FINAL DRAINAGE REPORT

MIDTOWN COLLECTION AT HANNAH RIDGE
FILINGS 1 AND 2
(A Replat of Tracts AA and BB, Hannah Ridge at Feathergrass Subdivision Filing No. 1)

PUDSP-19-004
SF-19-006
SF-19-007

March 2019

Prepared for:
ELITE PROPERTIES OF AMERICA, INC.
6385 CORPORATE DRIVE
COLORADO SPRINGS, CO 80919

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 CASCADE AVENUE, SUITE 200
COLORADO SPRINGS, CO 80903
(719) 785-0790

Job no. 1116.30

CLASSIC CONSULTING

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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.

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: 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. Date
County Engineer / ECM Administrator

Conditions:

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FINAL DRAINAGE REPORT FOR MIDTOWN COLLECTION AT HANNAH RIDGE FILINGS 1 AND 2 (A Replat of Tracts AA and BB, Hannah Ridge at Feathergrass Subdivision Filing No. 1)

PURPOSE

This document is the Final Drainage Report for Midtown Collection at Hannah Ridge Filings 1 and 2. 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 Filings 1 and 2 and discuss the final construction details, and more specifically, the final design details of the proposed sub-regional public detention/water quality facilities located within Filing 1 that will handle the treatment for Filings 1 and 2. Final design information for the Filings No. 1 and 2 detention/water quality facilities are 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 development includes a total of 345 single-family residences that will be developed in seven filings, as well as one commercial parcel, Tract CC and the two previously anticipated multi-family parcels, Tracts AA and BB, that are now proposed for a small lot PUD single family development. Midtown Collection at Hannah Ridge Filing No. 1 is 9.123 acres in size and contains 61 small lot, single-family lots. Midtown Collection at Hannah Ridge Filing No. 2 is 3.260 acres in size and contains 28 proposed small lot, single-family lots.

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 south portion of the overall Hannah Ridge at Feathergrass development. These two proposed residential filings are comprised of Basin E9 for Filing No. 1 and Basin F5 for Filing No. 2, as shown on the developed drainage map provided by MVE, Inc. (See Appendix). The abandoned railroad bed 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 Filing 2, 3 and 4 improvements included the public storm under Shawnee Drive out-falling into the existing 60" RCP storm that runs parallel to Constitution. The 84" RCP public storm from Hunter Jumper Drive to Hannah Ridge Drive was also previously constructed. The on-site pre-development drainage patterns are generally sheet flowing towards Shawnee Drive where existing inlets intercept the flows and transfer them to an existing stormwater quality only facility located on the east side of Shawnee Drive and constructed with Filing No. 4 (Filing No. 2). Filing No. 1 existing flows generally drain as sheet flow in an easterly direction towards the existing drainage channel west of Hannah Ridge Drive.

Provide an Existing conditions drainage plan/map.

DEVELOPED DRAINAGE CONDITIONS

Given some recent changes in City/County Drainage Criteria, the calculations for this development now reflects current criteria for stormwater quality and detention requirements. Proposed Pond 1 will be designed as a full spectrum facility to accommodate the developed flows from the west portion of Filing No. 1 and all of Filing No. 2. Pond 2 will accommodate the easterly portion of Filing No. 1. 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 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 other proposed storm facilities within easements or tracts and the proposed Pond 1 and Pond 2 will be owned and maintained by the Hannah Ridge HOA.

Design Point 1 (Q_5 = 4 cfs and Q_{100} = 8 cfs) collect developed flows from Basins A & B. At this sump condition, a 5' 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 then be conveyed via a 18" RCP storm sewer in a southerly direction towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 1 (Q_5 = 4 cfs and Q_{100} = 8 cfs).** The emergency overflow route at this location is in the southerly direction in Tract A directly into a drainage tract that will route the flows towards Constitution Avenue.

Design Point 2 (Q_5 = 2 cfs and Q_{100} = 3 cfs) and **Design Point 3** (Q_5 = 1 cfs and Q_{100} = 2 cfs) collect developed flows from Basins C & D. At this sump condition, a 5' 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 18" RCP storm sewer towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 3 (Q_5 = 3 cfs and Q_{100} = 6 cfs).** The emergency overflow route at this location is via Tract A directly and then to Constitution Avenue. **Pipe Run 4 (Q_5 = 7 cfs and Q_{100} = 13 cfs)** represents the combined pipe flows from Design Points 1-3. This 24" RCP storm sewer will route these combined developed flows directly into Pond 1. This pond inflow is designated later in this report.

Design Point 4 (Q_5 = 1 cfs and Q_{100} = 2 cfs) collects developed flows from Basin F. At this sump condition, a 5' 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 1.0' and then be conveyed via a 18" RCP storm sewer towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 5 (Q_5 = 1 cfs and Q_{100} = 2 cfs).** The emergency overflow route at this location is via Tract A directly and then to Shawnee Drive. **Pipe Run 6 (Q_5 = 8 cfs and Q_{100} = 15 cfs)** represents the combined pipe flows from Design Points 1, 2, 3 & 4. This 24" RCP storm sewer will route these combined developed flows directly into Pond 1. This pond inflow is designated later in this report.

Design Point 5 (Q_5 = 9 cfs and Q_{100} = 19 cfs) collect developed flows from Basins I. At this sump condition, a 15' 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 1.0' and then be conveyed via a 24" RCP storm sewer towards Pond 1. The total flow within the pipe at this location is given by **Pipe Run 7 (Q_5 = 9 cfs and Q_{100} = 19 cfs).** The emergency overflow route at this location is via a Tract directly behind the inlet and then to an existing rip rap lined drainage channel. **Pipe Run 8 (Q_5 = 15 cfs and Q_{100} = 30 cfs)** represents the combined pipe flows from Design Points 1, 2, 3, 4 & 5. This 30" RCP storm sewer will route these combined developed flows directly into Pond 1. This pond inflow is designated later in this report.

Design Point 6 (Q_5 = 3 cfs and Q_{100} = 6 cfs) collects developed flows from Basin N. At this sump condition, a 5' 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 18" RCP storm sewer in a southerly direction towards Pond 2. The total flow within the pipe at this location is given by **Pipe Run 6 (Q_5 = 3 cfs and Q_{100} = 6 cfs).** The emergency overflow route at this location is via a Tract directly behind the inlet and then to an existing rip rap lined drainage channel.

Design Point 7 (Q_5 = 2 cfs and Q_{100} = 3 cfs) collects developed flows from Basin O. At this sump condition, a 5' 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 18" RCP storm sewer in a southerly direction towards Pond 2. The total flow within the pipe at this location is given by **Pipe Run 10 (Q_5 = 2 cfs and Q_{100} = 3 cfs).** The emergency overflow route at this location is in the easterly direction directly into a Hannah Ridge Drive.

Basin E (Q_5 = 1 cfs and Q_{100} = 2 cfs) consists of flows from the landscaped residential front yards that will sheet flow into Shawnee Drive and be routed to the existing SWQ pond east of the intersection of Shawnee Drive and Constitution Ave.

Basin G (Q_5 = 1.1 cfs and Q_{100} = 2.1 cfs) consists of flows from the landscaped residential front yards that will sheet flow into existing Hunter Jumper Drive and then to existing Shawnee Drive and be routed to the existing SWQ pond east of the intersection of Shawnee Drive and Constitution Ave.

Basin H (Q_5 = 1 cfs and Q_{100} = 2 cfs) consists of landscaped flows from an area that contains the existing SWQ pond located at the intersection of Shawnee Drive and Constitution Ave.

Basin J (Q_5 = 2 cfs and Q_{100} = 4 cfs) consists of flows from the landscaped residential front yards that will sheet flow into existing Hunter Jumper Drive and be routed to the existing SWQ pond south of Hunter Jumper Drive in Basin K.

Basin K (Q_5 = 1 cfs and Q_{100} = 3 cfs) consists of landscaped flows from an area that contains the existing SWQ pond located south of Hunter Jumper Drive.

Basin L (Q_5 = 2 cfs and Q_{100} = 3 cfs) consists of landscaped flows from an area that contains Proposed Full Spectrum SWQ Pond 1.

Basin P (Q_5 = 1 cfs and Q_{100} = 1 cfs) consists of flows from the landscaped residential front yards that will sheet flow into existing Hunter Jumper Drive and be routed to the existing SWQ pond east of Hannah Ridge Drive.

Basin M (Q_5 = 2 cfs and Q_{100} = 4 cfs) consists of flows from the landscaped tract area that contains an existing rip rap outfall of an existing 90" RCP to an existing box culvert under Hannah Ridge Drive.

Design Point 8 The total inflow into Pond 1 equals Q_5 = 18 cfs and Q_{100} = 35 cfs. This facility will be constructed with the proposed Filing 1 development and the downstream flows will remain consistent with the previous filings. This facility will have one inflow point. The inflow (Q_5 = 18 cfs and Q_{100} = 35 cfs) will be from a 30" RCP into a concrete forebay with a required size of 90 CF based on 3% of the WQCV from this inflow. The forebay is designed with 12" high walls, 4.9" notch and a 30" wide concrete trickle channel routing the flows towards the pond outlet. The outlet structure consists of a 4'x4' concrete box with an integral 100 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 will have a height of 3.50'. (See UD-BMP Spreadsheets in Appendix) The orifice plate on the front of the outlet box consists of a series of 4 – 15/16" holes, 10.50" 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:

0.094 Ac.-ft. WQCV required
0.137 Ac.-ft. EURV required
0.493 Ac.-ft. 100-yr. storage required

Total In-flow:	**Q_5 = 18 cfs, Q_{100} = 35 cfs**
Pond Design Release:	**Q_5 = 0.07 cfs, Q_{100} = 6.7 cfs**
Pre-development Release:	**Q_5 = 0.14cfs, Q_{100} = 8.6 cfs**

Design Point 9 The total inflow into Pond 2 equals Q_5 = 5 cfs and Q_{100} = 9 cfs. This facility will be constructed with the proposed Filing 1 development and the downstream flows will remain consistent with the previous filings. This facility will have two inflow points. The west inflow (Q_5 = 3 cfs and Q_{100} = 6 cfs) will be from an 18" RCP into a concrete trickle channel. The north inflow (Q_5 = 2 cfs and Q_{100} = 3 cfs) will be from an 18" RCP into a concrete trickle channel. Per the UD-BMP spreadsheet (see appendix) forebays are not required for this small of a facility. The trick channel will be a 30" wide concrete trickle channel routing the flows towards the pond outlet. The outlet structure consists of a 3'x3' concrete box with an integral 100 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 will have a height of 2.35'. (See UD-BMP Spreadsheets in Appendix) The orifice plate on the front of the outlet box consists of a series of 3 holes, 9.40" apart. Two 7/16" diameter holes and 1 15/16" diameter hole. (See UD-Detention Spreadsheets in Appendix) This facility will be owned and maintained by the Hannah Ridge HOA.

Pond 2 has the following design parameters as a full-spectrum facility:

0.023 Ac.-ft. WQCV required

0.044 Ac.-ft. EURV required

0.057 Ac.-ft. 100-yr. storage required

Total In-flow:	**Q_5 = 5 cfs, Q_{100} = 9 cfs**
Pond Design Release:	**Q_5 = 0.03 cfs, Q_{100} = 2.4 cfs**
Pre-development Release:	**Q_5 = 0.038cfs, Q_{100} = 2.2 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 (Pond 1 and 2).

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).

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.

Midtown Collection at Hannah Ridge at Feathergrass Filing No. 1 and 2 Drainage Improvement Costs (Non-Reimbursable)

ITEM	DESCRIPTION	QUANTITY	UNIT COST	COST
1.	5' Type R Inlet	6 EACH	$3,791/EA	$ 23,400.00
2.	15' Type R Inlet	1 EACH	$7,923/EA	$ 4,200.00
3.	18" RCP Storm Drain	690 LF	$69/LF	$ 47,610.00
4.	24" RCP Storm Drain	980 LF	$84/LF	$ 82,320.00
5.	30" RCP Storm Drain	20 LF	$94/LF	$ 1,880.00
6.	Type I MH	1 EACH	$8,592/EA	$ 8,592.00
7.	Type II MH	8 EACH	$4,575/EA	$ 36,600.00
8.	Pond 1 FSD	1 EACH	$83,000/EA	$ 83,000.00
9.	Pond 2 FSD	1 EACH	$53,000/EA	$ 53,000.00
SUB-TOTAL				$ 340,602.00
10% ENGINEERING				$ 34,060.20
5% CONTINGENCIES				$ 17,030.10
SUB-TOTAL				**$ 391,692.30**

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. 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 1:	9.123 ac.
Filing 2:	3.260 ac.

The total development area for each Filing 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 2019 drainage/bridge fees for the Sand Creek Basin:

FILING 1:

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%)

5.40 Ac. x 65% = **3.51 Impervious Ac.**

Open Space Tracts

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

3.720 Ac. x 2% = **0.07 Impervious Ac.**

Total Impervious Acreage: **3.58 Imp. Ac.**

FILING 5 FEE TOTALS:

Bridge Fees $5,559.00

$ 5,210.00 x 3.58 Impervious Ac. = $ 18,651.80

Drainage Fees $18940.00

$ 17,751.00 x 3.58 Impervious Ac. = $ 63,548.58
These Drainage Fees will be paid by developer in the form of cash and/or credits.

FILING 2:

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%)

2.27 Ac. x 65% = **1.48 Impervious Ac.**

Open Space Tracts

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

0.99 Ac. x 2% = **0.02 Impervious Ac.**

Total Impervious Acreage: **1.50 Imp. Ac.**

FILING 6 FEE TOTALS:

Bridge Fees $5559.00

$ 5,210.00 x 1.50 Impervious Ac. = $ 7,815.00

Drainage Fees $18940.00

$ 17,751.00 x 1.50 Impervious Ac. = $ 26,626.50

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

Per the ECM 3.10.4a, this development requests a reduction of drainage fees based on the on-site full spectrum detention/SWQ facility proposed within the Sand Creek Drainage Basin to be constructed with the first Filing developed. The following facility seems to meet the required six criteria as follows:

1. No downstream regional facility in place yet.
2. Proposed facility is less than 15 ac-ft. in volume
3. The proposed on-site facility is not part of a regional plan.
4. The proposed outlet is designed to release to full-spectrum criteria.

This request is not allowed, because there is no downstream facility planned.

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5. Proposed facility is per County criteria and will gain County approval.
6. Proposed facility will be private with ownership and maintenance by HOA.

Total Reduction

Detention Pond 1	1.21 ac-ft. full spectrum	$ 83,000 x 50% =	**$ 41,500.00**
Detention Pond 1	0.359 ac-ft. full spectrum	$ 53,000 x 50% =	**$ 26,500.00**

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. 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

Kyle R. Campbell, P.E.
Division Manager

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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.

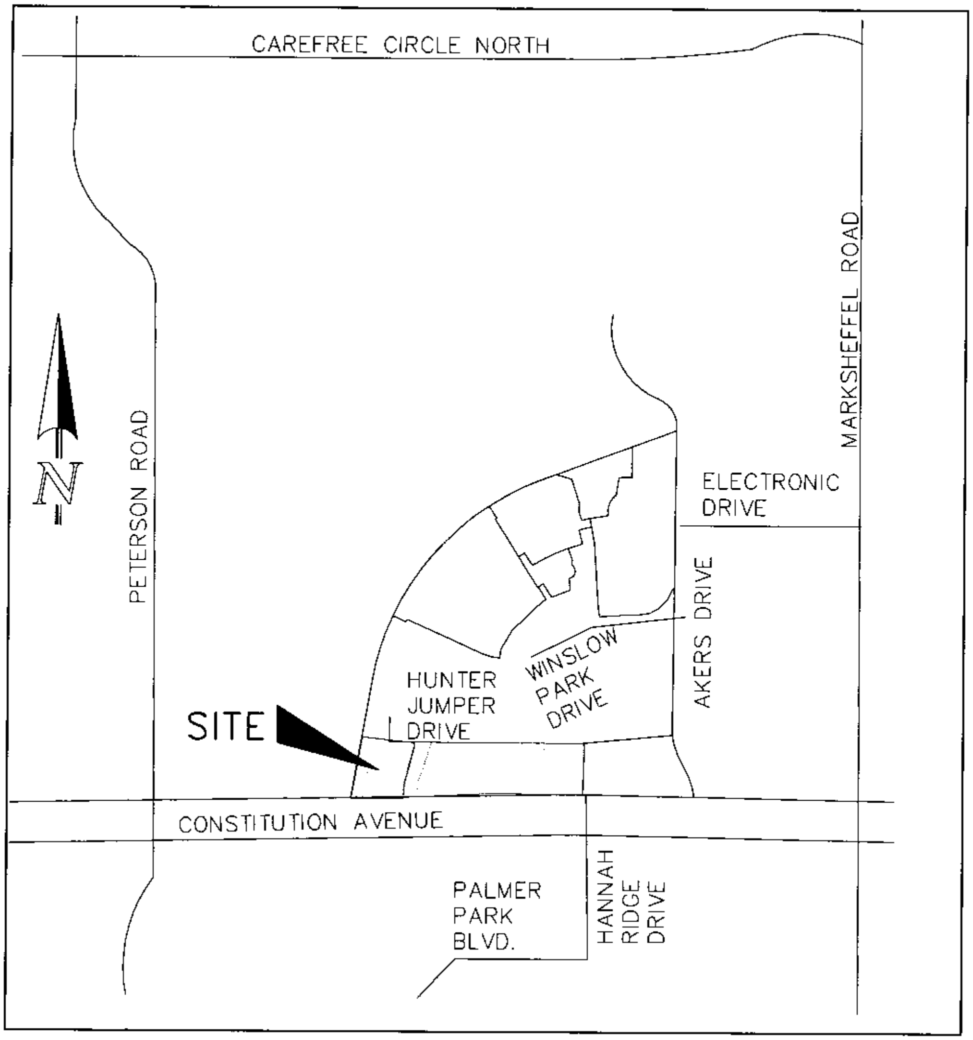
3. "Master Development Drainage Plan for Hannah Ridge", prepared by MVE, Inc. November 2007

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.

APPENDIX

VICINITY MAP

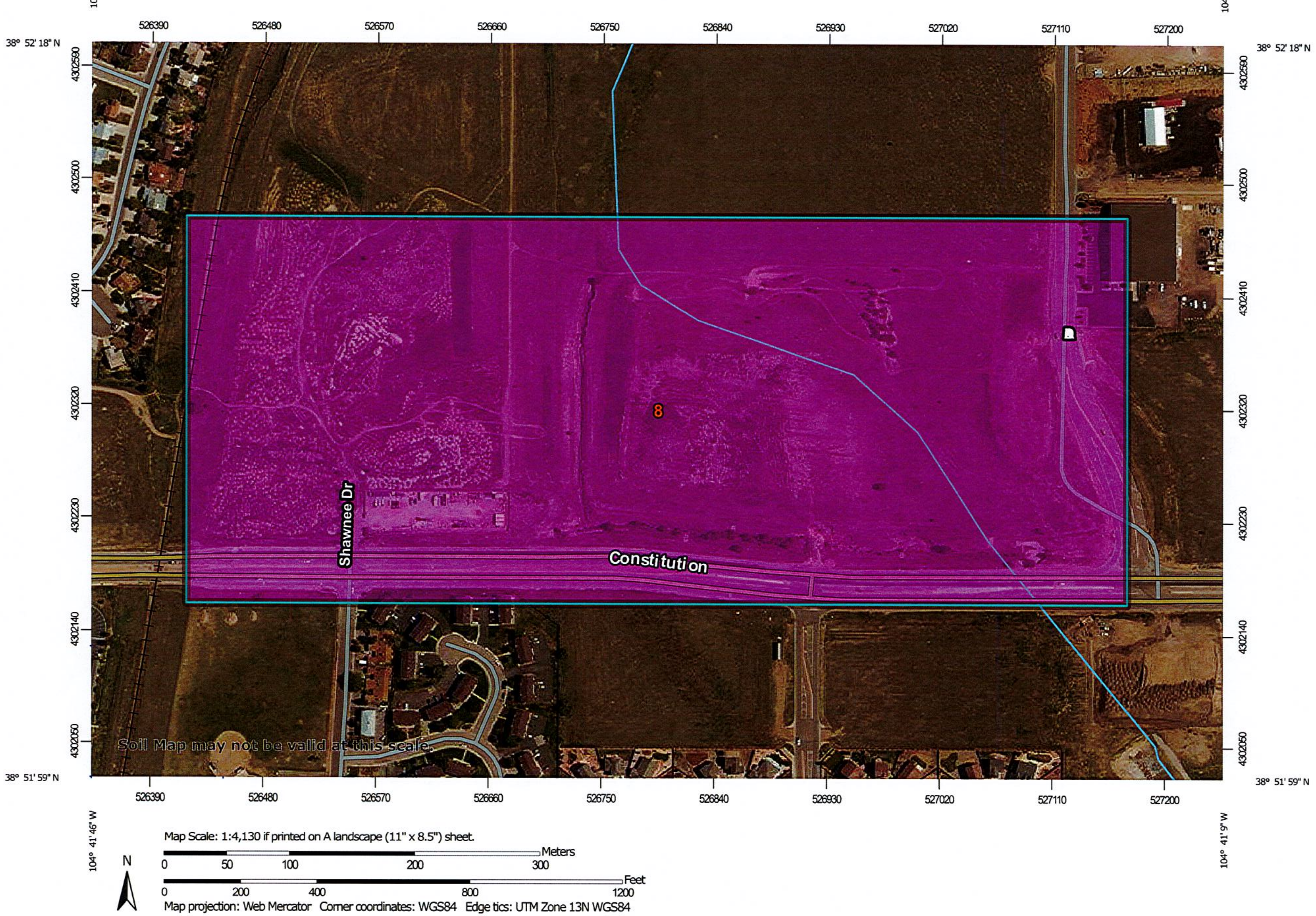


VICINITY MAP

N.T.S.

SOILS MAP (S.C.S SURVEY)

Hydrologic Soil Group—El Paso County Area, Colorado



MAP LEGEND

Area of Interest (AOI)

- □ Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- 〰 Streams and Canals

Transportation

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

Background

- ■ Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 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: Jun 3, 2014—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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	57.4	100.0%
Totals for Area of Interest			**57.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

F.E.M.A. MAP

National Flood Hazard Layer FIRMette

FEMA

Legend

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

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
	🟧	0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with drainag areas of less than one square mile *Zone*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
OTHER AREAS OF FLOOD HAZARD	▨	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	▨	Area with Flood Risk due to Levee *Zone D*
	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
	▭	Effective LOMRs
OTHER AREAS	▨	Area of Undetermined Flood Hazard *Zone*
GENERAL STRUCTURES	- - - -	Channel, Culvert, or Storm Sewer
	IIIIIII	Levee, Dike, or Floodwall
	20.2	Cross Sections with 1% Annual Chance
	17.5	Water Surface Elevation
	⑧- - -	Coastal Transect
	~~ 513 ~~~~	Base Flood Elevation Line (BFE)
	—	Limit of Study
	—	Jurisdiction Boundary
	--- ---	Coastal Transect Baseline
OTHER FEATURES	- —	Profile Baseline
	—	Hydrographic Feature
	☐	Digital Data Available
	⬚	No Digital Data Available
MAP PANELS	☒	Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represe 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 3/24/2019 at 5:51:46 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.

REFERENCE MATERIAL FROM ADJACENT STUDIES

MVE, INC.
ENGINEERS, SURVEYORS
1903 lelaray street, suite 200
colorado springs, co 80909
719.635.5736

Final Drainage Report

Hannah Ridge at Feathergrass Subdivision Filing No. 1

RECEIVED
APR 23 2014
BY: Fnel

January 31, 2014

Final Drainage Report

for

Hannah Ridge at Feathergrass Subdivision Filing No. 1

Project No. 60970

January 31, 2014

prepared for

Feathergrass Investments, LLC
4715 North Chestnut Street
Colorado Springs, CO 80907
719.593.8367

prepared by

MVE, Inc.
1903 Lelaray Street, Suite 200
Colorado Springs, CO 80909
719.635.5736

60970 Hannah Ridge Final Drainage Report.odt


D4
2.22
D6
1.31
D11
1.30
D7
3.93
D8
4.04
E6
1.80
D10
0.37
D12
0.52
E7
2.53
E5
0.90
E4
2.74
E8
0.65
E9
8.63
E3
0.92
E2
2.80
E1
1.23
F4
0.32
F3
3.21
F2
1.26
F1
2.41
F5
3.67
OSF3
0.52
21
22
24
25
26
Fil. No. 1
Fil. No. 2
CONSTITUTION AVE
EX 60" RCP
EX 48" RCP
EX 42" RCP
EX 24" RCP
EX 18" RCP
EX 5' TYPE R INLET
EXIST DRAINAGEWAY
TEMPORARY SWALE TO SILT BASIN FROM END OF FILING NO. 1
LOCATION OF TEMPORARY SILT BASIN FOR FILING NO. 1
CHANNEL B = 6' D = 4.5' SS = 3:1
B = 20' D = 6' SS = 3:1
10' TYPE R
15' TYPE R
5' TYPE R
18" RCP
24" RCP
60" RCP
OVERLAND FLOW FROM OSA5, OSA6
PIPE FLOW FROM OSA5 (INCLUDING OFF-SITE WATERS)
Q_5 = 130 cfs
Q_{100} = 703 cfs
TOTAL OSA5 FLOW (FROM DBPS)
PIPE FLOW FROM OSA5
Q_5 = 66 cfs
Q_{100} = 85 cfs
OVERLAND IN STREET
Q_5 = 39 cfs
Q_{100} = 121 cfs
BRIDGE OPENING
EQUINE COURT

HYDROLOGIC / HYDRAULIC CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME: *MIDTOWN COLLECTION AT HANNAH RIDGE FILING NO. 1 & 2*
JOB NUMBER: *1116.30*
DATE: *03/11/19*
CALCULATED BY: *K. CAMPBELL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

		IMPERVIOUS AREA / STREETS				LANDSCAPE/UNDEVELOPED AREAS				WEIGHTED			WEIGHTED CA		
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**
A	0.48	0.18	0.89	0.90	0.96	0.30	0.39	0.43	0.57	0.58	0.61	0.72	**0.28**	**0.29**	**0.34**
B	0.81	0.55	0.89	0.90	0.96	0.26	0.39	0.43	0.57	0.73	0.75	0.83	**0.59**	**0.61**	**0.68**
C	0.51	0.31	0.89	0.90	0.96	0.20	0.39	0.43	0.57	0.69	0.72	0.81	**0.35**	**0.37**	**0.41**
D	0.35	0.21	0.89	0.90	0.96	0.14	0.39	0.43	0.57	0.69	0.71	0.80	**0.24**	**0.25**	**0.28**
E	0.35	0.14	0.89	0.90	0.96	0.21	0.39	0.43	0.57	0.59	0.62	0.73	**0.21**	**0.22**	**0.25**
F	0.31	0.21	0.89	0.90	0.96	0.10	0.39	0.43	0.57	0.73	0.75	0.83	**0.23**	**0.23**	**0.26**
G	0.32	0.20	0.89	0.90	0.96	0.12	0.39	0.43	0.57	0.70	0.72	0.81	**0.22**	**0.23**	**0.26**
H	0.38	0.00	0.89	0.90	0.96	0.38	0.39	0.43	0.57	0.39	0.43	0.57	**0.15**	**0.16**	**0.22**
I	4.18	1.15	0.89	0.90	0.96	3.03	0.39	0.43	0.57	0.53	0.56	0.68	**2.21**	**2.34**	**2.83**
J	0.61	0.40	0.89	0.90	0.96	0.21	0.39	0.43	0.57	0.72	0.74	0.83	**0.44**	**0.45**	**0.50**
K	0.59	0.00	0.89	0.90	0.96	0.59	0.39	0.43	0.57	0.39	0.43	0.57	**0.23**	**0.25**	**0.34**
L	0.69	0.00	0.89	0.90	0.96	0.69	0.39	0.43	0.57	0.39	0.43	0.57	**0.27**	**0.30**	**0.39**
M	0.87	0.00	0.89	0.90	0.96	0.87	0.39	0.43	0.57	0.39	0.43	0.57	**0.34**	**0.37**	**0.50**
N	0.99	0.40	0.89	0.90	0.96	0.59	0.39	0.43	0.57	0.59	0.62	0.73	**0.59**	**0.61**	**0.72**
O	0.48	0.30	0.89	0.90	0.96	0.18	0.39	0.43	0.57	0.70	0.72	0.81	**0.34**	**0.35**	**0.39**
P	0.21	0.15	0.89	0.90	0.96	0.06	0.39	0.43	0.57	0.75	0.77	0.85	**0.16**	**0.16**	**0.18**

JOB NAME: *MIDTOWN COLLECTION AT HANNAH RIDGE FILING NO. 1 & 2*
JOB NUMBER: *1116.30*
DATE: *10/01/18*
CALC'D BY: *K. CAMPBELL*

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$

$V = C_v S_w^{0.5}$ Tc=L/V

Table 6-7. Conveyance Coefficient, C_v

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

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

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

	WEIGHTED						OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
BASIN	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)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
A	0.28	0.29	0.31	0.33	0.34	0.34	0.43	40	0.8	6.1	290	2.0%	2.8	1.7	7.8	3.59	4.50	7.56	1	1	3
B	0.59	0.61	0.63	0.65	0.67	0.68	0.43	50	1	6.8					6.8	3.75	4.71	7.90	2	3	5
C	0.35	0.37	0.38	0.40	0.40	0.41	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	1.4	1.8	3
D	0.24	0.25	0.26	0.27	0.28	0.28	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	1	1	2
E	0.21	0.22	0.23	0.24	0.25	0.25	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	1	1	2
F	0.23	0.23	0.24	0.25	0.25	0.26	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	0.9	1.1	2.1
G	0.22	0.23	0.24	0.25	0.26	0.26	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	0.9	1.1	2.1
H	0.15	0.16	0.18	0.20	0.21	0.22	0.43	40	12	2.5					5.0	4.12	5.17	8.68	1	1	2
I	2.21	2.34	2.48	2.66	2.76	2.83	0.43	60	0.8	8.5	400	2.0%	2.8	2.4	10.9	3.19	4.00	6.72	7	9	19
J	0.44	0.45	0.47	0.49	0.50	0.50	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	2	2	4
K	0.23	0.25	0.28	0.31	0.32	0.34	0.43	30	8	2.2					5.0	4.12	5.17	8.68	1	1	3
L	0.27	0.30	0.32	0.36	0.38	0.39	0.43	30	8	2.2					5.0	4.12	5.17	8.68	1	2	3
M	0.34	0.37	0.41	0.45	0.48	0.50	0.43	30	8	2.2					5.0	4.12	5.17	8.68	1	2	4
N	0.59	0.61	0.65	0.68	0.70	0.72	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	2	3	6
O	0.34	0.35	0.36	0.38	0.38	0.39	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	1.3	2	3
P	0.16	0.16	0.17	0.17	0.18	0.18	0.43	40	0.8	6.1					6.1	3.89	4.87	8.18	0.6	1	1

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

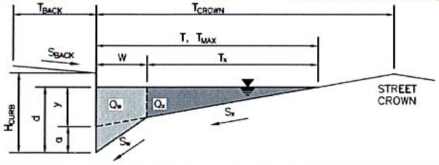
Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		
					I(5)	I(100)	Q(5)	Q(100)	Inlet Size
1	BASIN A & B	0.90	1.02	7.8	4.50	7.56	4	8	5' Type R Sump
2	BASIN C	0.37	0.41	6.1	4.87	8.18	2	3	5' Type R Sump
3	BASIN D	0.25	0.28	6.1	4.87	8.18	1	2	5' Type R Sump
4	BASIN F	0.23	0.26	6.1	4.87	8.18	1	2	5' Type R Sump
5	BASIN I	2.34	2.83	10.9	4.00	6.72	9	19	15' Type R Sump
6	BASIN N	0.61	0.72	6.1	4.87	8.18	3	6	5' Type R Sump
7	BASIN O	0.35	0.39	6.1	4.87	8.18	2	3	5' Type R Sump
8	POND 1 IN (PIPE 8 AND BASIN L)	4.38	5.20	10.9	4.00	6.72	18	35	N/A
9	POND 2 IN (PIPE 9 & PIPE 10 BASIN	0.96	1.11	6.1	4.87	8.18	5	9	N/A

Version 4.05 Released March 2017

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

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

Project: **Midtown Collection at Hannah Ridge Filing No. 1 & 2**
Inlet ID: **DP-1**

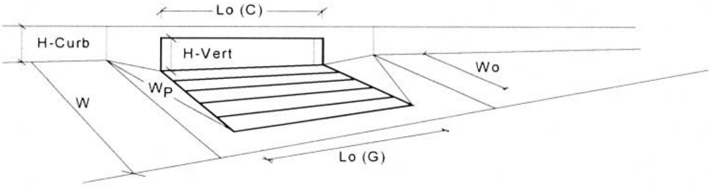


Gutter Geometry (Enter data in the blue cells)

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_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening ▾	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

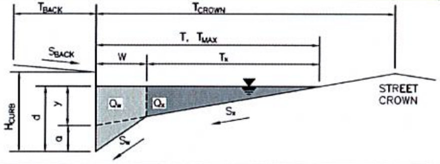
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.0	6.0	cfs

Version 4.05 Released March 2017

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

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

Project: **Midtown Collection at Hannah Ridge Filing No. 1 & 2**
Inlet ID: **DP-2**



Gutter Geometry (Enter data in the blue cells)

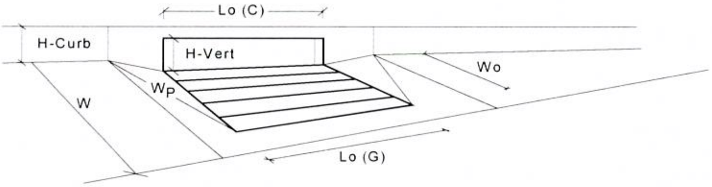
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



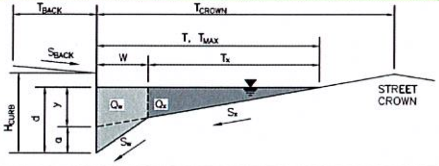
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.7	3.0	cfs

Version 4.05 Released March 2017

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

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

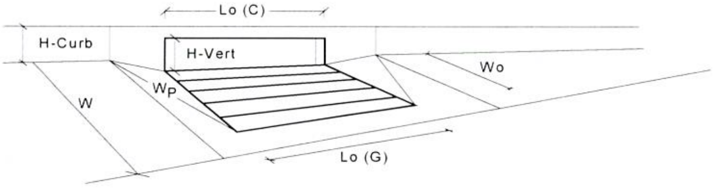
Project: **Midtown Collection at Hannah Ridge Filing No. 1 & 2**
Inlet ID: **DP-3**



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} =	12.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion **MAJOR STORM Allowable Capacity is based on Depth Criterion**	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet · CDOT Type R Curb Opening ▾	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	2.0	cfs

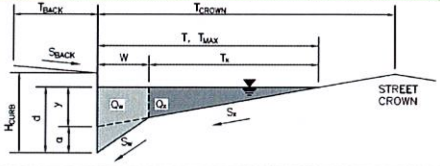
Version 4.05 Released March 2017

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

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

Project: Midtown Collection at Hannah Ridge Filing No. 1 & 2

Inlet ID: DP-4



Gutter Geometry (Enter data in the blue cells)

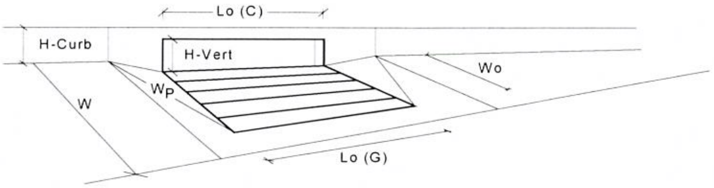
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet: CDOT Type R Curb Opening ▾	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.2	2.2	cfs

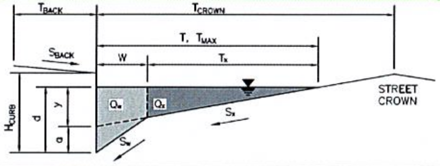
Version 4.05 Released March 2017

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

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

Project: Midtown Collection at Hannah Ridge Filing No. 1 & 2

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} =	50.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	50.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

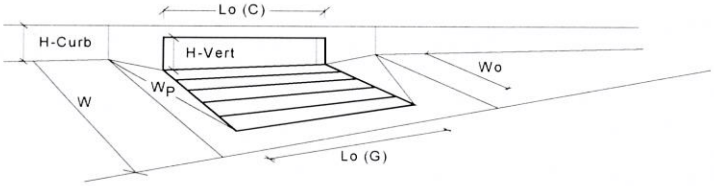
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	6.00	12.00	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	7.51	13.51	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	23.0	48.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.235	0.113	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	Q_T =	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	43.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	41.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.130	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	Q_d =	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

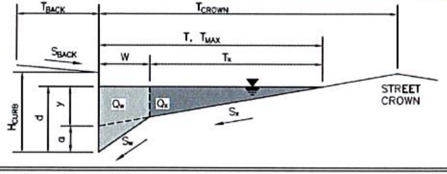
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**9.7**	**39.1**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	13.0	25.0	cfs

Version 4.05 Released March 2017

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

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

Project: **Midtown Collection at Hannah Ridge Filing No. 1 & 2**
Inlet ID: **DP-6**



Gutter Geometry (Enter data in the blue cells)

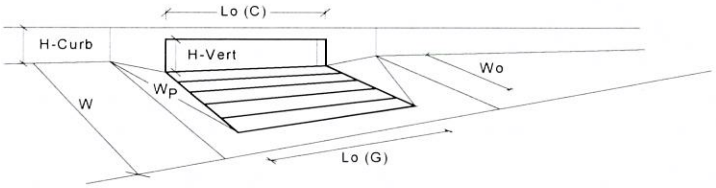
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



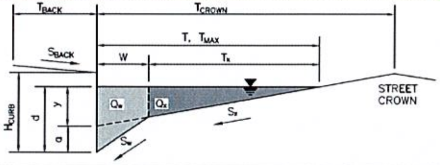
Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening ▼	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.0	6.0	cfs

Version 4.05 Released March 2017

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

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

Project: **Midtown Collection at Hannah Ridge Filing No. 1 & 2**
Inlet ID: **DP-7**



Gutter Geometry (Enter data in the blue cells)

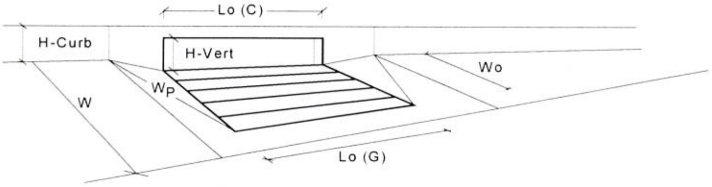
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	12.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	12.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)

Type of Inlet: CDOT Type R Curb Opening ▾

		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches

Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	

Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	3.0	cfs

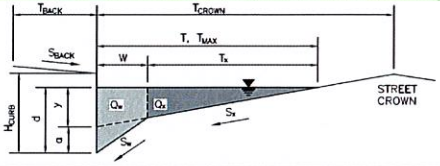
Version 4.05 Released March 2017

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

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

Project: **Midtown Collection at Hannah Ridge Filing No. 1 & 2**

Inlet ID: **DP-8**



Gutter Geometry (Enter data in the blue cells)

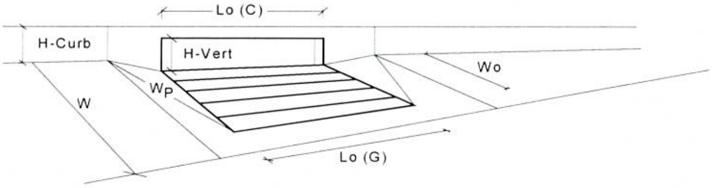
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.3**	**8.3**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor and Major Storms	$Q_{PEAK\ REQUIRED}$ =	13.0	25.0	cfs

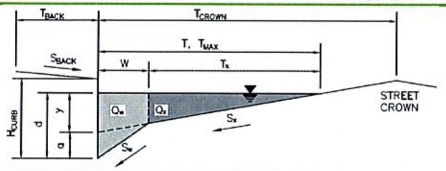
Version 4.05 Released March 2017

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

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

Project: Midtown Collection at Hannah Ridge Filing No. 1 & 2

Inlet ID: DP-9



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_O = 0.000 ft/ft

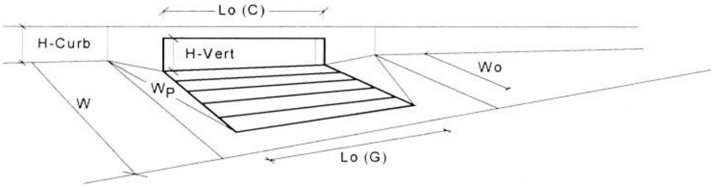
Manning's Roughness for Street Section (typically between 0.012 and 0.020) n_{STREET} = 0.016

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening ▼ Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.3**	**25.5**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	9.0	19.0	cfs

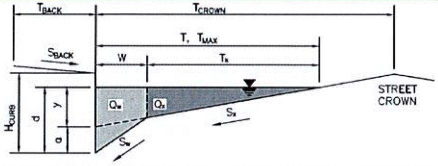
Version 4.05 Released March 2017

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

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

Project: Midtown Collection at Hannah Ridge Filing No. 1 & 2

Inlet ID: DP-10



Gutter Geometry (Enter data in the blue cells)

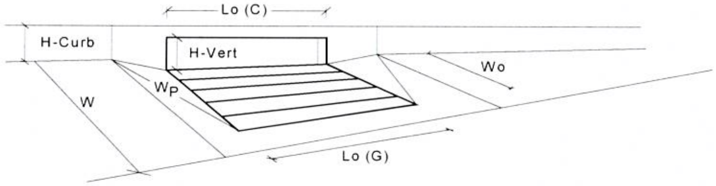
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet CDOT Type R Curb Opening ▾	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.0	5.0	cfs

JOB NAME: *MIDTOWN COLLECTION AT HANNAH RIDGE FILING NO. 1 & 2*
JOB NUMBER: *1116.30*
DATE: *03/11/19*
CALCULATED BY: ***K. CAMPBELL***

* 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		
					I(5)	I(100)	Q(5)	Q(100)	Pipe Size*
1	DP-1	0.90	1.02	7.8	4.50	7.56	4	8	18" RCP
2	DP 2	0.37	0.41	6.1	4.87	8.18	2	3	18" RCP
3	PIPE 2 & DP-3	0.61	0.69	6.1	4.87	8.18	3	6	18" RCP
4	PIPE 1 & PIPE 3	1.51	1.71	7.8	4.50	7.56	7	13	18" RCP
5	DP 4	0.23	0.26	6.1	4.87	8.18	1	2	18" RCP
6	PIPE 4 & PIPE 5	1.74	1.97	7.8	4.50	7.56	8	15	24" RCP
7	DP 5	2.34	2.83	10.9	4.00	6.72	9	19	24" RCP
8	PIPE 6 & PIPE 7	4.08	4.80	10.9	4.00	6.72	16	32	30" RCP
9	DP 6	0.61	0.72	6.1	4.87	8.18	3	6	18" RCP
10	DP 7	0.35	0.39	6.1	4.87	8.18	2	3	18" RCP

Worksheet for PIPE RUN 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.50	ft
Discharge	8.00	ft^3/s

Results

Normal Depth	0.98	ft
Flow Area	1.22	ft^2
Wetted Perimeter	2.82	ft
Hydraulic Radius	0.43	ft
Top Width	1.43	ft
Critical Depth	1.10	ft
Percent Full	65.3	%
Critical Slope	0.00743	ft/ft
Velocity	6.54	ft/s
Velocity Head	0.67	ft
Specific Energy	1.64	ft
Froude Number	1.25	
Maximum Discharge	11.30	ft^3/s
Discharge Full	10.50	ft^3/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	65.32	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 1

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.98	ft
Critical Depth	1.10	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00743	ft/ft

Worksheet for PIPE RUN 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.50	ft
Discharge	3.00	ft³/s

Results

Normal Depth	0.55	ft
Flow Area	0.59	ft²
Wetted Perimeter	1.95	ft
Hydraulic Radius	0.30	ft
Top Width	1.44	ft
Critical Depth	0.66	ft
Percent Full	36.6	%
Critical Slope	0.00513	ft/ft
Velocity	5.13	ft/s
Velocity Head	0.41	ft
Specific Energy	0.96	ft
Froude Number	1.42	
Maximum Discharge	11.30	ft³/s
Discharge Full	10.50	ft³/s
Slope Full	0.00082	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	36.58	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 2

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.66	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00513	ft/ft

Worksheet for PIPE RUN 3

Project Description

Friction Method	Manning Formula	
Solve For	Normal Depth	

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.50	ft
Discharge	6.00	ft³/s

Results

Normal Depth	0.81	ft
Flow Area	0.98	ft²
Wetted Perimeter	2.48	ft
Hydraulic Radius	0.39	ft
Top Width	1.49	ft
Critical Depth	0.95	ft
Percent Full	54.2	%
Critical Slope	0.00622	ft/ft
Velocity	6.14	ft/s
Velocity Head	0.59	ft
Specific Energy	1.40	ft
Froude Number	1.34	
Maximum Discharge	11.30	ft³/s
Discharge Full	10.50	ft³/s
Slope Full	0.00326	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	54.15	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 3

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.81	ft
Critical Depth	0.95	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00622	ft/ft

Worksheet for PIPE RUN 4

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	13.00	ft^3/s

Results

Normal Depth	1.09	ft
Flow Area	1.74	ft^2
Wetted Perimeter	3.32	ft
Hydraulic Radius	0.53	ft
Top Width	1.99	ft
Critical Depth	1.30	ft
Percent Full	54.4	%
Critical Slope	0.00581	ft/ft
Velocity	7.45	ft/s
Velocity Head	0.86	ft
Specific Energy	1.95	ft
Froude Number	1.40	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00330	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	54.36	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 4

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.09	ft
Critical Depth	1.30	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00581	ft/ft

Worksheet for PIPE RUN 5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.50	ft
Discharge	2.00	ft³/s

Results

Normal Depth	0.44	ft
Flow Area	0.44	ft²
Wetted Perimeter	1.72	ft
Hydraulic Radius	0.25	ft
Top Width	1.37	ft
Critical Depth	0.53	ft
Percent Full	29.6	%
Critical Slope	0.00495	ft/ft
Velocity	4.58	ft/s
Velocity Head	0.33	ft
Specific Energy	0.77	ft
Froude Number	1.43	
Maximum Discharge	11.30	ft³/s
Discharge Full	10.50	ft³/s
Slope Full	0.00036	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	29.57	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 5

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.44	ft
Critical Depth	0.53	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00495	ft/ft

Worksheet for PIPE RUN 6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	2.00	ft
Discharge	15.00	ft³/s

Results

Normal Depth	1.54	ft
Flow Area	2.59	ft²
Wetted Perimeter	4.28	ft
Hydraulic Radius	0.61	ft
Top Width	1.69	ft
Critical Depth	1.40	ft
Percent Full	76.9	%
Critical Slope	0.00632	ft/ft
Velocity	5.79	ft/s
Velocity Head	0.52	ft
Specific Energy	2.06	ft
Froude Number	0.82	
Maximum Discharge	17.21	ft³/s
Discharge Full	16.00	ft³/s
Slope Full	0.00440	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	76.88	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 6

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.54	ft
Critical Depth	1.40	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00632	ft/ft

Worksheet for PIPE RUN 7

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	19.00	ft^3/s

Results

Normal Depth	1.40	ft
Flow Area	2.36	ft^2
Wetted Perimeter	3.97	ft
Hydraulic Radius	0.59	ft
Top Width	1.83	ft
Critical Depth	1.57	ft
Percent Full	70.2	%
Critical Slope	0.00769	ft/ft
Velocity	8.07	ft/s
Velocity Head	1.01	ft
Specific Energy	2.41	ft
Froude Number	1.25	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00705	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	70.18	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 7

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.40	ft
Critical Depth	1.57	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00769	ft/ft

Worksheet for PIPE RUN 8

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	32.00	ft^3/s

Results

Normal Depth	1.66	ft
Flow Area	3.46	ft^2
Wetted Perimeter	4.76	ft
Hydraulic Radius	0.73	ft
Top Width	2.36	ft
Critical Depth	1.93	ft
Percent Full	66.4	%
Critical Slope	0.00688	ft/ft
Velocity	9.24	ft/s
Velocity Head	1.33	ft
Specific Energy	2.99	ft
Froude Number	1.35	
Maximum Discharge	44.12	ft^3/s
Discharge Full	41.01	ft^3/s
Slope Full	0.00609	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	66.44	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 8

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.66	ft
Critical Depth	1.93	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00688	ft/ft

Worksheet for PIPE RUN 9

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.50	ft
Discharge	6.00	ft³/s

Results

Normal Depth	0.81	ft
Flow Area	0.98	ft²
Wetted Perimeter	2.48	ft
Hydraulic Radius	0.39	ft
Top Width	1.49	ft
Critical Depth	0.95	ft
Percent Full	54.2	%
Critical Slope	0.00622	ft/ft
Velocity	6.14	ft/s
Velocity Head	0.59	ft
Specific Energy	1.40	ft
Froude Number	1.34	
Maximum Discharge	11.30	ft³/s
Discharge Full	10.50	ft³/s
Slope Full	0.00326	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	54.15	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 9

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.81	ft
Critical Depth	0.95	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00622	ft/ft

Worksheet for PIPE RUN 10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Diameter	1.50	ft
Discharge	3.00	ft³/s

Results

Normal Depth	0.55	ft
Flow Area	0.59	ft²
Wetted Perimeter	1.95	ft
Hydraulic Radius	0.30	ft
Top Width	1.44	ft
Critical Depth	0.66	ft
Percent Full	36.6	%
Critical Slope	0.00513	ft/ft
Velocity	5.13	ft/s
Velocity Head	0.41	ft
Specific Energy	0.96	ft
Froude Number	1.42	
Maximum Discharge	11.30	ft³/s
Discharge Full	10.50	ft³/s
Slope Full	0.00082	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	36.58	%
Downstream Velocity	Infinity	ft/s

Worksheet for PIPE RUN 10

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	0.55	ft
Critical Depth	0.66	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00513	ft/ft

SWQ / DETENTION CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52	
Max Intensity for Optional User Defined Storm	2.51496		

Designer:
Company: **Classic Consulting Engineers**
Date: **MARCH 26 2019**
Project: **MIDTOWN AT HANNAH RIDGE**
Location: **POND 1**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**Basin A**	**Basin B**	**Basin C**	**Basin D**	**Basin F**	**Basin I**	**Basin L**							
Receiving Pervious Area Soil Type	Sand	Sand	Sand	Sand	Sand	Sand	Sand							
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.480	0.810	0.510	0.350	0.310	4.180	0.690							
Directly Connected Impervious Area (DCIA, acres)	0.000	0.210	0.150	0.080	0.100	1.150	0.000							
Unconnected Impervious Area (UIA, acres)	0.050	0.050	0.040	0.030	0.030	0.350	0.000							
Receiving Pervious Area (RPA, acres)	0.170	0.200	0.080	0.170	0.140	2.580	0.000							
Separate Pervious Area (SPA, acres)	0.260	0.350	0.240	0.070	0.040	0.100	0.690							
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C							

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	0.480	0.810	0.510	0.350	0.310	4.180	0.690							
Directly Connected Impervious Area (DCIA, %)	0.0%	25.9%	29.4%	22.9%	32.3%	27.5%	0.0%							
Unconnected Impervious Area (UIA, %)	10.4%	6.2%	7.8%	8.6%	9.7%	8.4%	0.0%							
Receiving Pervious Area (RPA, %)	35.4%	24.7%	15.7%	48.6%	45.2%	61.7%	0.0%							
Separate Pervious Area (SPA, %)	54.2%	43.2%	47.1%	20.0%	12.9%	2.4%	100.0%							
A_R (RPA / UIA)	3.400	4.000	2.000	5.667	4.667	7.371	0.000							
I_a Check	0.230	0.200	0.330	0.150	0.180	0.120	1.000							
f / I for WQCV Event:	11.0	11.0	11.0	11.0	11.0	11.0	11.0							
f / I for 5-Year Event:	0.6	0.6	0.6	0.6	0.6	0.6	0.6							
f / I for 100-Year Event:	0.6	0.6	0.6	0.6	0.6	0.6	0.6							
f / I for Optional User Defined Storm CUHP:	**0.57**	**0.57**	**0.57**	**0.57**	**0.57**	**0.57**	**0.57**							
IRF for WQCV Event:	0.45	0.43	0.51	0.32	0.39	0.26	1.00							
IRF for 5-Year Event:	0.80	0.80	0.82	0.60	0.72	0.48	1.00							
IRF for 100-Year Event:	0.82	0.82	0.84	0.61	0.73	0.49	1.00							
IRF for Optional User Defined Storm CUHP:	**0.82**	**0.82**	**0.84**	**0.61**	**0.73**	**0.49**	**1.00**							
Total Site Imperviousness: I_{total}	10.4%	32.1%	37.3%	31.4%	41.9%	35.9%	0.0%							
Effective Imperviousness for WQCV Event:	4.7%	28.6%	33.4%	25.6%	36.0%	29.7%	0.0%							
Effective Imperviousness for 5-Year Event:	8.4%	30.9%	35.9%	28.0%	39.2%	31.5%	0.0%							
Effective Imperviousness for 100-Year Event:	8.6%	31.0%	36.0%	28.1%	39.4%	31.6%	0.0%							
Effective Imperviousness for Optional User Defined Storm CUHP:	**8.6%**	**31.0%**	**36.0%**	**28.1%**	**39.4%**	**31.6%**	**0.0%**							

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	50.7%	6.9%	6.3%	12.1%	8.6%	10.8%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	22.0%	3.8%	3.6%	11.3%	6.4%	12.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:	**10.7%**	**2.6%**	**2.6%**	**7.6%**	**5.0%**	**9.0%**	**0.0%**							

Total Site Imperviousness:	**30.6%**
Total Site Effective Imperviousness for WQCV Event:	**25.5%**
Total Site Effective Imperviousness for 5-Year Event:	**27.4%**
Total Site Effective Imperviousness for 100-Year Event:	**27.5%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**27.5%**

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Sheet 1 of 4

Designer:
Company: **Classic Consulting Engineers**
Date: **March 28, 2019**
Project: **Midtown at Hannah Ridge Fil. 1**
Location: **Pond 1**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 30.6 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.306
C) Contributing Watershed Area	Area = 7.330 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ● Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}= 0.094 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6{*}(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= 0.091 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ○ A ● B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.231 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 3.00 ft / ft DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 2 of 4

Designer:
Company: **Classic Consulting Engineers**
Date: **March 28, 2019**
Project: **Midtown at Hannah Ridge Fil. 1**
Location: **Pond 1**

5. Forebay

A) Minimum Forebay Volume
(V_{FMIN} = 2% of the WQCV)
V_{FMIN} = 0.002 ac-ft

B) Actual Forebay Volume
V_F = 0.002 ac-ft

C) Forebay Depth
(D_F = 18 inch maximum)
D_F = 12.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge
Q_{100} = 35.00 cfs

ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)
Q_F = 0.70 cfs

E) Forebay Discharge Design
Choose One
○ Berm With Pipe
● Wall with Rect. Notch
○ Wall with V-Notch Weir

(flow too small for berm w/ pipe)

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

G) Rectangular Notch Width
Calculated W_N = 4.9 in

6. Trickle Channel

A) Type of Trickle Channel
Choose One
● Concrete
○ Soft Bottom

F) Slope of Trickle Channel
S = 0.0100 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum)
D_M = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum)
A_M = 100 sq ft

C) Outlet Type
Choose One
● Orifice Plate
○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)
$D_{orifice}$ = 1.00 inches

E) Total Outlet Area
A_{ot} = 3.00 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 4

Designer:
Company: **Classic Consulting Engineers**
Date: **March 28, 2019**
Project: **Midtown at Hannah Ridge Fil. 1**
Location: **Pond 1**

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume
(Minimum recommended depth is 4 inches)

D_{IS} = 6 in

B) Minimum Initial Surcharge Volume
(Minimum volume of 0.3% of the WQCV)

V_{IS} = cu ft

C) Initial Surcharge Provided Above Micropool

V_s= 50.0 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$

A_t = 105 square inches

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 are to the total screen are for the material specified.)

S.S. Well Screen with 60% Open Area

Other (Y/N): N

C) Ratio of Total Open Area to Total Area (only for type 'Other')

User Ratio =

D) Total Water Quality Screen Area (based on screen type)

A_{total} = 175 sq. in.

E) Depth of Design Volume (EURV or WQCV)
(Based on design concept chosen under 1E)

H= 3.5 feet

F) Height of Water Quality Screen (H_{TR})

H_{TR}= 70 inches

G) Width of Water Quality Screen Opening ($W_{opening}$)
(Minimum of 12 inches is recommended)

$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 4 of 4

Designer:
Company: **Classic Consulting Engineers**
Date: **March 28, 2019**
Project: **Midtown at Hannah Ridge Fil. 1**
Location: **Pond 1**

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

11. Vegetation

Choose One
○ Irrigated
○ Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

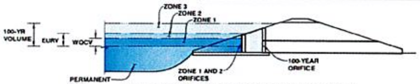
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: MIDTOWN AT HANNA RIDGE FILING NO. 1

Basin ID: POND 1



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type = EDB
Watershed Area = 7.33 acres
Watershed Length = 1,020 ft
Watershed Slope = 0.040 ft/ft
Watershed Imperviousness = 30.60% 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) = 0.094 acre-feet
Excess Urban Runoff Volume (EURV) = 0.231 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) = 0.177 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) = 0.252 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) = 0.382 acre-feet
25-yr Runoff Volume (P1 = 2 in.) = 0.634 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) = 0.800 acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) = 1.017 acre-feet
500-yr Runoff Volume (P1 = 3 in.) = 1.386 acre-feet
Approximate 2-yr Detention Volume = 0.165 acre-feet
Approximate 5-yr Detention Volume = 0.236 acre-feet
Approximate 10-yr Detention Volume = 0.343 acre-feet
Approximate 25-yr Detention Volume = 0.397 acre-feet
Approximate 50-yr Detention Volume = 0.418 acre-feet
Approximate 100-yr Detention Volume = 0.493 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
3.00 inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) = 0.094 acre-feet
Zone 2 Volume (EURV - Zone 1) = 0.137 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) = 0.262 acre-feet
Total Detention Basin Volume = 0.493 acre-feet
Initial Surcharge Volume (ISV) = user ft^3
Initial Surcharge Depth (ISD) = user ft
Total Available Detention Depth (H_{TOTAL}) = user ft
Depth of Trickle Channel (H_{TC}) = user ft
Slope of Trickle Channel (S_{TC}) = user ft/ft
Slopes of Main Basin Sides (S_{main}) = user H:V
Basin Length-to-Width Ratio ($R_{L/W}$) = user

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

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002		
51	--	0.50	--	--	--	100	0.002	49	0.001
52	--	1.00	--	--	--	6,120	0.140	1,544	0.035
53	--	2.00	--	--	--	7,612	0.175	8,395	0.193
54	--	3.00	--	--	--	9,238	0.212	16,896	0.388
55	--	4.00	--	--	--	10,996	0.252	27,013	0.620
56	--	5.00	--	--	--	12,882	0.296	38,952	0.894
57	--	6.00	--	--	--	14,920	0.343	52,853	1.213
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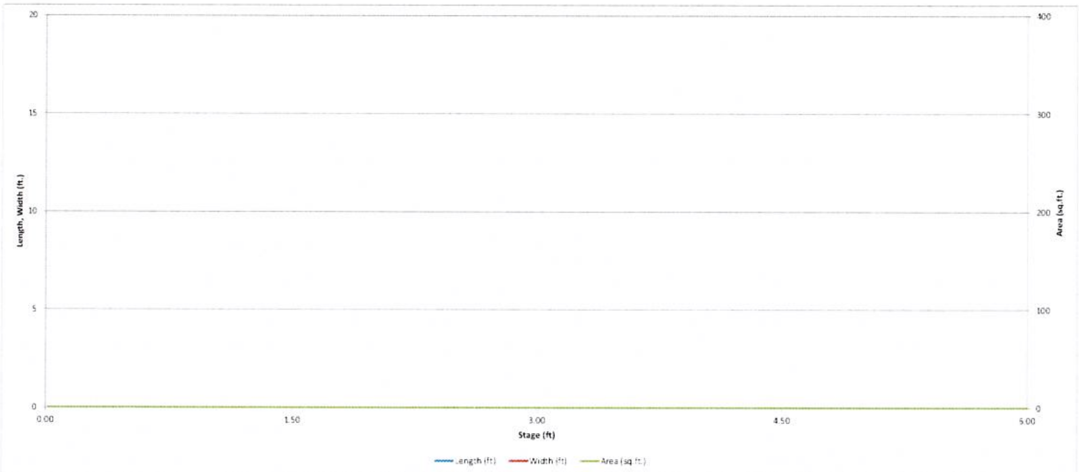
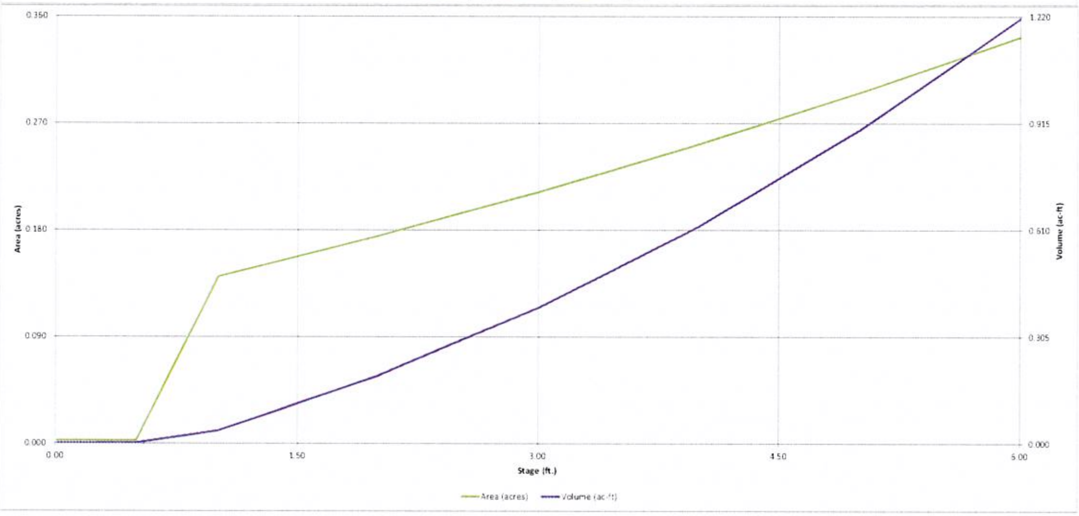
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



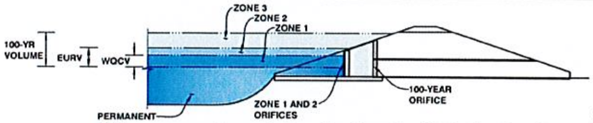


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: MIDTOWN AT HANNAH RIDGE FIL. NO. 1

Basin ID: POND 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.39	0.094	Orifice Plate
Zone 2 (EURV)	2.21	0.137	Orifice Plate
one 3 (100-year)	3.48	0.262	Weir&Pipe (Restrict)
		0.493	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 =	3.50	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	10.50	inches
Orifice Plate: Orifice Area per Row =	0.67	sq. inches (diameter = 15/16 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.653E-03	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	0.90	1.80	2.70				
Orifice Area (sq. inches)	0.67	0.67	0.67	0.67				

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	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 % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.50	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.53	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	11.54	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.77	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	18.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

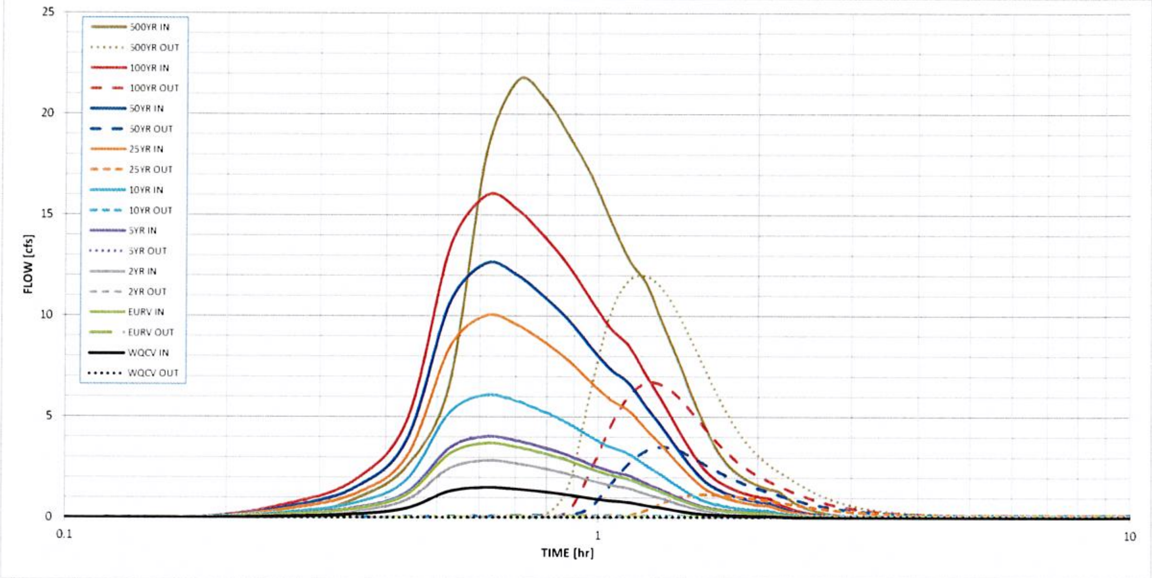
Spillway Design Flow Depth=	0.23	feet
Stage at Top of Freeboard =	5.73	feet
Basin Area at Top of Freeboard =	0.33	acres

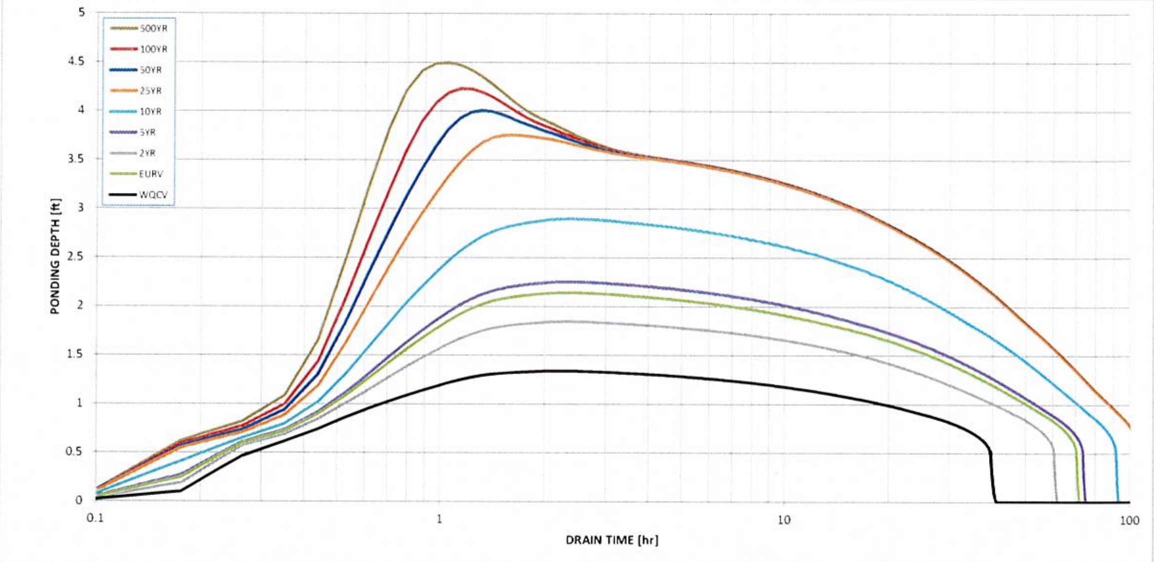
Routed Hydrograph Results

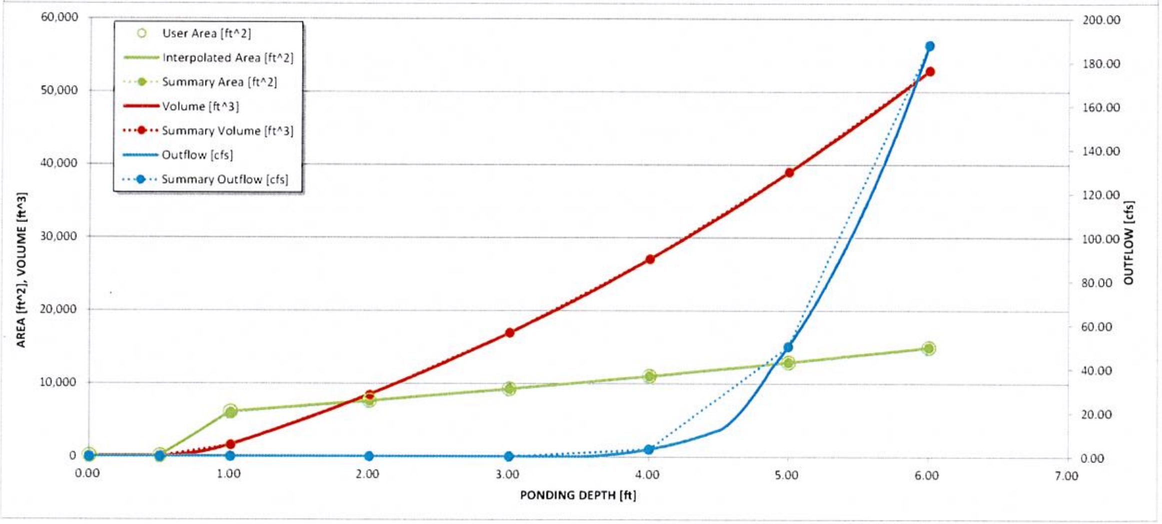
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.094	0.231	0.177	0.252	0.382	0.634	0.800	1.017	1.386
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.093	0.230	0.177	0.251	0.382	0.634	0.800	1.017	1.386
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.19	0.63	0.87	1.17	1.65
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.143	1.4	4.6	6.3	8.6	12.1
Peak Inflow Q (cfs) =	1.5	3.7	2.8	4.0	6.1	10.0	12.6	16.0	21.7
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.075	0.1	1.2	3.5	6.7	12.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.1	0.3	0.6	0.8	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.1	0.3	0.6	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	66	58	69	85	96	93	90	86
Time to Drain 99% of Inflow Volume (hours) =	40	70	60	73	90	104	103	101	99
Maximum Ponding Depth (ft) =	1.34	2.14	1.84	2.25	2.90	3.75	4.01	4.23	4.49
Area at Maximum Ponding Depth (acres) =	0.15	0.18	0.17	0.18	0.21	0.24	0.25	0.26	0.27
Maximum Volume Stored (acre-ft) =	0.085	0.217	0.167	0.239	0.365	0.558	0.620	0.677	0.749

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

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

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

Time Interval	Hydrograph Constant
5.26 min	0.951

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:15:47	0.07	0.17	0.13	0.18	0.27	0.44	0.56	0.70	0.94
0:21:02	0.18	0.44	0.34	0.48	0.73	1.19	1.50	1.89	2.56
0:26:18	0.47	1.14	0.88	1.24	1.87	3.07	3.85	4.87	6.58
0:31:34	1.30	3.14	2.43	3.42	5.15	8.43	10.58	13.37	18.06
0:36:49	1.51	3.68	2.84	4.01	6.07	10.01	12.60	15.97	21.68
0:42:05	1.43	3.50	2.70	3.82	5.78	9.55	12.03	15.26	20.73
0:47:20	1.30	3.19	2.45	3.48	5.26	8.69	10.95	13.89	18.88
0:52:36	1.15	2.83	2.17	3.09	4.69	7.76	9.79	12.44	16.92
0:57:52	0.98	2.43	1.86	2.65	4.03	6.70	8.47	10.77	14.68
1:03:07	0.85	2.12	1.63	2.31	3.52	5.84	7.37	9.37	12.76
1:08:23	0.77	1.92	1.47	2.09	3.19	5.29	6.68	8.49	11.57
1:13:38	0.62	1.57	1.20	1.71	2.62	4.36	5.52	7.04	9.62
1:18:54	0.50	1.27	0.97	1.39	2.13	3.56	4.52	5.77	7.91
1:24:10	0.37	0.96	0.73	1.05	1.62	2.74	3.49	4.48	6.16
1:29:25	0.26	0.70	0.53	0.77	1.20	2.04	2.61	3.36	4.66
1:34:41	0.20	0.51	0.39	0.56	0.87	1.48	1.89	2.43	3.40
1:39:56	0.16	0.40	0.31	0.44	0.68	1.15	1.46	1.87	2.60
1:45:12	0.13	0.33	0.25	0.36	0.56	0.94	1.20	1.54	2.13
1:50:28	0.11	0.28	0.22	0.31	0.48	0.80	1.02	1.30	1.80
1:55:43	0.10	0.25	0.19	0.27	0.42	0.70	0.89	1.14	1.57
2:00:59	0.09	0.22	0.17	0.25	0.38	0.63	0.80	1.03	1.41
2:06:14	0.08	0.21	0.16	0.23	0.35	0.58	0.74	0.95	1.30
2:11:30	0.06	0.15	0.12	0.17	0.26	0.43	0.54	0.69	0.96
2:16:46	0.04	0.11	0.09	0.12	0.19	0.31	0.40	0.51	0.70
2:22:01	0.03	0.08	0.06	0.09	0.14	0.23	0.29	0.37	0.51
2:27:17	0.02	0.06	0.05	0.07	0.10	0.17	0.22	0.28	0.38
2:32:32	0.02	0.04	0.03	0.05	0.07	0.12	0.15	0.20	0.27
2:37:48	0.01	0.03	0.02	0.03	0.05	0.09	0.11	0.14	0.19
2:43:04	0.01	0.02	0.02	0.02	0.04	0.06	0.08	0.10	0.14
2:48:19	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.07	0.10
2:53:35	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.06
2:58:50	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03
3:04:06	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
3:09:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:14:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:19:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:25:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:30:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:35:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:40:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:46:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:51:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:56:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:01:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:07:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:12:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:17:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:23:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:28:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:33:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:38:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:44:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:49:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:54:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:59:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:05:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:10:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:15:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:20:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:26:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:31:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:36:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:41:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:47:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:52:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:57:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:02:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:08:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:13:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:18:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	100	0.002	0	0.000	0.00
	0.50	100	0.002	49	0.001	0.02
	1.00	6,000	0.138	1,544	0.035	0.03
	2.00	7,597	0.174	8,395	0.193	0.06
	3.00	9,238	0.212	16,896	0.388	0.11
	4.00	10,996	0.252	27,013	0.620	3.43
	5.00	12,882	0.296	38,952	0.894	50.32
	6.00	14,920	0.343	52,853	1.213	187.93

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

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

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

Designer:
Company: **CLASSIC CONSULTING ENGINEERS**
Date: **March 26, 2019**
Project: **MIDTOWN AT HANNAH RIDGE**
Location: **POND 2**

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52	
Max Intensity for Optional User Defined Storm	2.51496		

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**Basin N**	**Basin 0**												
Receiving Pervious Area Soil Type	Sand	Sandy Loam												
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.990	0.480												
Directly Connected Impervious Area (DCIA, acres)	0.400	0.150												
Unconnected Impervious Area (UIA, acres)	0.040	0.040												
Receiving Pervious Area (RPA, acres)	0.250	0.150												
Separate Pervious Area (SPA, acres)	0.300	0.140												
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C												

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	0.990	0.480												
Directly Connected Impervious Area (DCIA, %)	40.4%	31.3%												
Unconnected Impervious Area (UIA, %)	4.0%	8.3%												
Receiving Pervious Area (RPA, %)	25.3%	31.3%												
Separate Pervious Area (SPA, %)	30.3%	29.2%												
A_R (RPA / UIA)	6.250	3.750												
I_a Check	0.140	0.210												
f / I for WQCV Event:	11.0	2.0												
f / I for 5-Year Event:	0.6	0.5												
f / I for 100-Year Event:	0.6	0.3												
f / I for Optional User Defined Storm CUHP:	**0.57**	**0.31**												
IRF for WQCV Event:	0.30	0.45												
IRF for 5-Year Event:	0.56	0.85												
IRF for 100-Year Event:	0.57	0.89												
IRF for Optional User Defined Storm CUHP:	**0.57**	**0.89**												
Total Site Imperviousness: I_{total}	44.4%	39.6%												
Effective Imperviousness for WQCV Event:	41.6%	35.0%												
Effective Imperviousness for 5-Year Event:	42.7%	38.3%												
Effective Imperviousness for 100-Year Event:	42.7%	38.7%												
Effective Imperviousness for Optional User Defined Storm CUHP:	**42.7%**	**38.7%**												

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	3.9%	6.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	3.9%	2.4%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:	**3.3%**	**1.8%**												

Total Site Imperviousness:	**42.9%**
Total Site Effective Imperviousness for WQCV Event:	**39.5%**
Total Site Effective Imperviousness for 5-Year Event:	**41.2%**
Total Site Effective Imperviousness for 100-Year Event:	**41.4%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**41.4%**

Notes:

[*] Use Green-Ampt average infiltration rate values from Table 3-3.

[**] Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Sheet 1 of 4

Designer:
Company:
Date: **March 28, 2019**
Project:
Location:

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 42.9 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.429

C) Contributing Watershed Area — Area = 1.470 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.42 in

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

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

F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$) — V_{DESIGN}= 0.023 ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$) — $V_{DESIGN\ OTHER}$= 0.022 ac-ft

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

I) Predominant Watershed NRCS Soil Group

Choose One
○ A
● B
○ C / D

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

EURV = 0.067 ac-f t

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

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 3.00 ft / ft

DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

4. Inlet

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

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 2 of 4

Designer:
Company:
Date: **March 28, 2019**
Project:
Location:

5. Forebay

A) Minimum Forebay Volume
(V$_{FMIN}$ = 0% of the WQCV)
V$_{FMIN}$ = 0.000 ac-ft
A FOREBAY MAY NOT BE NECESSARY FOR THIS SIZE SITE

B) Actual Forebay Volume
V$_F$ = 0.000 ac-ft

C) Forebay Depth
(D$_F$ = 12 inch maximum)
D$_F$ = ______ in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge
Q$_{100}$ = ______ cfs

ii) Forebay Discharge Design Flow
(Q$_F$ = 0.02 * Q$_{100}$)
Q$_F$ = ______ cfs

E) Forebay Discharge Design
Choose One
○ Berm With Pipe
○ Wall with Rect. Notch
○ Wall with V-Notch Weir
(flow too small for berm w/ pipe)

F) Discharge Pipe Size (minimum 8-inches)
Calculated D$_P$ = ______ in

G) Rectangular Notch Width
Calculated W$_N$ = ______ in

6. Trickle Channel

A) Type of Trickle Channel
Choose One
● Concrete
○ Soft Bottom

F) Slope of Trickle Channel
S = 0.0100 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum)
D$_M$ = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum)
A$_M$ = 100 sq ft

C) Outlet Type
Choose One
● Orifice Plate
○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)
D$_{orifice}$ = ______ inches

E) Total Outlet Area
A$_{ot}$ = ______ square inches

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 4

Designer:
Company:
Date: **March 28, 2019**
Project:
Location:

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume
(Minimum recommended depth is 4 inches)

D_{IS} = 6 in

B) Minimum Initial Surcharge Volume
(Minimum volume of 0.3% of the WQCV)

V_{IS} = cu ft

C) Initial Surcharge Provided Above Micropool

V_s= 50.0 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$

A_t = square inches

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 are to the total screen are for the material specified.)

Other (Y/N): N

C) Ratio of Total Open Area to Total Area (only for type 'Other')

User Ratio =

D) Total Water Quality Screen Area (based on screen type)

A_{total} = sq. in.

E) Depth of Design Volume (EURV or WQCV)
(Based on design concept chosen under 1E)

H= feet

F) Height of Water Quality Screen (H_{TR})

H_{TR}= inches

G) Width of Water Quality Screen Opening ($W_{opening}$)
(Minimum of 12 inches is recommended)

$W_{opening}$ = inches

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 4 of 4

Designer:

Company:

Date: **March 28, 2019**

Project:

Location:

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping:

B) Slope of Overflow Embankment
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

11. Vegetation

Choose One

○ Irrigated

○ Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

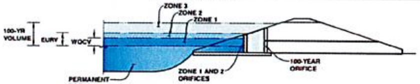
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: MIDTOWN AT HANNAH RIDGE FIL NO. 1

Basin ID: POND 2



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type = **EDB**
Watershed Area = **1.47** acres
Watershed Length = **325** ft
Watershed Slope = **0.060** ft/ft
Watershed Imperviousness = **42.90%** 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) = 0.023 acre-feet
Excess Urban Runoff Volume (EURV) = 0.067 acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) = 0.053 acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) = 0.073 acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) = 0.102 acre-feet
25-yr Runoff Volume (P1 = 2 in.) = 0.150 acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) = 0.182 acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) = 0.225 acre-feet
500-yr Runoff Volume (P1 = 3 in.) = 0.297 acre-feet
Approximate 2-yr Detention Volume = 0.049 acre-feet
Approximate 5-yr Detention Volume = 0.069 acre-feet
Approximate 10-yr Detention Volume = 0.093 acre-feet
Approximate 25-yr Detention Volume = 0.104 acre-feet
Approximate 50-yr Detention Volume = 0.109 acre-feet
Approximate 100-yr Detention Volume = 0.123 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
3.00 inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) = 0.023 acre-feet
Zone 2 Volume (EURV - Zone 1) = 0.044 acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) = 0.057 acre-feet
Total Detention Basin Volume = 0.123 acre-feet
Initial Surcharge Volume (ISV) = **user** ft^3
Initial Surcharge Depth (ISD) = **user** ft
Total Available Detention Depth (H_{total}) = **user** ft
Depth of Trickle Channel (H_{TC}) = **user** ft
Slope of Trickle Channel (S_{TC}) = **user** ft/ft
Slopes of Main Basin Sides (S_{main}) = **user** H:V
Basin Length-to-Width Ratio ($R_{L/W}$) = **user**

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

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	**100**	0.002		
49	--	**0.50**	--	--	--	**100**	0.002	49	0.001
50	--	**1.00**	--	--	--	**1,896**	0.044	530	0.012
51	--	**2.00**	--	--	--	**2,713**	0.062	2,826	0.065
52	--	**3.00**	--	--	--	**3,667**	0.084	6,043	0.139
53	--	**4.00**	--	--	--	**4,760**	0.109	10,257	0.235
54	--	**5.00**	--	--	--	**5,997**	0.138	15,635	0.359
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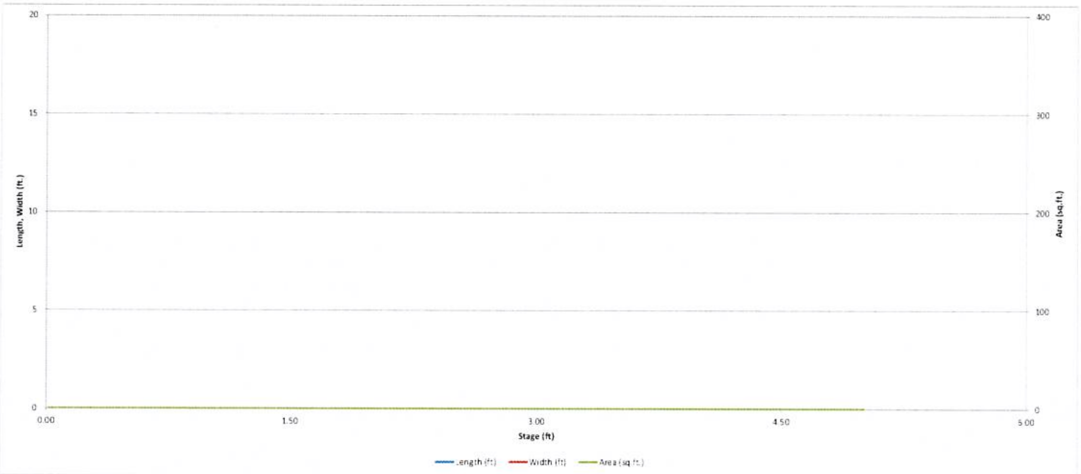
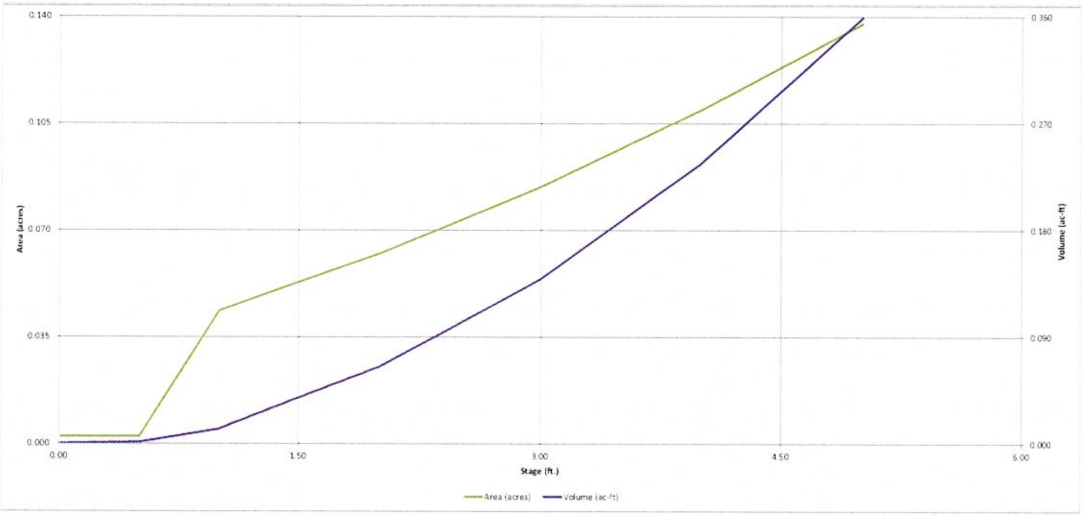
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



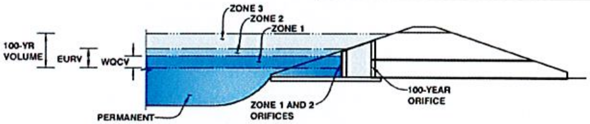


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: MIDTOWN AT HANNAH RIDGE FIL. 1

Basin ID: POND 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.23	0.023	Orifice Plate
Zone 2 (EURV)	2.02	0.044	Orifice Plate
'one 3 (100-year)	2.82	0.057	Weir&Pipe (Restrict)
		0.123	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.35	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.40	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	0.80	1.60					
Orifice Area (sq. inches)	0.17	0.17	0.69					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.35	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Open Area % =	50%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H$_t$ =	3.10	N/A	feet
Over Flow Weir Slope Length =	3.09	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.62	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	4.64	N/A	ft^2
Overflow Grate Open Area w/ Debris =	2.32	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	18.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

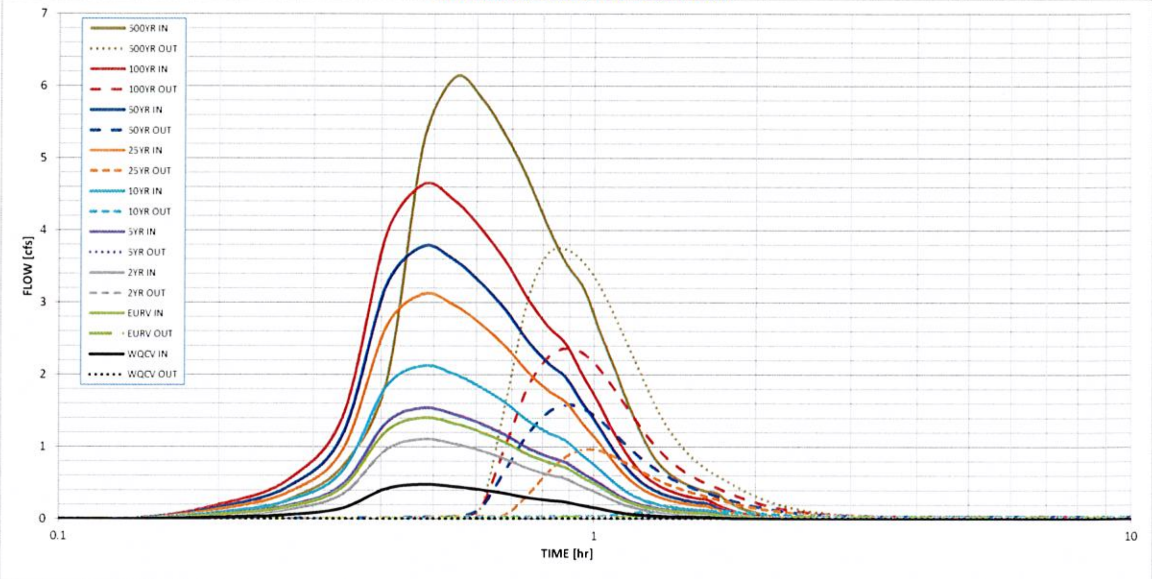
Spillway Design Flow Depth=	0.23	feet
Stage at Top of Freeboard =	4.73	feet
Basin Area at Top of Freeboard =	0.13	acres

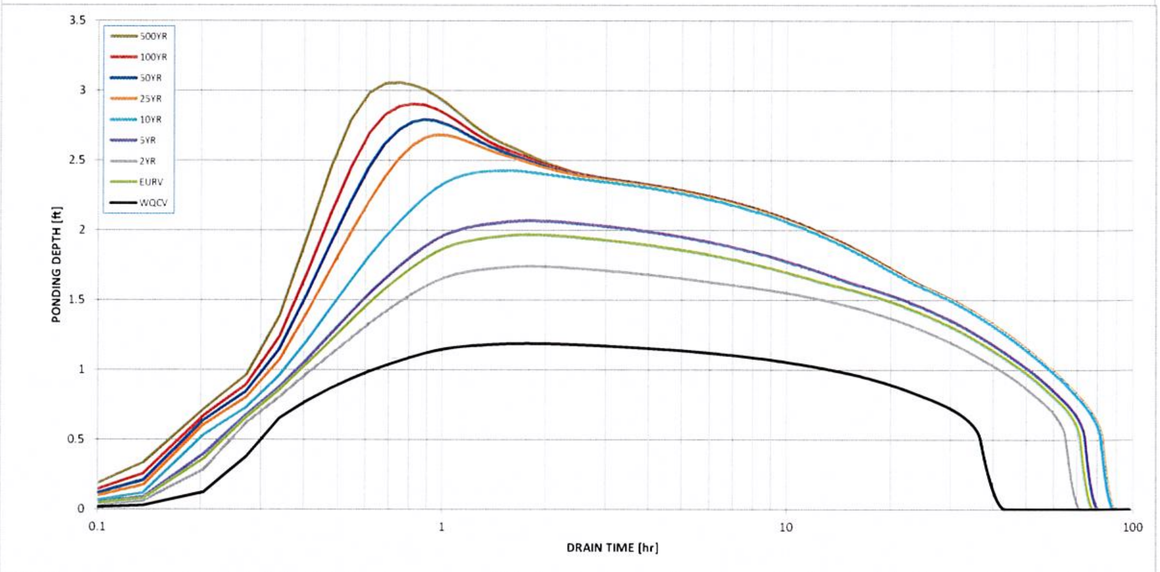
Routed Hydrograph Results

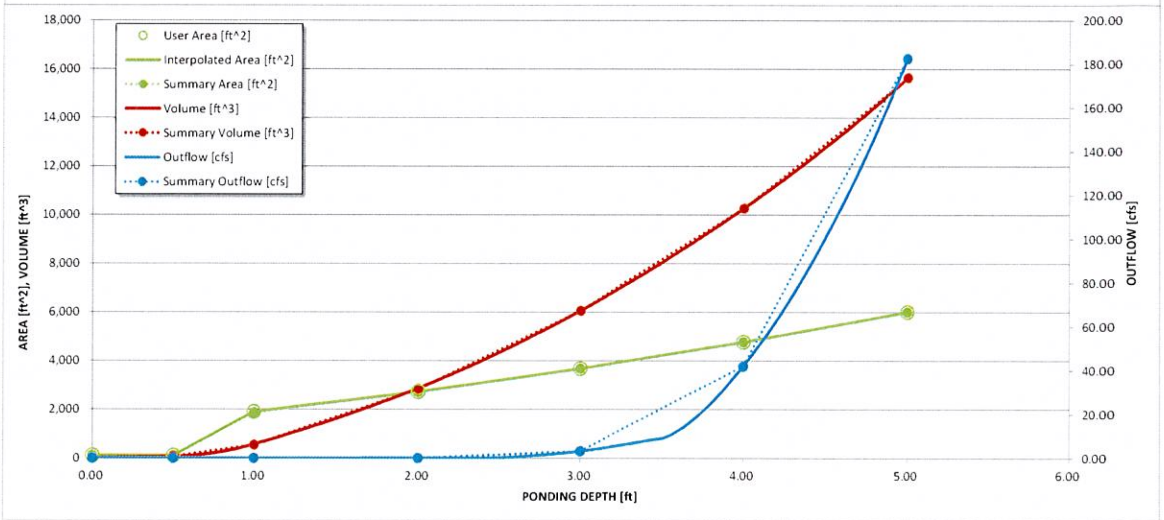
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.023	0.067	0.053	0.073	0.102	0.150	0.182	0.225	0.297
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.022	0.066	0.052	0.073	0.102	0.150	0.183	0.225	0.298
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.03	0.25	0.81	1.11	1.49	2.09
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.038	0.4	1.2	1.6	2.2	3.1
Peak Inflow Q (cfs) =	0.5	1.4	1.1	1.5	2.1	3.1	3.8	4.6	6.1
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.030	0.1	1.0	1.6	2.4	3.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.3	0.8	1.0	1.1	1.2
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.3	0.5	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	64	71	77	74	71	69	65
Time to Drain 99% of Inflow Volume (hours) =	**41**	73	67	76	82	81	80	79	78
Maximum Ponding Depth (ft) =	1.19	1.97	1.74	2.07	2.43	2.68	2.79	2.90	3.05
Area at Maximum Ponding Depth (acres) =	0.05	0.06	0.06	0.06	0.07	0.08	0.08	0.08	0.09
Maximum Volume Stored (acre-ft) =	0.021	0.063	0.050	0.069	0.094	0.113	0.122	0.130	0.143

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

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

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.08 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:08:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:12:14	0.02	0.06	0.05	0.07	0.10	0.14	0.17	0.21	0.28
1.227	0:16:19	0.06	0.17	0.14	0.19	0.26	0.38	0.46	0.56	0.74
	0:20:24	0.15	0.44	0.35	0.48	0.66	0.97	1.17	1.44	1.89
	0:24:29	0.42	1.21	0.96	1.33	1.82	2.67	3.23	3.96	5.20
	0:28:34	0.48	1.40	1.11	1.53	2.12	3.11	3.78	4.63	6.12
	0:32:38	0.45	1.32	1.05	1.45	2.01	2.96	3.59	4.41	5.82
	0:36:43	0.41	1.20	0.95	1.32	1.83	2.69	3.26	4.01	5.30
	0:40:48	0.36	1.06	0.83	1.16	1.61	2.38	2.90	3.56	4.71
	0:44:53	0.30	0.90	0.71	0.99	1.37	2.04	2.48	3.05	4.05
	0:48:58	0.26	0.79	0.62	0.87	1.20	1.78	2.17	2.67	3.53
	0:53:02	0.24	0.71	0.56	0.78	1.09	1.61	1.96	2.41	3.20
	0:57:07	0.19	0.57	0.45	0.63	0.88	1.31	1.60	1.97	2.62
	1:01:12	0.15	0.46	0.36	0.50	0.70	1.05	1.29	1.59	2.12
	1:05:17	0.11	0.34	0.26	0.37	0.52	0.79	0.97	1.20	1.61
	1:09:22	0.08	0.24	0.18	0.26	0.38	0.57	0.70	0.88	1.19
	1:13:26	0.06	0.18	0.14	0.20	0.28	0.42	0.52	0.64	0.87
	1:17:31	0.05	0.14	0.11	0.16	0.22	0.33	0.41	0.51	0.68
	1:21:36	0.04	0.12	0.09	0.13	0.18	0.27	0.34	0.42	0.56
	1:25:41	0.03	0.10	0.08	0.11	0.16	0.23	0.29	0.36	0.47
	1:29:46	0.03	0.09	0.07	0.10	0.14	0.21	0.25	0.31	0.42
	1:33:50	0.03	0.08	0.06	0.09	0.13	0.19	0.23	0.28	0.38
	1:37:55	0.03	0.08	0.06	0.08	0.12	0.17	0.21	0.26	0.35
	1:42:00	0.02	0.06	0.04	0.06	0.09	0.13	0.16	0.19	0.26
	1:46:05	0.01	0.04	0.03	0.04	0.06	0.09	0.11	0.14	0.19
	1:50:10	0.01	0.03	0.02	0.03	0.05	0.07	0.08	0.10	0.14
	1:54:14	0.01	0.02	0.02	0.02	0.03	0.05	0.06	0.07	0.10
	1:58:19	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.07
	2:02:24	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05
	2:06:29	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03
	2:10:34	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02
	2:14:38	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	2:18:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:22:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:26:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:39:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:43:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:47:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:51:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:59:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:03:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:07:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:11:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:24:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:28:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:36:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:48:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:04:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:08:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:12:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:17:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:21:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:33:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:41:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	100	0.002	0	0.000	0.00
	0.50	100	0.002	49	0.001	0.00
	1.00	1,860	0.043	530	0.012	0.01
	2.00	2,705	0.062	2,826	0.065	0.03
	3.00	3,667	0.084	6,043	0.139	3.20
	4.00	4,760	0.109	10,257	0.235	41.90
	5.00	5,997	0.138	15,635	0.359	182.56

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

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

DRAINAGE MAPS

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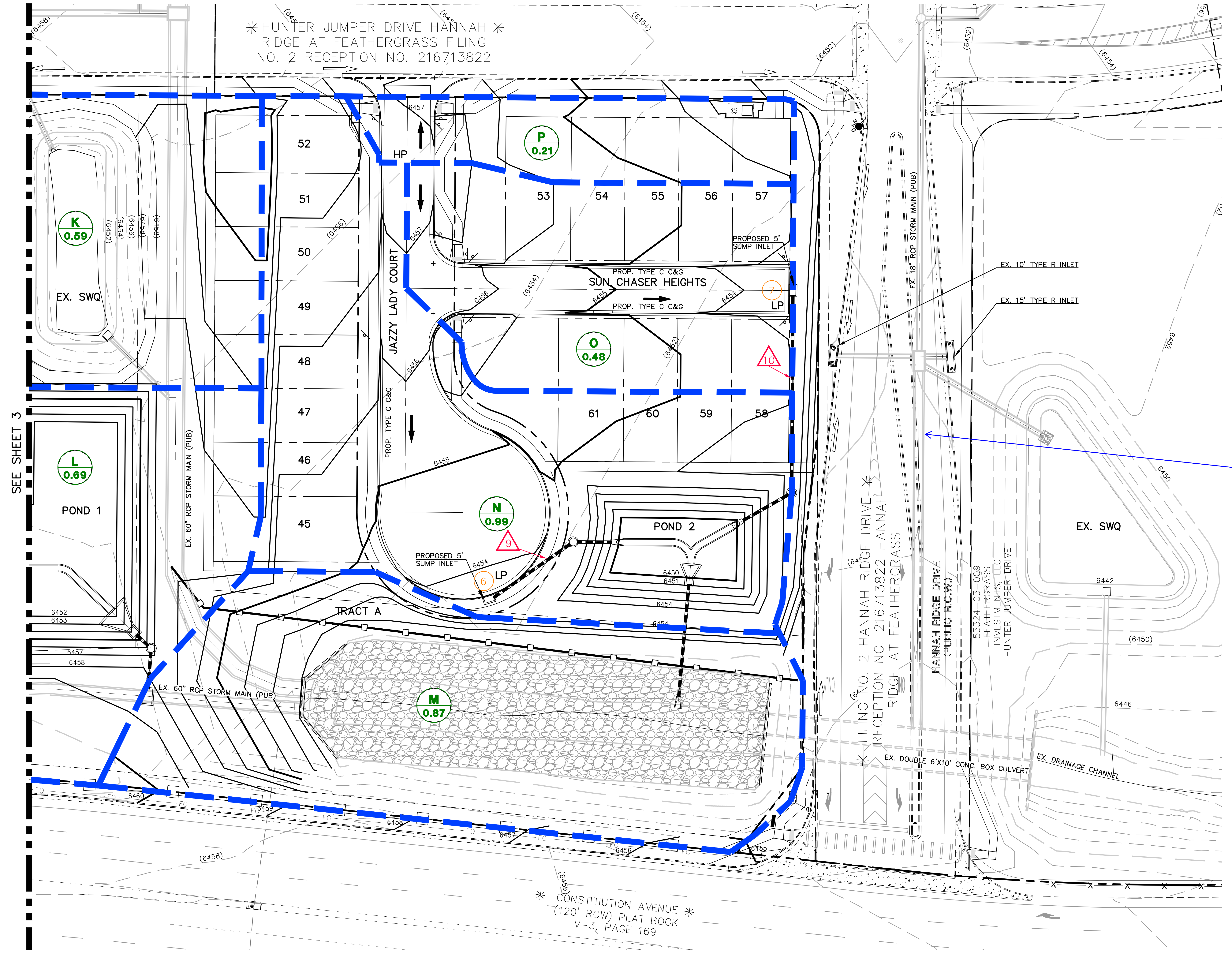
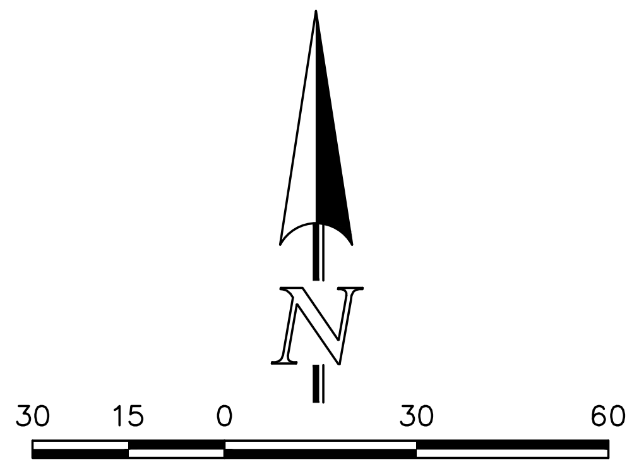


Please include an existing conditions plan that shows the existing storm sewer. This connecting pipe and the one the next sheet need to be shown. It is unclear how the storm gets captured in the existing SWQ facilities currently.



SCALE: 1" = 30'

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 1.41	BASIN IDENTIFIER AREA IN ACRES
△ 1	PIPE RUN
○ 1	DESIGN POINT

SF-19-___

48 HOURS BEFORE YOU DIG,
CALL UTILITY LOCATORS
811
UTILITY NOTIFICATION CENTER OF COLORADO
IT'S THE LAW

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE CAUSED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NO.	REVISION	DATE

REVIEW:

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

KYLE R. CAMPBELL, COLORADO P.E. #29794 DATE

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799(Fax)

MIDTOWN COLLECTION AT HANNAH RIDGE
FILING NO. 1
DEVELOPED CONDITIONS DRAINAGE MAP

DESIGNED BY	KRC	SCALE	DATE 03/22/19
DRAWN BY	LDB	(H) 1"= 30'	SHEET 1 OF 3
CHECKED BY		(V) 1"= NA	JOB NO. 1116.30

N:\111630\DRAWINGS\DEVELOPMENT\111630-FDR-MAP 01.dwg, 3/28/2019 12:30:09 PM, 1:1

Identify design point 8.

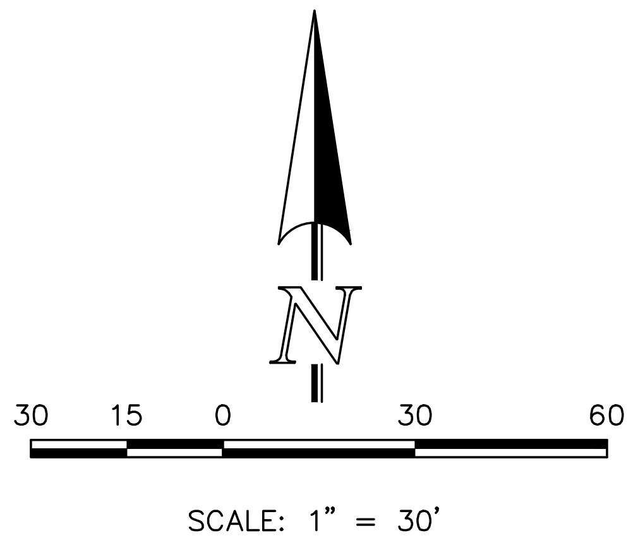
Basin E needs to flow to a Detention SWQ facility.

Please include an existing conditions plan that shows the existing storm sewer. This connecting pipe and the one on the previous sheet need to be shown. It is unclear how the storm gets captured in the existing SWQ facilities currently.

This is Sheet 2

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 1.41	BASIN IDENTIFIER AREA IN ACRES
△1	PIPE RUN
①	DESIGN POINT



SCALE: 1" = 30'

SF-19-___

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NO.	REVISION	DATE

REVIEW:

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KYLE R. CAMPBELL, COLORADO P.E. #29794 DATE

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Colorado Springs, Colorado 80903 (719)785-0799(Fax)

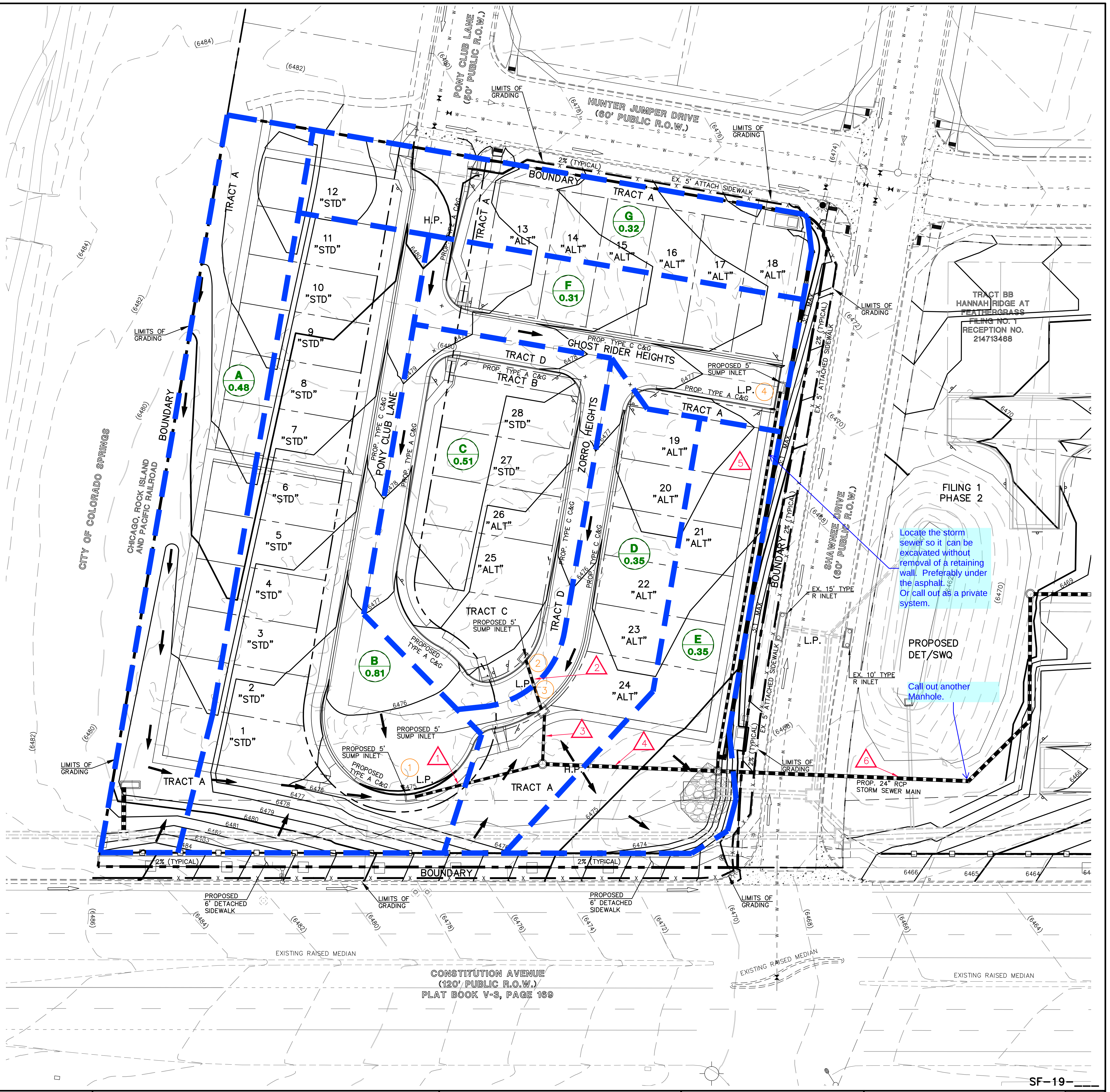
MIDTOWN COLLECTION AT HANNAH RIDGE
FILING NO. 1
DEVELOPED CONDITIONS DRAINAGE MAP

DESIGNED BY	KRC	SCALE	DATE 03/22/19
DRAWN BY	KC	(H) 1"= 30'	SHEET 2 OF 3
CHECKED BY		(V) 1"= NA	JOB NO. 1116.30

30 15 0 30 60

SCALE: 1" = 30'

Provide a summary of all design points for all design flows. In a table, on these plans. Sheet 33?
Darken design points so they can be identified on a printed version.
Basin E needs to flow to a detention/SWQ Facility.



Locate the storm sewer so it can be excavated without removal of a retaining wall. Preferably under the asphalt.
Or call out as a private system.

Call out another Manhole.

SF-19-___

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
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NO.	REVISION	DATE

REVIEW:

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

KYLE R. CAMPBELL, COLORADO P.E. #29794 DATE

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619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799(Fax)

MIDTOWN COLLECTION AT HANNAH RIDGE
FILING NO. 2
DEVELOPED CONDITIONS DRAINAGE MAP

DESIGNED BY	KRC	SCALE		DATE	03/22/19
DRAWN BY	LDB	(H) 1"= 30'		SHEET 3	OF 3
CHECKED BY		(V) 1"= NA		JOB NO.	1116.30