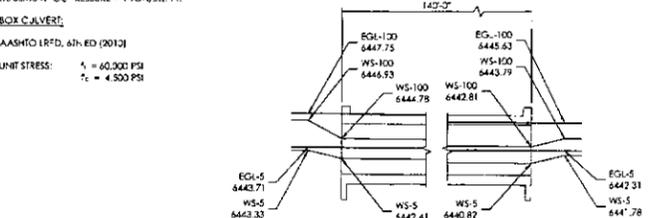
**SECTION E-E**

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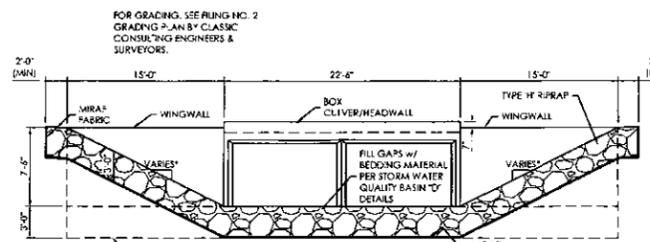
**DETAIL G**

SCALE 1/2" = 1'-0"



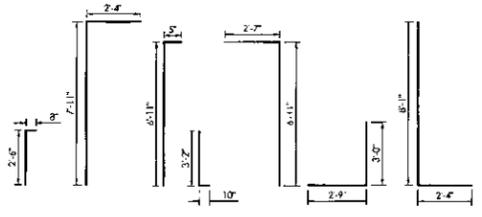
**HYDRAULIC PROFILE**

SCALE: NOT TO SCALE



**SECTION F-F**

SCALE 1/2" = 1'-0"

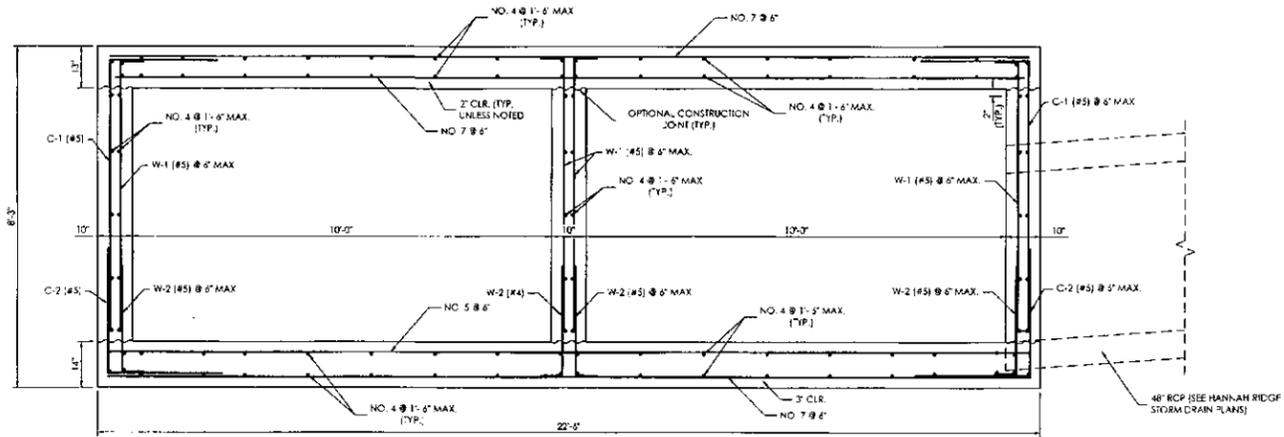


**L BAR DETAIL**

SCALE: NOT TO SCALE

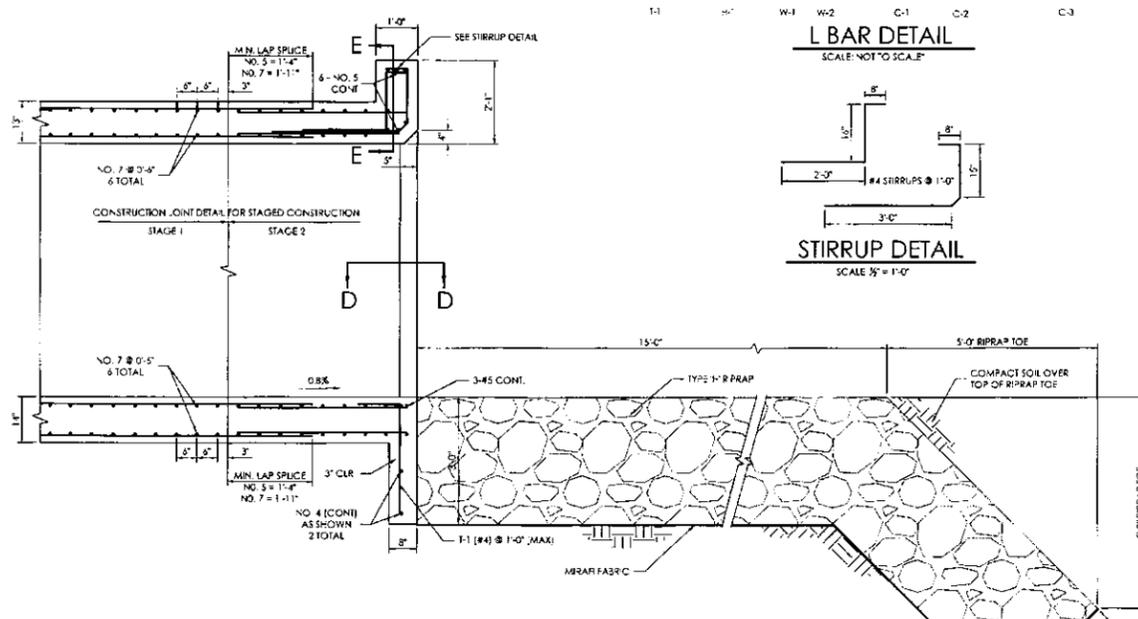
**STIRRUP DETAIL**

SCALE 3/8" = 1'-0"



**SECTION B-B**

SCALE 1/2" = 1'-0"



**SECTION C-C**

SCALE 1/2" = 1'-0"

**REVISIONS**

DESIGNED BY TJW  
 DRAWN BY TJW  
 CHECKED BY \_\_\_\_\_  
 AS-BUILT BY \_\_\_\_\_  
 CHECKED BY \_\_\_\_\_

**Hannah Ridge at Feathergrass  
 HANNAH RIDGE  
 BOX CULVERT DETAILS**

MVE PROJECT 60970  
 MVE DRAWING 60970067-F2

SEPTEMBER 21, 2015  
 SHEET 32



BOX CULVERT  
CENTERLINE DATA:  
STA: 9+00.00  
N: 10819.64'  
E: 6109.02'

S 84°24'54"E, 100.00'

STA: 1+00.00  
N: 10809.71'  
E: 6208.54'

S 84°24'54"E, 140.00'

STA: 2+40.00  
N: 10796.29'  
E: 6347.88'

S 84°24'54"E, 100.00'

STA: 3+40.00  
N: 10786.56'  
E: 6447.40'

**LOAD DATA**

IVE LOAD = AASHTO LRFD HL-93 TRUCK, HL-93  
TANDEN, COLORADO PERMIT TRK  
DEAD LOAD CASE 1: VERTICAL EARTH LOAD =  
120 LBS./CU. FT.  
HORIZONTAL EARTH LOAD =  
30:35:35 J.C.J. FT.  
DEAD LOAD CASE 2: VERTICAL EARTH LOAD =  
20:35:35 J.C.J. FT.  
HORIZONTAL EARTH LOAD =  
60:35:35 J.C.J. FT.

FUTURE HMA OVERLAY =  
48 LBS./SQ. FT. BASED ON 4 IN. THICKNESS  
LIVE LOAD SURCHARGE ON EXTERIOR WALLS =  
2 FT. OF EARTH

**DESIGN DATA**

UNIT STRESS:  $f_c = 24,000$  PSI  
 $f_s = 1,200$  PSI  
 $n = 9$   
EQUIVALENT FLUID PRESSURE = 34 LBS./CU. FT.  
MAXIMUM FLOOD PRESSURE = 1 TO 1.50 SQ. FT.

BOX CULVERT:  
AASHTO LRFD, 6TH ED (2010)  
UNIT STRESS:  $f_c = 60,000$  PSI  
 $f_s = 4,500$  PSI

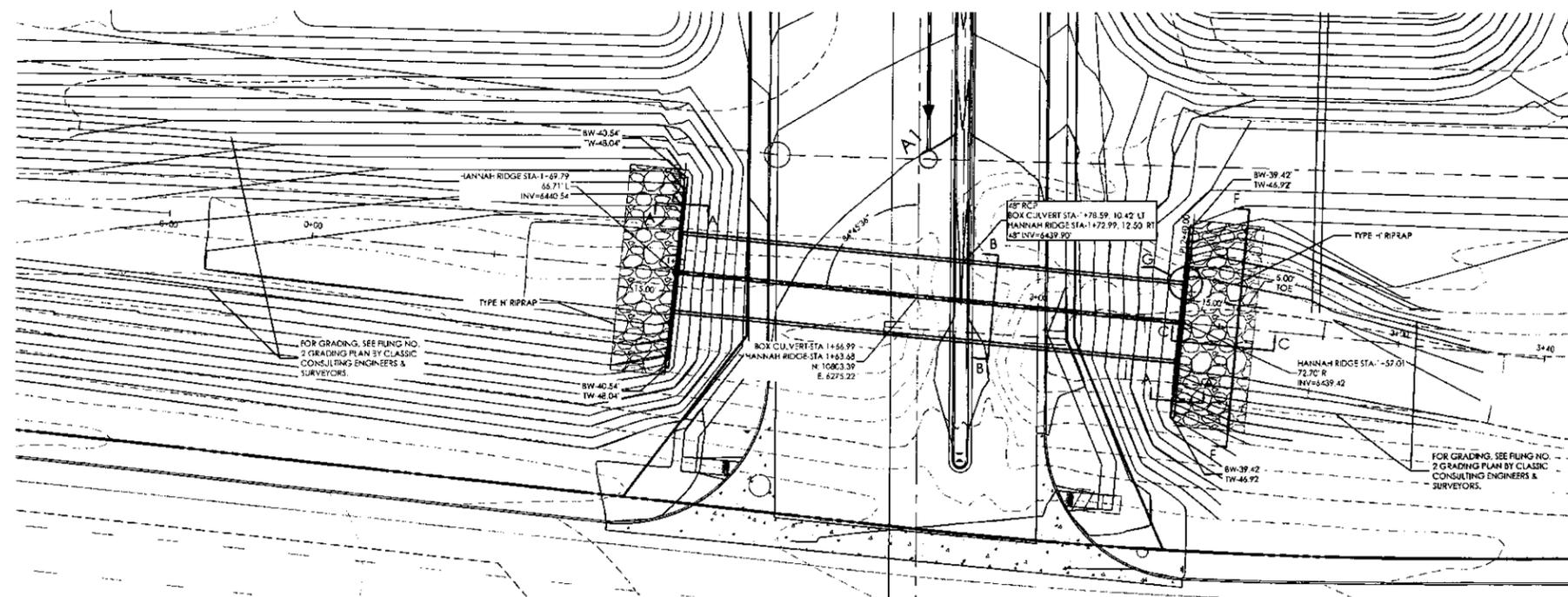
**GENERAL NOTES**

- ALL CONCRETE SHALL BE CLASS B (BOX CULVERT).
- CONSTRUCTION JOINTS ARE NOT SHOWN ON THE PLANS. CONTRACTOR SHALL PROVIDE A PLAN IDENTIFYING LOCATION OF CONTRACTOR'S PROPOSED CONSTRUCTION JOINTS FOR STAGED CONSTRUCTION PRIOR TO THE BEGINNING OF ANY BOX CULVERT FORMING. THE CONSTRUCTION JOINT DETAIL FOR STAGED CONSTRUCTION SHALL BE AS SHOWN IN SECTION C-C AS DEPICTED ON THESE PLANS.
- ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE FRESH CONCRETE IS PLACED.
- THE CONTRACTOR SHALL MAINTAIN THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH CDOT STANDARD METHOD.
- BACKFILL SHALL NOT BEGIN UNTIL TOP SLAB HAS REACHED DESIGN STRENGTH =  $f_c$ .
- REINFORCING STEEL SHALL BE GRADE 60 UNCOATED.
- A... DIMENSIONS ARE PERPENDICULAR TO THE CENTERLINE OF THE BOX.
- A... TRANSVERSE REINFORCING SHALL BE NORMAL TO THE CENTERLINE OF THE BOX.
- A... EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 1/4 IN.
- STANDARD PLANS REFERENCED ARE COLORADO DEPARTMENT OF TRANSPORTATION STANDARD PLANS. THEY ARE M-206-1, M-60-1, M-60-2, AND M-601-20, DATED 7/4/2012.
- WINGWALL FOOTINGS AND FLOOR OF BOX CULVERT SHALL BE PLACED MONOCHROMATIC CONCRETE CLASS B OR D (BOX CULVERT) FOR CBC'S.
- AN ALTERNATE PRECAST CONCRETE BOX CULVERT MAY BE USED FOR THIS PROJECT IN ACCORDANCE WITH STANDARD PLAN NO. M-603-3 DATED JULY 04, 2012. TAPER SHALL BE HAND FORMED AND CONSTRUCTED ON SITE.

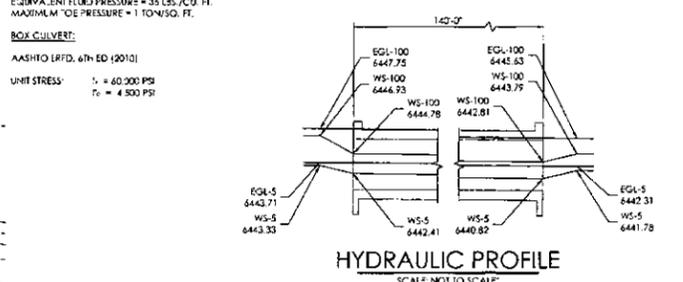


VICINITY MAP

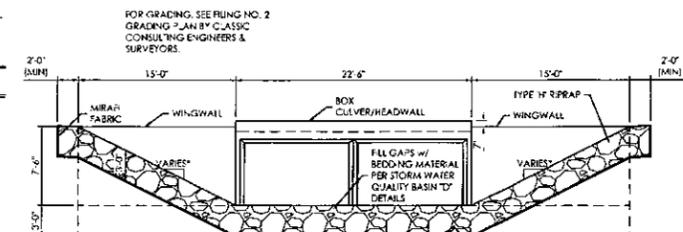
BENCHMARK



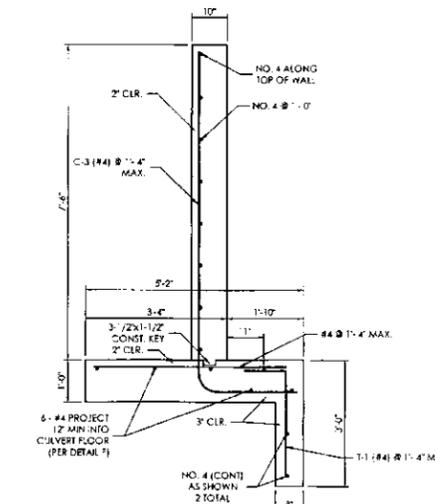
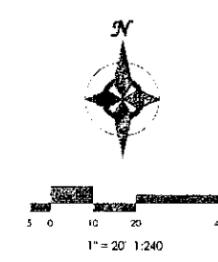
DOUBLE 6' X 10' BOX CULVERT PLAN  
SCALE: 1" = 20'-0"



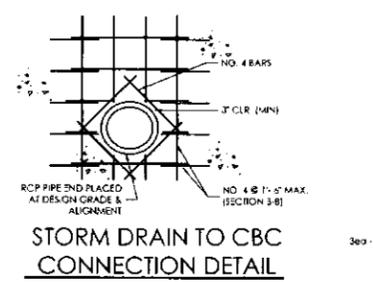
HYDRAULIC PROFILE  
SCALE: NOT TO SCALE



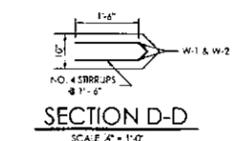
SECTION F-F  
SCALE: 1/2" = 1'-0"



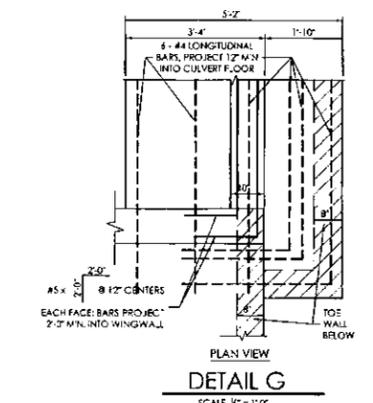
SECTION A-A  
SCALE: 1/2" = 1'-0"



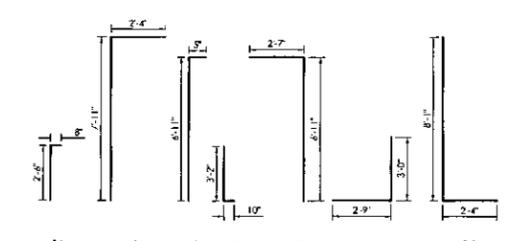
STORM DRAIN TO CBC CONNECTION DETAIL  
NOT TO SCALE



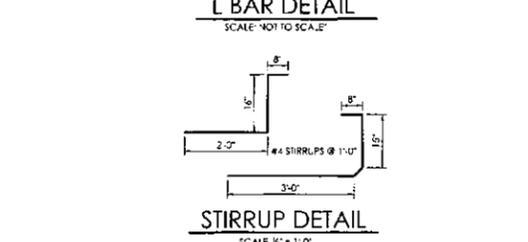
SECTION D-D  
SCALE: 1/2" = 1'-0"



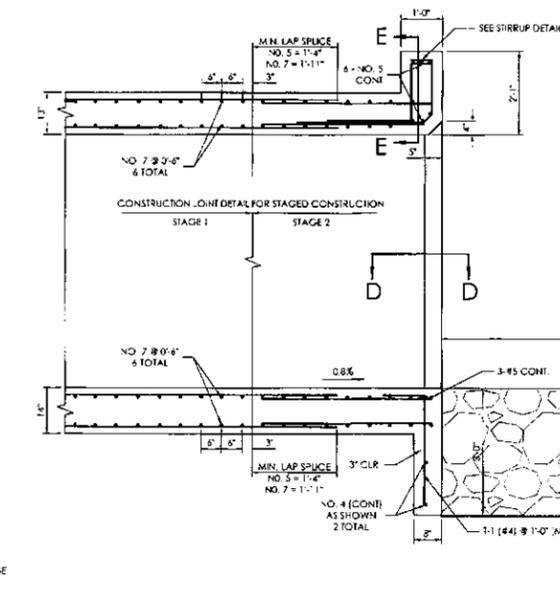
DETAIL G  
SCALE: 1/2" = 1'-0"



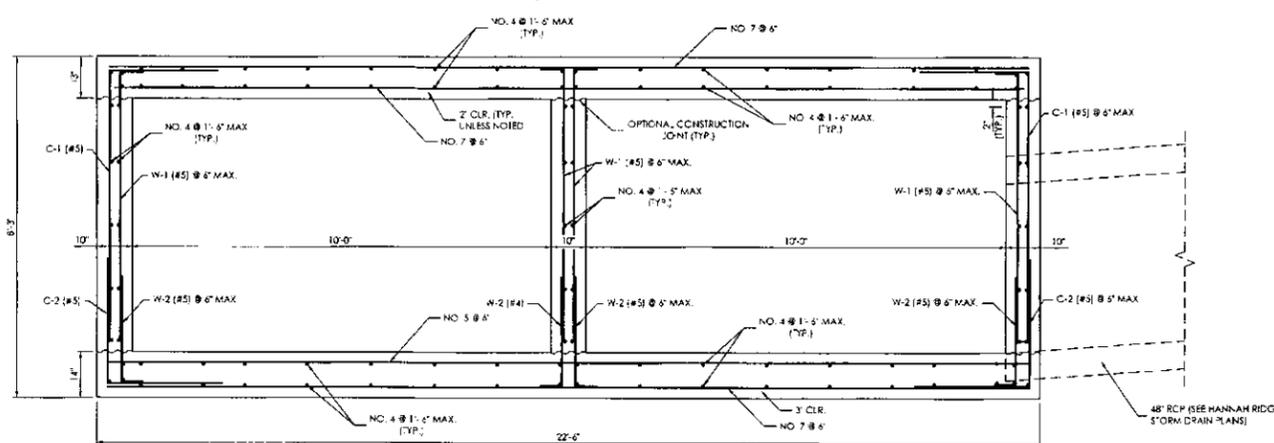
L BAR DETAIL  
SCALE: NOT TO SCALE



STIRRUP DETAIL  
SCALE: 1/2" = 1'-0"



SECTION C-C  
SCALE: 1/2" = 1'-0"



SECTION B-B  
SCALE: 1/2" = 1'-0"

REVISIONS

DESIGNED BY TJW  
DRAWN BY TJW  
CHECKED BY \_\_\_\_\_  
AS-BUILT BY \_\_\_\_\_  
CHECKED BY \_\_\_\_\_

Hannah Ridge  
at Feathergrass  
HANNAH RIDGE  
BOX CULVERT DETAILS

MVE PROJECT 60970  
MVE DRAWING 60970067-F2

SEPTEMBER 21, 2015  
SHEET 32



1000 Library Street, Suite 500, CO Springs, CO 80909 719.635.5736

## HYDROLOGIC / HYDRAULIC CALCULATIONS

Provide DCM Table 6-6



JOB NAME: Madison Collection at Hannah Ridge Piling No. 3  
 JOB NUMBER: 1116.35  
 DATE: 08/20/20  
 CALCULATED BY: KRC

**FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY (PROPOSED CONDITIONS)**

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(5)	CA(100)					
A	0.76	0.48	0.89	0.90	0.92	0.94	0.96	0.96	0.28	0.04	0.15	0.25	0.37	0.44	0.5	0.58	0.62	0.79	0.47	0.60					
B	1.97	1.03	0.89	0.90	0.92	0.94	0.96	0.96	0.94	0.04	0.15	0.25	0.37	0.44	0.5	0.48	0.54	0.74	1.07	1.46					
C	0.61	0.41	0.89	0.90	0.92	0.94	0.96	0.96	0.20	0.04	0.15	0.25	0.37	0.44	0.5	0.61	0.65	0.81	0.40	0.49					
D	1.20	0.79	0.89	0.90	0.92	0.94	0.96	0.96	0.41	0.04	0.15	0.25	0.37	0.44	0.5	0.60	0.64	0.80	0.77	0.96					
E	0.89	0.41	0.89	0.90	0.92	0.94	0.96	0.96	0.48	0.04	0.15	0.25	0.37	0.44	0.5	0.43	0.50	0.71	0.44	0.63					
F	0.88	0.07	0.89	0.90	0.92	0.94	0.96	0.96	0.82	0.04	0.15	0.25	0.37	0.44	0.5	0.11	0.21	0.34	0.19	0.48					
G	1.46	0.00	0.89	0.90	0.92	0.94	0.96	0.96	1.46	0.04	0.15	0.25	0.37	0.44	0.5	0.04	0.15	0.50	0.22	0.73					
H	0.40	0.00	0.89	0.90	0.92	0.94	0.96	0.96	0.40	0.04	0.15	0.25	0.37	0.44	0.5	0.04	0.15	0.50	0.06	0.20					

JOB NAME: **Midwon Collection at Hannah Ridge Filing No. 3**

JOB NUMBER: **11116.35**

DATE: **08/20/20**

CALC'D BY: **KRC**

**BASIN RUNOFF SUMMARY (PROPOSED CONDITIONS)**

BASIN	WEIGHTED		OVERLAND		STREET / CHANNEL FLOW			Tc		INTENSITY		TOTAL FLOWS				
	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
A	0.44	0.47	0.60	0.15	80	3	9.9	150	4.0%	7.0	0.4	10.3	4.09	6.86	1.9	4.1
B	0.95	1.07	1.46	0.15	200	5	17.9	0	0.0%	0.0	0.0	17.9	3.25	5.46	3.5	8.0
C	0.37	0.40	0.49	0.15	45	0.9	9.2	92	1.5%	4.3	0.4	9.5	4.20	7.06	1.7	3.5
D	0.72	0.77	0.96	0.15	50	1	9.6	290	3.0%	6.1	0.8	10.4	4.06	6.82	3.1	6.6
E	0.38	0.44	0.63	0.15	240	8	17.9	0	0.0%	0.0	0.0	17.9	3.26	5.47	1.4	3.5
F	0.10	0.19	0.48	0.15	50	1	9.6	0	0.0%	0.0	0.0	9.6	4.18	7.02	0.8	3.4
G	0.06	0.22	0.73	0.15	50	1	9.6	0	0.0%	0.0	0.0	9.6	4.18	7.02	0.9	5.1
H	0.02	0.06	0.20	0.15	95	3	11.4	0	0.0%	0.0	0.0	11.4	3.93	6.59	0.2	1.3

JOB NAME: *Midvon Collection at Hannah Ridge Filing No. 3*

JOB NUMBER: *1116.35*

DATE: *08/20/20*

CALCULATED BY: *KRC*

**SURFACE ROUTING SUMMARY (PROPOSED CONDITIONS)**

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size/Conveyance
					I(5)	I(100)	Q(5)	Q(100)	
1	BASIN A	0.47	0.60	10.3	4.08	6.86	1.9	4.1	Street flow south to DP #2
2	BASIN A and B	1.54	2.06	17.9	3.26	5.47	5.0	11.3	Proposed 10' type R public inlet
3	BASIN D and E	1.21	1.59	17.9	3.26	5.47	3.9	8.7	Proposed 5' type R public inlet
4	BASIN C	0.40	0.49	9.5	4.21	7.06	1.7	3.5	Proposed 5' type R public inlet
5	DP #4 and Off-site	7.83	9.18	12.1	3.84	6.45	30.1	59.2	Outfall into pond
6	Pond Outlet								Pond Discharge
7	DP #2 and #4	1.94	2.55	17.9	3.26	5.47	6.3	13.9	East discharge into pond

**\* OFF-SITE FLOW SUMMARY  
FROM MVE FILING NO.1 REPORT**

Basin Label	Channel Type or Basin	Cont. Area A <sub>c</sub> (Ac)	5 Year Coef. C <sub>s</sub>	100 Yr Coef. or Curve No. C <sub>100</sub> or CN	Manning Rough. n	Length L (ft)	Elev Change (ft)	Average Slope S	Channel Flow Q (cfs)	Flow Depth d (ft)	Flow Area A (ft <sup>2</sup> )	Flow Velocity v (ft/s)	Time of Cont. T <sub>c</sub> (min)	Total Time T <sub>0</sub> (min)	5 Year Intensity I <sub>5</sub> (in/hr)	100 Year Intensity I <sub>100</sub> (in/hr)	5 Year Discharge Q <sub>5</sub> (cfs)	100 Year Discharge Q <sub>100</sub> (cfs)
D1+D2+D3+D4	3	5.7	0.61	0.71	0.016	140	0	0.250	31.76	0.33	2.39	13.31	0.0	10.0	4.09	7.00	14.3	28.3
D5	0	0.7	0.57	0.66	0.016	310	13	0.040	3.87	0.22	0.97	3.98	7.2	6.5	4.36	7.46	1.9	3.6
D1+D2+D3+D4+D5	3	5.7	0.61	0.71	0.016	140	0	0.250	31.76	0.33	2.39	13.31	0.0	10.0	4.09	7.00	14.3	28.3
D6	0	1.3	0.80	0.70	0.016	60	0	0.013	35.58	0.34	2.60	13.69	6.6	6.6	4.09	7.00	16.0	31.7
D7	0	1.3	0.80	0.70	0.016	60	0	0.013	35.58	0.34	2.60	13.69	6.6	6.6	4.09	7.00	16.0	31.7
D8	0	1.3	0.80	0.70	0.016	60	0	0.013	35.58	0.34	2.60	13.69	6.6	6.6	4.09	7.00	16.0	31.7
D1+D2+D3+D4+D5+D6	3	6.5	0.60	0.70	0.016	210	4	0.020	7.52	0.31	2.07	3.63	1.0	9.5	4.18	7.15	3.3	6.6
D1+D2+D3+D4+D5+D6+D7	3	7.8	0.60	0.70	0.016	35	1	0.040	42.78	0.51	5.94	7.20	0.1	10.0	4.08	6.97	19.2	38.0
D7	0	4.0	0.80	0.70	0.016	140	2	0.015	19.58	0.38	3.32	5.90	9.7	10.0	3.77	6.43	8.9	17.8
D7	0	4.0	0.80	0.70	0.016	140	2	0.015	19.58	0.38	3.32	5.90	9.7	10.0	3.77	6.43	8.9	17.8
D1+D2+D3+D4+D5+D6+D7	3	4.0	0.80	0.70	0.016	270	4	0.015	4.28	0.23	1.12	3.83	2.5	8.2	4.42	7.58	26.6	52.8
D7	0	11.7	0.60	0.70	0.016	300	11	0.036	46.67	0.53	6.60	7.07	10.0	10.7	3.87	6.78	20.3	40.3
D8	0	12.5	0.59	0.69	0.016	300	7	0.020	2.33	0.21	0.87	2.68	12.1	12.1	3.77	6.43	29.2	56.0
D8	0	3.1	0.60	0.70	0.016	120	0	0.250	61.69	0.42	3.53	15.69	10.2	10.2	3.77	6.43	29.2	56.0
D8	0	3.1	0.60	0.70	0.016	120	0	0.250	61.69	0.42	3.53	15.69	10.2	10.2	3.77	6.43	29.2	56.0
D8	0	3.1	0.60	0.70	0.016	120	0	0.250	61.69	0.42	3.53	15.69	10.2	10.2	3.77	6.43	29.2	56.0
D10	0	0.4	0.60	0.70	0.016	30	0	0.015	3.43	0.25	1.30	2.64	4.2	12.8	3.68	6.28	6.8	13.4
D8+D10	3	3.1	0.60	0.70	0.016	150	0	0.015	16.61	0.26	1.47	11.33	10.7	10.7	4.85	8.35	1.1	2.2
D8+D10	3	3.4	0.60	0.70	0.016	150	0	0.015	16.61	0.26	1.47	11.33	10.7	10.7	4.85	8.35	1.1	2.2
D11	0	1.3	0.38	0.47	0.016	210	4	0.019	3.43	0.25	1.30	2.64	15.9	15.9	3.68	6.28	7.6	15.1
D11	0	1.3	0.38	0.47	0.016	210	4	0.019	3.43	0.25	1.30	2.64	15.9	15.9	3.68	6.28	7.6	15.1
D1+D2+D3+D4+D5+D6+D7+D8+D9+D10+D11	3	8.6	0.58	0.68	0.016	95	1	0.015	51.42	0.64	9.77	5.27	12.1	12.1	3.90	6.87	21.9	43.7
D1+D2+D3+D4+D5+D6+D7+D8+D9+D10+D11	3	9.8	0.56	0.66	0.016	130	2	0.015	65.98	0.71	11.89	5.55	12.1	12.1	3.71	6.33	29.6	59.0
D1+D2+D3+D4+D5+D6+D7+D8+D9+D10+D11	3	13.9	0.57	0.67	0.016	140	2	0.015	85.98	0.71	11.89	5.55	12.1	12.1	3.90	6.87	21.9	43.7
D12	0	0.5	0.65	0.72	0.016	85	3	0.035	3.33	0.24	1.25	2.67	5.1	5.1	4.93	8.50	1.7	3.2
D12	0	0.5	0.65	0.72	0.016	85	3	0.035	3.33	0.24	1.25	2.67	5.1	5.1	4.93	8.50	1.7	3.2
D8+D10+D12	3	3.4	0.60	0.70	0.016	130	2	0.015	19.19	0.45	4.66	4.12	12.8	12.8	3.61	6.16	8.7	17.1
D8+D10+D12	3	4.0	0.81	0.70	0.016	130	2	0.015	19.19	0.45	4.66	4.12	12.8	12.8	3.61	6.16	8.7	17.1
E1	0	1.2	0.80	0.70	0.016	65	1	0.015	7.08	0.31	2.08	3.40	6.5	6.5	4.16	7.12	3.1	6.1
E1	0	1.2	0.80	0.70	0.016	65	1	0.015	7.08	0.31	2.08	3.40	6.5	6.5	4.16	7.12	3.1	6.1
E2	0	2.8	0.90	0.70	0.016	130	3	0.020	14.63	0.39	3.47	4.22	2.3	10.8	3.96	6.77	6.7	13.3
E2	0	2.8	0.90	0.70	0.016	130	3	0.020	14.63	0.39	3.47	4.22	2.3	10.8	3.96	6.77	6.7	13.3
E1+E2	3	4.0	0.60	0.70	0.016	580	11	0.020	21.06	0.29	1.75	12.02	10.8	10.8	3.96	6.77	9.6	19.1
E1+E2	3	4.0	0.60	0.70	0.016	580	11	0.020	21.06	0.29	1.75	12.02	10.8	10.8	3.96	6.77	9.6	19.1
E3	0	1.0	0.60	0.70	0.016	60	1	0.015	5.64	0.28	1.88	3.37	6.3	6.3	4.28	7.33	2.5	5.0
E3	0	1.0	0.60	0.70	0.016	60	1	0.015	5.64	0.28	1.88	3.37	6.3	6.3	4.28	7.33	2.5	5.0
E1+E2+E3	3	4.0	0.60	0.70	0.016	515	10	0.020	26.13	0.31	2.06	12.68	10.8	10.8	3.96	6.77	11.9	23.7
E1+E2+E3	3	4.0	0.60	0.70	0.016	515	10	0.020	26.13	0.31	2.06	12.68	10.8	10.8	3.96	6.77	11.9	23.7
E4	0	2.7	0.60	0.70	0.016	125	3	0.020	14.43	0.38	3.24	4.45	8.3	8.3	4.06	6.93	6.7	13.3
E4	0	2.7	0.60	0.70	0.016	125	3	0.020	14.43	0.38	3.24	4.45	8.3	8.3	4.06	6.93	6.7	13.3
E1+E2+E3+E4	3	5.0	0.60	0.70	0.016	500	11	0.023	40.45	0.54	6.75	5.98	10.8	10.8	4.06	6.93	17.8	35.5
E1+E2+E3+E4	3	5.0	0.60	0.70	0.016	500	11	0.023	40.45	0.54	6.75	5.98	10.8	10.8	4.06	6.93	17.8	35.5
E5	0	7.7	0.60	0.70	0.016	295	8	0.025	5.24	0.27	1.50	3.50	2.2	8.5	4.35	7.45	2.3	4.7
E5	0	7.7	0.60	0.70	0.016	295	8	0.025	5.24	0.27	1.50	3.50	2.2	8.5	4.35	7.45	2.3	4.7
E1+E2+E3+E4+E5	3	9.9	0.60	0.70	0.016	60	1	0.015	45.16	0.37	3.11	14.52	11.6	11.6	3.84	6.56	18.9	39.7
E1+E2+E3+E4+E5	3	9.9	0.60	0.70	0.016	60	1	0.015	45.16	0.37	3.11	14.52	11.6	11.6	3.84	6.56	18.9	39.7
E6	0	1.8	0.60	0.70	0.016	105	3	0.029	10.23	0.36	2.96	3.45	6.8	6.8	4.16	7.12	4.5	9.0
E6	0	1.8	0.60	0.70	0.016	105	3	0.029	10.23	0.36	2.96	3.45	6.8	6.8	4.16	7.12	4.5	9.0
E7	0	2.3	0.43	0.61	0.016	575	8	0.015	10.23	0.36	2.96	3.45	14.1	14.1	3.33	5.69	3.3	8.1
E7	0	2.3	0.43	0.61	0.016	575	8	0.015	10.23	0.36	2.96	3.45	14.1	14.1	3.33	5.69	3.3	8.1
E4+E5	3	2.7	0.60	0.70	0.016	365	7	0.019	19.17	0.28	1.63	11.74	10.2	10.2	4.06	6.93	8.9	17.7
E4+E5	3	2.7	0.60	0.70	0.016	365	7	0.019	19.17	0.28	1.63	11.74	10.2	10.2	4.06	6.93	8.9	17.7
E4+E5+E7	3	3.6	0.60	0.70	0.016	0	0	0.250	29.94	0.49	5.42	5.52	10.2	10.2	4.01	6.85	12.8	27.2
E4+E5+E7	3	3.6	0.60	0.70	0.016	0	0	0.250	29.94	0.49	5.42	5.52	10.2	10.2	4.01	6.85	12.8	27.2
E1+E2+E3+E4+E5+E7	3	8.6	0.60	0.70	0.016	100	3	0.025	55.85	0.72	12.21	4.57	11.6	11.6	3.79	6.47	23.4	48.4
E1+E2+E3+E4+E5+E7	3	8.6	0.60	0.70	0.016	100	3	0.025	55.85	0.72	12.21	4.57	11.6	11.6	3.79	6.47	23.4	48.4
E1+E2+E3+E4+E5+E7	3	11.0	0.58	0.68	0.016	100	1	0.010	11.0	0.4	12.21	4.57	0.4	0.4	3.79	6.47	23.4	48.4



JOB NAME: Midwon Collection at Hannah Ridge Filing No. 3

JOB NUMBER: 1116.35

DATE: 08/20/20

CALCULATED BY: MAL

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

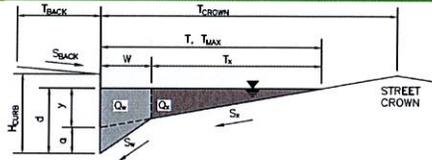
**FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY**

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
1	DP 2	1.54	2.06	17.9	3.26	5.47	5.0	11.3	24" public
2	DP 4	0.40	0.49	9.5	4.21	7.06	1.7	3.5	18" priv.
3	DP 2 and 4	1.94	2.55	17.9	3.26	5.47	6.3	13.9	24" public
4	DP 3	1.21	1.59	17.9	3.26	5.47	3.9	8.7	18" priv.

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

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

Project: Midtown Collection at Hannah Ridge Filing No. 3  
 Inlet ID: 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)

$T_{BACK} = 10.0$  ft  
 $S_{BACK} = 0.020$  ft/ft  
 $n_{BACK} = 0.016$

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$H_{CURB} = 6.00$  inches  
 $T_{CROWN} = 36.0$  ft  
 $W = 1.00$  ft  
 $S_X = 0.040$  ft/ft  
 $S_G = 0.083$  ft/ft  
 $S_L = 0.000$  ft/ft  
 $n_{STREET} = 0.018$

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	
$T_{MAX} =$	15.0	36.0	ft
$d_{MAX} =$	6.0	7.7	inches
	<input type="checkbox"/>	<input type="checkbox"/>	

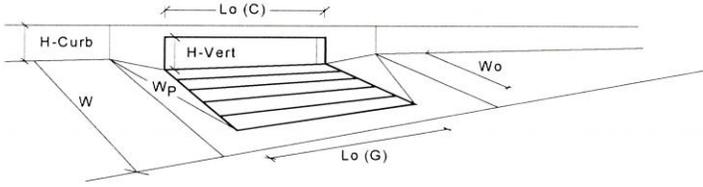
MINOR STORM Allowable Capacity is based on Depth Criterion  
 MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{ALLOW} =$ 

Minor Storm	Major Storm	
SUMP	SUMP	cfs

## INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017

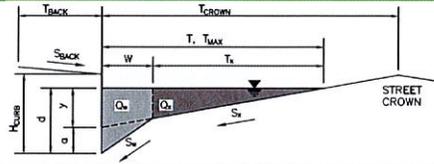


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1		
Water Depth at Flowline (outside of local depression)	6.0	7.7	inches
<b>Grate Information</b>	MINOR	MAJOR	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	
<b>Curb Opening Information</b>	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)	1.00	1.00	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	
<b>Low Head Performance Reduction (Calculated)</b>	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.42	0.56	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.57	0.73	
Curb Opening Performance Reduction Factor for Long Inlets	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	10.0	16.6	cfs
Q PEAK REQUIRED	5.0	11.3	cfs

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

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

Project: Midtown Collection at Hannah Ridge Filing No. 3  
 Inlet ID: DP #3

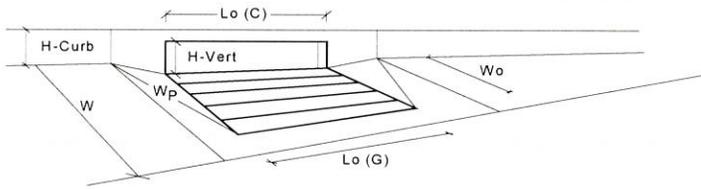


**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb	$T_{BACK} =$ <input type="text" value="0.0"/> ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} =$ <input type="text" value="0.020"/> ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} =$ <input type="text" value="0.016"/>				
Height of Curb at Gutter Flow Line	$H_{CURB} =$ <input type="text" value="6.00"/> inches				
Distance from Curb Face to Street Crown	$T_{CROWN} =$ <input type="text" value="24.0"/> ft				
Gutter Width	$W =$ <input type="text" value="1.00"/> ft				
Street Transverse Slope	$S_x =$ <input type="text" value="0.020"/> ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_y =$ <input type="text" value="0.083"/> ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_D =$ <input type="text" value="0.000"/> ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} =$ <input type="text" value="0.018"/>				
Max. Allowable Spread for Minor & Major Storm	$T_{MAX} =$ <table border="1" style="display: inline-table;"><tr><td>Minor Storm</td><td>Major Storm</td></tr><tr><td><input type="text" value="24.0"/></td><td><input type="text" value="24.0"/></td></tr></table> ft	Minor Storm	Major Storm	<input type="text" value="24.0"/>	<input type="text" value="24.0"/>
Minor Storm	Major Storm				
<input type="text" value="24.0"/>	<input type="text" value="24.0"/>				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX} =$ <table border="1" style="display: inline-table;"><tr><td>Minor Storm</td><td>Major Storm</td></tr><tr><td><input type="text" value="6.0"/></td><td><input type="text" value="6.0"/></td></tr></table> inches	Minor Storm	Major Storm	<input type="text" value="6.0"/>	<input type="text" value="6.0"/>
Minor Storm	Major Storm				
<input type="text" value="6.0"/>	<input type="text" value="6.0"/>				
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;"><tr><td>Minor Storm</td><td>Major Storm</td></tr><tr><td><input type="text" value="SUMP"/></td><td><input type="text" value="SUMP"/></td></tr></table> cfs	Minor Storm	Major Storm	<input type="text" value="SUMP"/>	<input type="text" value="SUMP"/>
Minor Storm	Major Storm				
<input type="text" value="SUMP"/>	<input type="text" value="SUMP"/>				

## INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



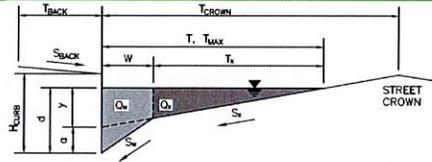
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	6.0	inches
<b>Grate Information</b>	MINOR	MAJOR	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	
<b>Curb Opening Information</b>	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)	1.00	1.00	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	
<b>Low Head Performance Reduction (Calculated)</b>	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.42	0.42	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	MINOR	MAJOR	
<b>Inlet Capacity IS GOOD for Minor and Major Storms(&gt;Q PEAK)</b>	10.0	10.0	cfs
Q <sub>PEAK</sub> REQUIRED =	3.9	8.7	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:

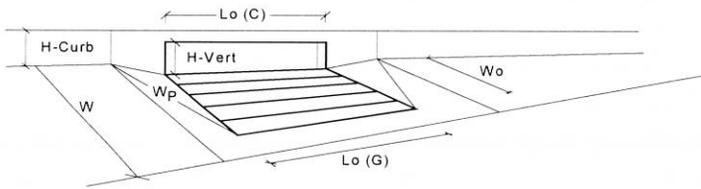
Midtown Collection at Hannah Ridge Filing No. 3  
DP #4



Gutter Geometry (Enter data in the blue cells)																	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 0.0$ ft																
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft																
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$																
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches																
Distance from Curb Face to Street Crown	$T_{CROWN} = 25.0$ ft																
Gutter Width	$W = 1.00$ ft																
Street Transverse Slope	$S_X = 0.040$ ft/ft																
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_Y = 0.083$ 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)	$n_{STREET} = 0.018$																
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><math>T_{MAX} =</math></td> <td>25.0</td> <td>25.0</td> <td>ft</td> </tr> <tr> <td><math>d_{MAX} =</math></td> <td>6.0</td> <td>6.0</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		$T_{MAX} =$	25.0	25.0	ft	$d_{MAX} =$	6.0	6.0	inches		<input type="checkbox"/>	<input type="checkbox"/>	
	Minor Storm	Major Storm															
$T_{MAX} =$	25.0	25.0	ft														
$d_{MAX} =$	6.0	6.0	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																	
	<table border="1"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>Q_{ALLOW} =</math></td> <td>SUMP</td> <td>SUMP</td> <td>cfs</td> </tr> </tbody> </table>		Minor Storm	Major Storm		$Q_{ALLOW} =$	SUMP	SUMP	cfs								
	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)	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	6.0	6.0	inches
<b>Grate Information</b>	MINOR	MAJOR	Override Depths
Length of a Unit Grate	N/A	N/A	
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	
<b>Curb Opening Information</b>	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)	1.00	1.00	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	
<b>Low Head Performance Reduction (Calculated)</b>	MINOR	MAJOR	
Depth for Grate Midwidth	N/A	N/A	ft
Depth for Curb Opening Weir Equation	0.42	0.42	ft
Combination Inlet Performance Reduction Factor for Long Inlets	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	N/A	N/A	
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	MINOR	MAJOR	
<b>Inlet Capacity IS GOOD for Minor and Major Storms(&gt;Q PEAK)</b>	5.9	5.9	cfs
$Q_{PEAK REQUIRED}$	1.7	3.5	cfs

## Pipe Run #1

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	24.0 in
Discharge	11.30 cfs
Results	
Normal Depth	14.9 in
Flow Area	2.0 ft <sup>2</sup>
Wetted Perimeter	3.6 ft
Hydraulic Radius	6.8 in
Top Width	1.94 ft
Critical Depth	14.5 in
Percent Full	62.0 %
Critical Slope	0.005 ft/ft
Velocity	5.52 ft/s
Velocity Head	0.47 ft
Specific Energy	1.71 ft
Froude Number	0.948
Maximum Discharge	17.21 cfs
Discharge Full	16.00 cfs
Slope Full	0.002 ft/ft
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	50.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	14.9 in
Critical Depth	14.5 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

## Pipe Run #2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	3.50 cfs
Results	
Normal Depth	8.7 in
Flow Area	0.8 ft <sup>2</sup>
Wetted Perimeter	2.3 ft
Hydraulic Radius	4.4 in
Top Width	1.50 ft
Critical Depth	8.6 in
Percent Full	48.3 %
Critical Slope	0.005 ft/ft
Velocity	4.14 ft/s
Velocity Head	0.27 ft
Specific Energy	0.99 ft
Froude Number	0.973
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.001 ft/ft
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	31.8 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	8.7 in
Critical Depth	8.6 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

## Pipe Run #3

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	24.0 in
Discharge	13.90 cfs
Results	
Normal Depth	17.3 in
Flow Area	2.4 ft <sup>2</sup>
Wetted Perimeter	4.1 ft
Hydraulic Radius	7.2 in
Top Width	1.79 ft
Critical Depth	16.1 in
Percent Full	72.1 %
Critical Slope	0.006 ft/ft
Velocity	5.73 ft/s
Velocity Head	0.51 ft
Specific Energy	1.95 ft
Froude Number	0.870
Maximum Discharge	17.21 cfs
Discharge Full	16.00 cfs
Slope Full	0.004 ft/ft
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	31.8 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	17.3 in
Critical Depth	16.1 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

## Pipe Run #4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

---

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Diameter	18.0 in
Discharge	8.70 cfs

---

Results	
Normal Depth	12.5 in
Flow Area	1.3 ft <sup>2</sup>
Wetted Perimeter	3.0 ft
Hydraulic Radius	5.3 in
Top Width	1.38 ft
Critical Depth	13.7 in
Percent Full	69.4 %
Critical Slope	0.008 ft/ft
Velocity	6.64 ft/s
Velocity Head	0.69 ft
Specific Energy	1.73 ft
Froude Number	1.204
Maximum Discharge	11.30 cfs
Discharge Full	10.50 cfs
Slope Full	0.007 ft/ft
Flow Type	Supercritical

---

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

---

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	69.4 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.5 in
Critical Depth	13.7 in
Channel Slope	0.010 ft/ft
Critical Slope	0.008 ft/ft

## Pipe Run #5

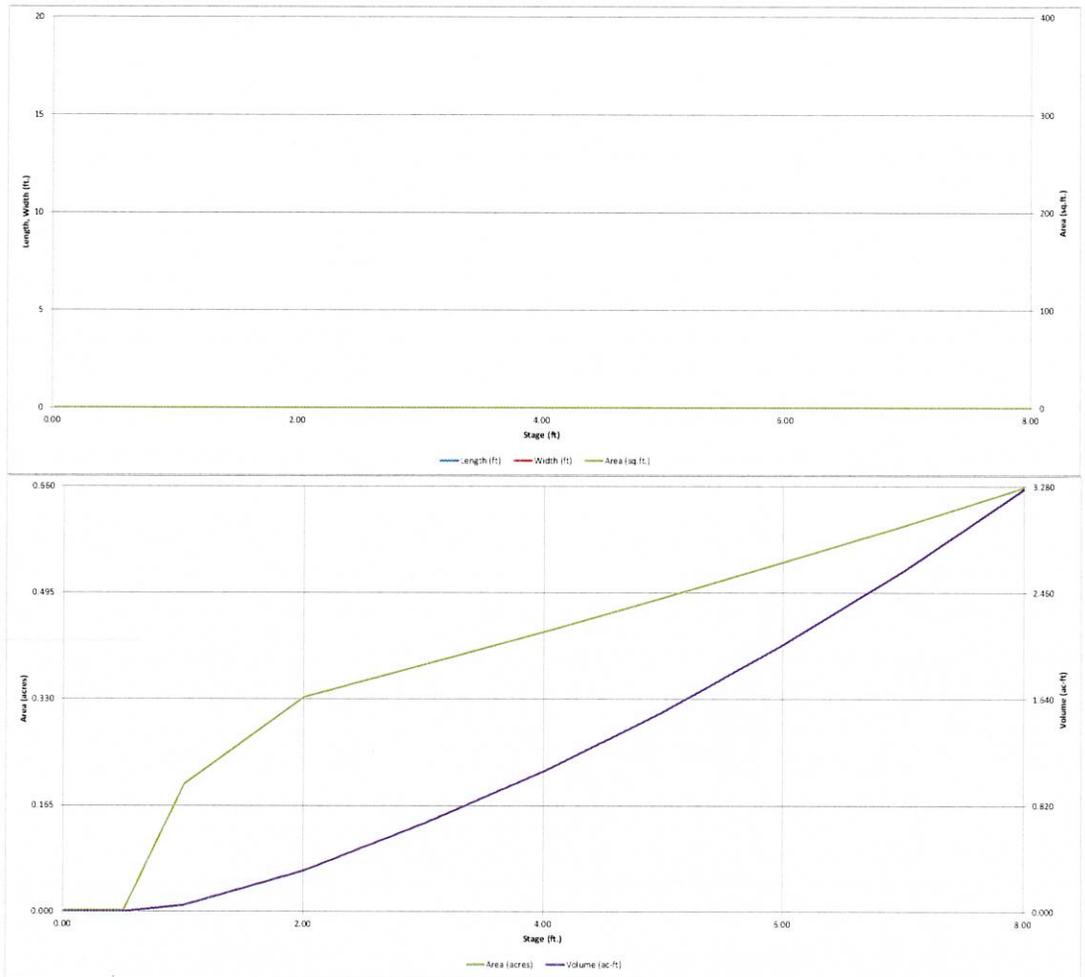
Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Diameter	48.0 in
Discharge	59.20 cfs
Results	
Normal Depth	21.5 in
Flow Area	5.4 ft <sup>2</sup>
Wetted Perimeter	5.9 ft
Hydraulic Radius	11.1 in
Top Width	3.98 ft
Critical Depth	27.8 in
Percent Full	44.7 %
Critical Slope	0.004 ft/ft
Velocity	10.88 ft/s
Velocity Head	1.84 ft
Specific Energy	3.63 ft
Froude Number	1.640
Maximum Discharge	154.51 cfs
Discharge Full	143.64 cfs
Slope Full	0.002 ft/ft
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	44.7 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	21.5 in
Critical Depth	27.8 in
Channel Slope	0.010 ft/ft
Critical Slope	0.004 ft/ft

**SWQ / FULL SPECTRUM  
DETENTION CALCULATIONS**



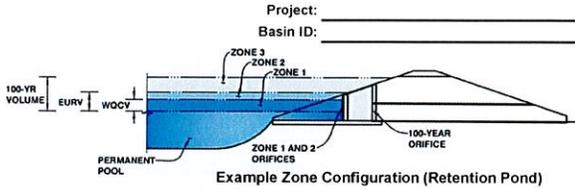
# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



# Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.09	0.346	Orifice Plate
Zone 2 (EURV)	3.84	0.666	Orifice Plate
Zone 3 (100-year)	5.63	0.849	Weir&Pipe (Restrict)
		1.861	Total

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =  ft<sup>2</sup>  
 Underdrain Orifice Centroid =  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 =  ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
 Orifice Plate: Orifice Vertical Spacing =  inches  
 Orifice Plate: Orifice Area per Row =  sq. inches (diameter = 1-5/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =  ft<sup>2</sup>  
 Elliptical Half-Width =  feet  
 Elliptical Slot Centroid =  feet  
 Elliptical Slot Area =  ft<sup>2</sup>

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.30	2.60					
Orifice Area (sq. inches)	2.16	2.16	2.16					

	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 =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft <sup>2</sup>
Vertical Orifice Centroid =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	<input type="text" value="6.00"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Slope =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	<input type="text" value="5.00"/>	<input type="text" value="N/A"/>	feet
Overflow Grate Open Area % =	<input type="text" value="60%"/>	<input type="text" value="N/A"/>	%, grate open area/total area
Debris Clogging % =	<input type="text" value="50%"/>	<input type="text" value="N/A"/>	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>u</sub> =	<input type="text" value="5.25"/>	<input type="text" value="N/A"/>	feet
Over Flow Weir Slope Length =	<input type="text" value="5.15"/>	<input type="text" value="N/A"/>	feet
Grate Open Area / 100-yr Orifice Area =	<input type="text" value="5.91"/>	<input type="text" value="N/A"/>	should be ≥ 4
Overflow Grate Open Area w/o Debris =	<input type="text" value="18.55"/>	<input type="text" value="N/A"/>	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	<input type="text" value="9.28"/>	<input type="text" value="N/A"/>	ft <sup>2</sup>

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 =	<input type="text" value="2.50"/>	<input type="text" value="N/A"/>	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	<input type="text" value="24.00"/>	<input type="text" value="N/A"/>	inches
Restrictor Plate Height Above Pipe Invert =	<input type="text" value="24.00"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	<input type="text" value="3.14"/>	<input type="text" value="N/A"/>	ft <sup>2</sup>
Outlet Orifice Centroid =	<input type="text" value="1.00"/>	<input type="text" value="N/A"/>	feet
Half-Central Angle of Restrictor Plate on Pipe =	<input type="text" value="3.14"/>	<input type="text" value="N/A"/>	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	<input type="text" value="6.00"/>	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	<input type="text" value="50.00"/>	feet
Spillway End Slopes =	<input type="text" value="4.00"/>	H:V
Freeboard above Max Water Surface =	<input type="text" value="1.00"/>	feet

Calculated Parameters for Spillway

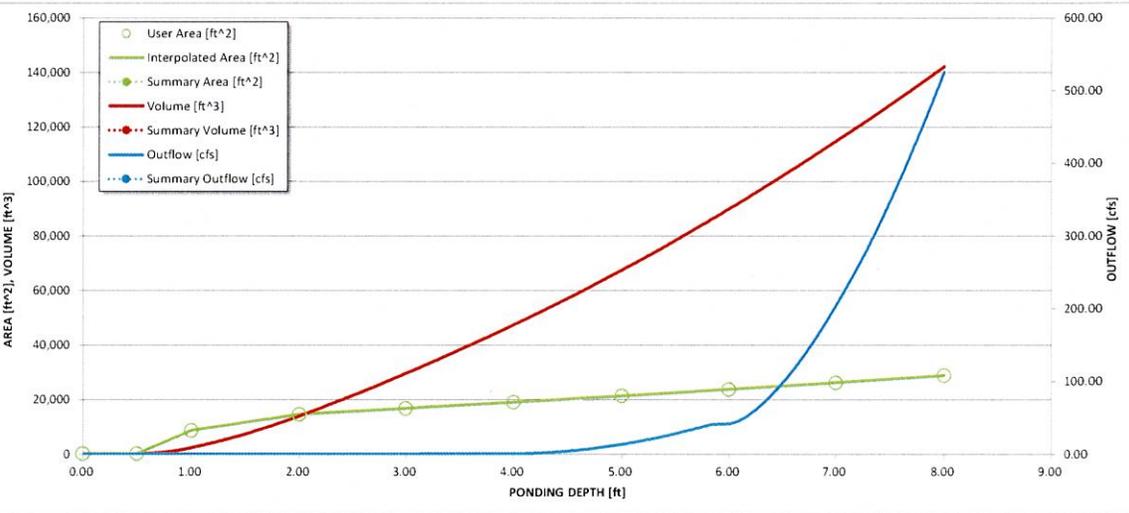
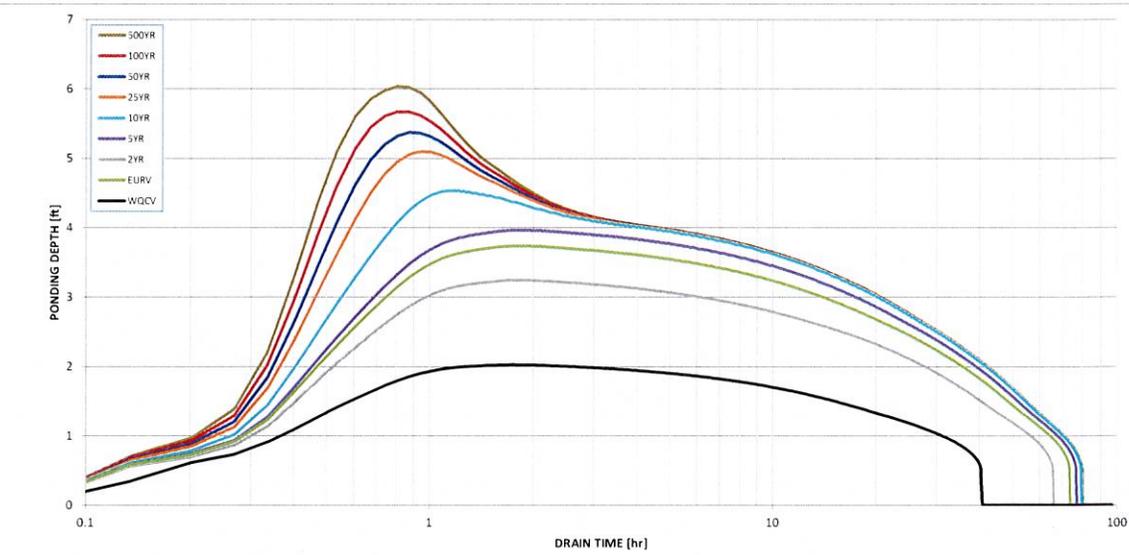
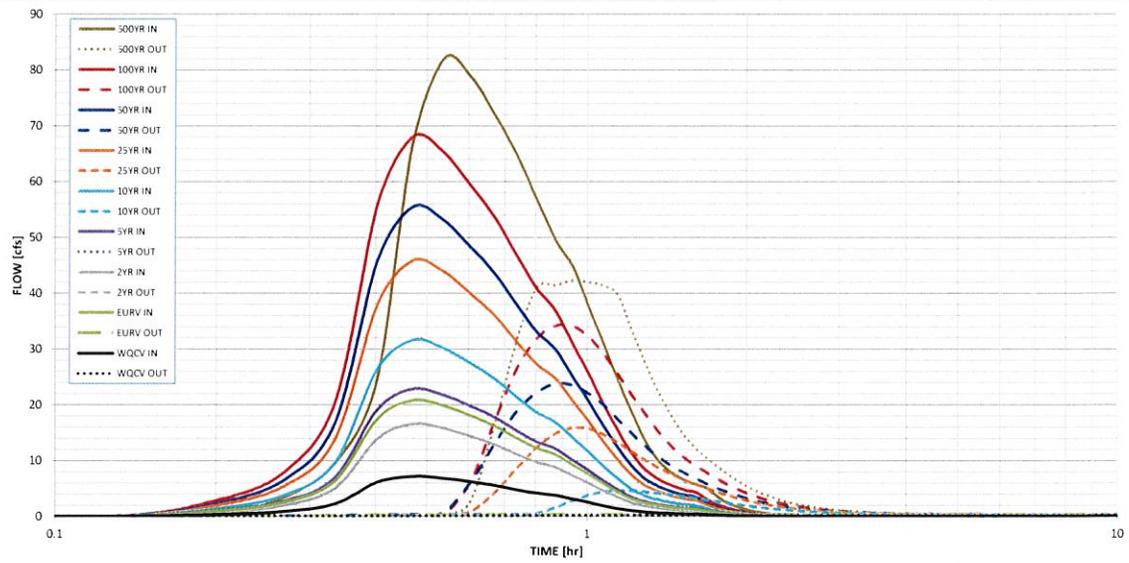
Spillway Design Flow Depth =	<input type="text" value="0.57"/>	feet
Stage at Top of Freeboard =	<input type="text" value="7.57"/>	feet
Basin Area at Top of Freeboard =	<input type="text" value="0.63"/>	acres

## 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	2.75
Calculated Runoff Volume (acre-ft) =	0.346	1.012	0.805	1.111	1.548	2.256	2.738	3.371	4.077
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.345	1.010	0.804	1.110	1.546	2.254	2.736	3.367	4.074
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.26	0.83	1.15	1.53	1.98
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	0.579	5.7	18.2	25.2	33.6	43.3
Peak Inflow Q (cfs) =	7.2	20.7	16.5	22.7	31.5	45.7	55.4	67.9	81.9
Peak Outflow Q (cfs) =	0.2	0.3	0.3	0.346	4.6	15.8	23.7	34.1	42.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.8	0.9	0.9	1.0	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.8	1.3	1.8	2.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	68	61	71	71	68	66	63	60
Time to Drain 99% of Inflow Volume (hours) =	40	72	64	75	77	76	75	74	73
Maximum Ponding Depth (ft) =	2.02	3.73	3.24	3.96	4.53	5.09	5.37	5.67	6.03
Area at Maximum Ponding Depth (acres) =	0.33	0.42	0.40	0.43	0.46	0.49	0.51	0.52	0.54
Maximum Volume Stored (acre-ft) =	0.324	0.969	0.769	1.067	1.317	1.590	1.725	1.879	2.072

# 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 MAP**

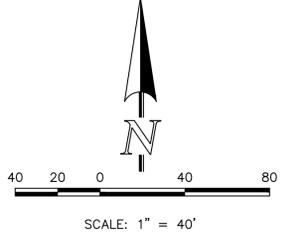
Provide Existing or overall Drainage Plan showing the entire drainage area to the FSD. This can be combined with the MS4 map requested in the comments.



DESIGN POINT SUMMARY			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	INLET SIZE
1	1.9	4.1	STREET FLOW
2	5.0	11.3	10' TYPE R SUMP
3	3.9	8.7	5' TYPE R SUMP
4	1.7	3.5	5' TYPE R SUMP
5	30.1	59.2	OUTFALL TO POND
6	-	-	POND DISCHARGE
7	6.3	13.9	OUTFALL TO POND

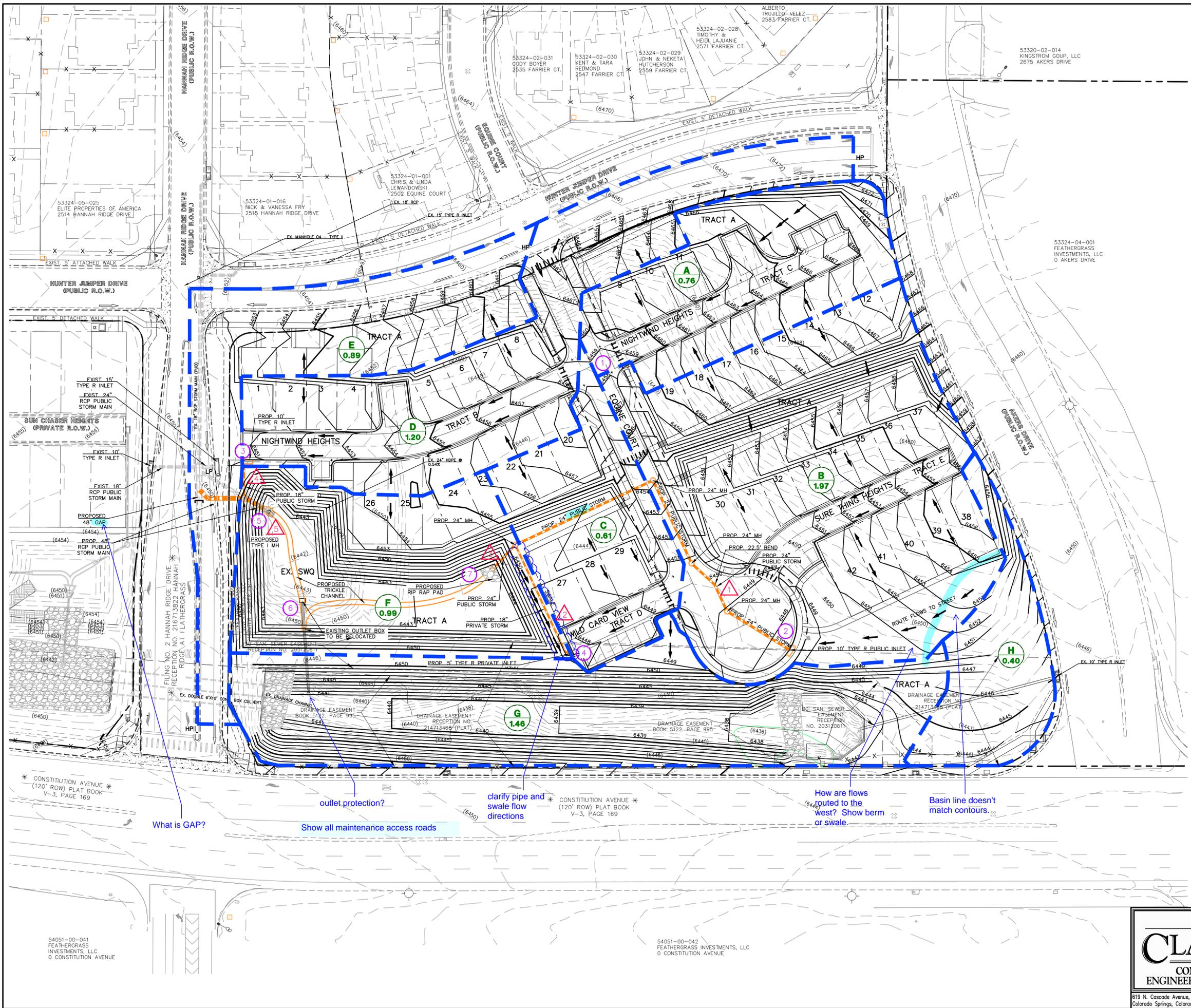
BASIN RUNOFF SUMMARY			
BASIN	Q5 (CFS)	Q100 (CFS)	
A	1.9	4.1	
B	3.5	8.0	
C	1.7	3.5	
D	3.1	6.6	
E	1.4	3.5	
F	0.8	3.4	
G	0.9	5.1	
H	0.2	1.3	

PIPE ROUTING SUMMARY			
PIPE RUN	Q5 (CFS)	Q100 (CFS)	PIPE SIZE
1	5.0	11.3	24" RCP
2	1.7	3.5	18" RCP
3	6.3	13.9	24" RCP
4	3.9	8.7	18" RCP
5	30.1	59.2	48" RCP



**LEGEND**

- (6770) EXISTING CONTOUR
- 6770 PROPOSED CONTOUR
- FILING LINE
- BOUNDARY/R.O.W. LINE
- EXISTING FLOW DIRECTION
- PROPOSED FLOW
- "A" A LOT
- "B" B LOT
- "W/O" WALKOUT LOT
- "T" TRANSITION LOT
- "G" GARDEN LOT
- PROPOSED INLET
- PROPOSED STORM SEWER PIPE
- HP PROPOSED HIGH POINT
- LP PROPOSED LOW POINT
- (D) BASIN IDENTIFIER
- (1.41) AREA IN ACRES
- △ PIPE RUN
- DESIGN POINT



What is GAP?

Show all maintenance access roads

clarify pipe and swale flow directions

How are flows routed to the west? Show berm or swale.

Basin line doesn't match contours.

54051-00-041  
FEATHERGRASS INVESTMENTS, LLC  
0 CONSTITUTION AVENUE

54051-00-042  
FEATHERGRASS INVESTMENTS, LLC  
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**CLASSIC**  
CONSULTING ENGINEERS & SURVEYORS

MIDTOWN COLLECTION AT HANNAH RIDGE  
FILING NO. 3  
DEVELOPED CONDITIONS DRAINAGE MAP

DESIGNED BY	KRC	SCALE	DATE	08/21/20
DRAWN BY	KC	(H) 1" = 30'	SHEET	1 OF 1
CHECKED BY	(V) 1" = N/A	JOB NO.	1116.35	

**CLASSIC**  
ENGINEERS & SURVEYORS

PUD SP-20-

N:\11635\DRAWINGS\DEVELOPMENT\11635-FDR-MAP DEVELOPED.dwg, 8/21/2020, 2:18:22 PM, 1/1