PRELIMINARY DRAINAGE REPORT
for
HAVEN VALLEY

El Paso County, Colorado

April 2021

EL PASO COUNTY PCD FILE NO. _____

Prepared for:

Richmond American Homes
4350 S. Monaco Street
Denver, CO 80237
Contact: Matthew Jenkins
(303) 773-1100

Prepared by:

Drexel, Barrell & Co.
3 South 7th Street
Colorado Springs, CO 80905
Contact: Tim McConnell, P.E.
(719) 260-0887

TABLE OF CONTENTS

APPENDICES

PRELIMINARY DRAINAGE REPORT
for
HAVEN VALLEY
Security, Colorado

1.0 CERTIFICATION STATEMENTS

ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by El Paso County for drainage reports, and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omission on my part in preparing this report.

_____

Tim D. McConnell, P.E. Date
Colorado P.E. License No. 33797
For and on Behalf of Drexel, Barrell & Co.

DEVELOPER'S STATEMENT

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

Business Name: Richmond American Homes

By: _____
Matthew Jenkins Date
Title: Director, Land Acquisition
Address: 4350 S. Monaco Street
Denver, CO 80237

EL PASO COUNTY

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

_____

For the County Engineer Date
CONDITIONS:

PRELIMINARY DRAINAGE REPORT
for
HAVEN VALLEY
Security, Colorado

2.0 PURPOSE

This report is prepared by Drexel, Barrell & Co in support of the Haven Valley in Security, CO. 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 outfall facilities.

3.0 GENERAL SITE DESCRIPTION

Location

Haven Valley is a 11.768 acre subdivision within the northwest quarter of Section 12, Township 15 South, Range 66 West of the 6th Principle Meridian in El Paso County, Colorado. The site is located southwest of Cable Ln and west of Hunters Run. The site is bounded on the north by Calvary Fellowship Fountain Valley church and Cable Ln, the west by Good Shepherd United Methodist church, and the south and the east by residential subdivision Pheasant Run Ranch Filing No. 1. See Vicinity Map in Appendix.

Existing Site Conditions

The site is approximately 11.768 acres in size surrounded by existing development. There are no existing structures on the site, only native grasses, a few trees and shrubs. There are no existing irrigation facilities on the project site. The project site slopes moderately from the northeast to southwest at approximately 5-7%. Existing drainage flows to the southwest where it drains overland between two houses to Pecos Drive, then south on Widefield Drive. Severe flooding has been observed between these two houses and one of the houses has experienced mold issues in the past.

Proposed Site Conditions

Haven Valley is a small lot single-family development, consisting of approximately 98 lots, streets, landscape areas and open space. A proposed full-spectrum detention pond is proposed to be constructed in an existing off-site drainage easement adjacent to the west side of the site. The flows will be released from the detention pond and be carried by pipe between the two houses and outlet via a bubbler in Widefield Drive.

Soils

According to the Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, the site is underlain by the Blakeland loamy sand (Soil No. 8). This soil is a type 'A' hydrologic soil group. This type of soil typically exhibits rapid infiltration rates and slow runoff characteristics with moderate erosion potential. See appendix for Soil Map.

Climate

This area of El Paso County can be described as the foothills, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry, and summers relatively warm and dry. Precipitation ranges from 12 to 14 inches per year, with the majority of this moisture occurring in the spring and summer in the form of rainfall. Thunderstorms are common during the summer months.

Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel 08041C0763G (December 7, 2018), the site does not lie within a designated 100-year floodplain. The site is in Zone X, an area of minimal flood hazard. See Appendix for FIRMette map.

Previous Drainage Studies

The site is located within the Security Drainage Basin, as studied in the Little Johnson/Security Drainage Basin Planning Study, prepared by Simons Li & Associates, Inc., 1987.

4.0 EXISTING CONDITION HYDROLOGY SUMMARY

Basin OS1 is an offsite basin to the north. This basin drains the Elm Grove Subdivision (town homes, age restricted) and several commercial buildings on the east side of Main St. and the Wilson Elementary School on the west side of Main St. The runoff path begins on Main Street near the intersection of Bradley Road, then flows southerly down Main Street via curb and gutter. The runoff at this intersection is collected by a storm sewer constructed as part of the 1993 Main Street reconstruction by El Paso County. The storm drain system conveys runoff east underground via storm sewer and discharges in to a valley gutter within the Elm Grove Subdivision. The valley gutter drains south to an existing detention pond (roughly 3-4' deep) where it is detained slightly. The pond discharges via a 24" CMP to the south. The 24" CMP is undersized for the 100-year which overtops the pond and drains into a swale which in turn drains south overland between two houses in the Security Colorado Addition 4, then south to the curb and gutter in Pecos Drive and Widefield Drive. The runoff generated by Basin OS1 is calculated to be 46.0 cfs and 88.8 cfs for the 5-year and 100-year storm respectively into the detention pond. After detention, the pond outflows are 18.1 cfs and 52.3 cfs respectively for the 5-year and 100-year storms.

Basin OS2 is an offsite basin to the north of the site. Runoff from this basin is primarily generated from roof, parking lot and vacant land. The runoff path begins on Cable Lane and generally flows southerly along the west property line until it reaches Design Point A. Design Point A collects the flow from Basin OS2 and the release from the detention pond in Basin OS1. This flow is routed southerly through a small swale that divides Basins OS3 and H1. The calculated runoff from Basin OS2 is 11.8 cfs and 21.5 cfs for the 5-year and 100-year storm respectively.

Design Point A. The drainage swale previously mentioned conveys the flow from Design Point A to Design Point B. The calculated flow at Design Point A is 29.9 cfs and 73.8 cfs for the 5-year and 100-year storm respectively. This flow includes detained flow from the Elm Grove pond and from Basin OS-2 which is conveyed south in an existing swale to a historic low point just north of Security Colorado Addn. No. 4 (Des. Pt. B).

Basin OS3 is an offsite basin to the west of the site. Runoff from this basin is generated from roof, street, parking lot and vacant land. The runoff path flows southerly down Main Street via curb and gutter and then easterly onto Leta Drive. The flow then continues south through a parking lot until it empties onto vacant land, then travels to the southeast to Design Point B. Design Point B collects the flow from all basins; OS1, OS2, OS3 and H1 and drains them overland between two houses in the Security Colorado Addition 4, then south to the curb and gutter in Pecos Drive and Widefield Drive. Severe flooding between these houses has been observed on numerous occasions in the past. The calculated runoff from Basin OS3 is 15.6 cfs and 37.4 cfs for the 5-year and 100-year storm respectively.

Basin H1 is an onsite basin which drains the site plus street runoff from Alturas Drive and Cable Lane. The east half of Alturas Drive drains is not included in this basin which drains overland eastward into the Windmill Creek Subdivision per the approved drainage report by Jefferies Engineering, October 10, 2001. Runoff from the undeveloped lot west of Alturas Drive is currently collected in a swale west of the ROW and directed south into a detention pond which outlets into the FMIC superditch. Future conditions for this undeveloped lot will need to remain the same as existing since additional runoff down Alturas would severely affect downstream properties. Runoff from the west half of Alturas Drive only is included in this basin per existing conditions. The runoff path for Basin H1 begins near the intersection of Alturas Drive and Bradley Road (west half), and then flows southwesterly via an asphalt curb southward and over the top of the FMIC superditch. The flow then crosses Cable Lane and generally flows southwesterly through vacant land to Design Point B. The calculated runoff for Basin H1 is 6.9 cfs and 30.4 cfs for the 5-year and 100-year storm respectively.

Design Point B includes flow from Design Point A, Basin OS-3, and H1. Design Point B discharges through the Security Colorado Addition No. 4 Refile Subdivision overland between two houses, then south to curb and gutter Pecos Drive and Widefield Drive. The total flow at Design Point B is 46.1 cfs and 129.0 cfs for the 5-year and 100-year storm respectively between the two houses. Both of these two homeowners have indicated that they have experienced severe flooding of the backyard and crawl spaces of their homes.

Basin OS4 is an offsite basin to the west of the site including Main Street and a portion of land west of Main Street. Runoff from this basin is generated from roof, street, and parking lot. The runoff path flows southerly down Main Street via curb and gutter to the intersection of Pecos Drive. An existing storm sewer system was constructed in 1993 as part of the 1993 Main Street reconstruction project by El Paso County. The storm system picks up street flow and discharges it to a 15' bubbler located just east of the intersection of Pecos Drive and Main Street. From the bubbler, all runoff is carried overland east to Widefield Drive (Design Pt C), then south on Widefield Drive via curb and gutter. There is no existing storm sewer system within Pecos or Widefield Drive. The calculated runoff from Basin OS4 is 39.6 cfs and 82.3 cfs for the 5-year and 100-year storm respectively. The existing street capacity of

Widefield Drive (0.54% street slope) as it flows south from Pecos Drive is 12 cfs and 54 cfs for the 5-year and 100-year storm respectively. As shown, the flow from this basin alone exceeds the street capacity of Widefield Drive.

Design Point C is located at the intersection of Pecos Drive and Widefield Drive and includes flow from Design Point B and Basin OS-4. At Design Point C the existing flow with detention from the Elm Grove pond is 80.3 cfs and 200.0 cfs for the 5-year and 100-year storm respectively, which is all overland flow. The existing street capacity of Widefield Drive as it flows south (0.54% street slope) from Pecos Drive is 12 cfs and 54 cfs for the 5-year and 100-year storm events. As shown, the existing street capacity is severely exceeded in existing conditions which is echoed by the residents in this area experiencing chronic flooding at this intersection. This development is proposing to reduce the flooding issues in this area which will be discussed later in this report.

5.0 PROPOSED HYDROLOGY (RATIONAL METHOD) & HYDRAULIC SUMMARY

The Rational Method was used to determine runoff quantities for the 5- and 100-year storm recurrence intervals. Urban Drainage UD-Detention and Flowmaster were used to determine pond and storm system sizing. UD-Inlet and UD-Sewer were also used to identify pond and storm system sizing (see appendix for calculations). See below for a summary runoff table of the basins and for descriptions of each design point. See appendix for Proposed Drainage Map showing the proposed drainage basin locations.

Rational Method Runoff Summary

BASIN	AREA (AC)	Q5 (cfs)	Q100 (cfs)
A	0.44	0.5	1.5
OS-1	16.90	46.0	88.8
OS-2	2.85	11.8	21.5
B	1.42	3.2	6.6
C	3.43	6.4	14.0
D	0.98	1.2	3.5
E	1.59	3.1	6.7
F	3.29	6.9	15.3
G	0.83	1.0	3.0
OS-3	9.74	15.6	37.4
H	1.77	2.4	6.1
OS-4	20.04	39.6	82.3

Design Point 1 (DP-1) represents flows generated from existing Elm Grove pond release in offsite basin OS-1, as well as flows from offsite basin OS-2 and onsite Basin A. The flows are conveyed via a swale and are then captured by a proposed private Type D area inlet. The flows leave this inlet via a proposed private 36" RCP storm pipe and are conveyed to the proposed Extended Detention Basin to the south. The total flow at DP-1 is 28.1 cfs and

71.0 cfs for the 5-year and 100-year storm respectively. The Type D area inlet can capture all of the flows from basin OS-2 and A, but not the flows released from the existing pond. A swale is to be installed from DP-1 to the proposed EDB and this swale can carry 75 cfs.

Design Point 2 (DP-2) represents flows generated from onsite Basin B. The flows are captured by a proposed private at-grade 5' Type R inlet in Basin B. The flows leave this inlet via a proposed private 18" RCP storm pipe and are carried south to DP-J1. The total flow at DP-2 is 3.2 cfs and 6.6 cfs for the 5-year and 100-year storm respectively.

Design Point 3 (DP-3) represents flows generated from Basin C. The flows are captured by a proposed private at-grade 15' Type R inlet in Basin C. The flows leave this inlet via a proposed private 24" RCP storm pipe and are carried west to DP-J1. The total flow at DP-3 is 6.4 cfs and 14.0 cfs for the 5-year and 100-year storm respectively.

Design Point J1 (DP-J1) represents flows generated from Basins B and C. This design point is located at a proposed junction with a Type II manhole in Basin C. The flows leave this manhole via a proposed private 24" RCP storm pipe and are carried south to DP-J3. The total flow at DP-J1 is 9.5 cfs and 20.3 cfs for the 5-year and 100-year storm respectively.

Design Point 4 (DP-4) represents flows generated from Basin D. The flows are conveyed via a swale and are then captured by a proposed private sump condition Type C area inlet in Basin D. The flows leave this inlet via a proposed private 18" RCP storm pipe and are carried west to DP-J2. The total flow at DP-4 is 1.2 cfs and 3.5 cfs for the 5-year and 100-year storm respectively.

Design Point 5 (DP-5) represents flows generated from Basin E. The flows are captured by a proposed private at-grade 5' Type R inlet in Basin E. The flows leave this inlet via a proposed private 18" RCP storm pipe and are carried south to DP-J2. The total flow at DP-5 is 3.1 cfs and 6.7 cfs for the 5-year and 100-year storm respectively.

Design Point J2 (DP-J2) represents flows generated from Basins D and E. This design point is located at a proposed junction with a Type II manhole in Basin E. The flows leave this manhole via a proposed private 18" RCP storm pipe and are carried west to DP-J3. The total flow at DP-J2 is 4.3 cfs and 10.0 cfs for the 5-year and 100-year storm respectively.

Design Point J3 (DP-J3) represents flows generated from Basins B, C, D and E. This design point is located at a proposed junction with a Type II manhole in Basin F. The flows leave this manhole via a proposed private 24" RCP storm pipe and are carried west to DP-6. The total flow at DP-J3 is 13.5 cfs and 29.8 cfs for the 5-year and 100-year storm respectively.

Design Point 6 (DP-6) represents flows generated from Basins B, C, D, E and F. The flows are captured by a proposed private sump 15' Type R inlet in Basin F. The flows leave this inlet via a proposed private 24" RCP storm pipe and are carried west to the proposed Extended Detention Basin. The total flow at DP-6 is 19.2 cfs and 42.4 cfs for the 5-year and 100-year storm respectively.

Design Point 7 (DP-7) represents flows generated from Basin G. The flows are captured by a proposed swale and are carried to the proposed Extended Detention Basin. The

total flow at DP-7 is 1.0 cfs and 3.0 cfs for the 5-year and 100-year storm respectively.

Design Point P1 (DP-P1) represents all of the flows generated from Basins OS-1, Exist. Elm Pond release and Basins A through G. These are all of the flows that are captured by the proposed Extended Detention Basin. Further detail is provided on the EDB in the following section of this report. The total flows at DP-P1 is 63.1 cfs and 152.1 cfs for the 5-year and 100-year storm respectively.

Design Point 8 (DP-8) represents flows generated from Basin H combined with the released flows from the proposed EDB. The flows are conveyed via a swale and are then captured by a proposed public sump condition Type D area inlet in Basin H. The flows leave this inlet via a proposed public 18" RCP storm pipe and are carried south to DP-J4. By piping these flows between the two houses, flooding for these two existing residences will be eliminated in this area. In the event of a storm event that overtops the EDB spillway, a concrete channel is proposed between the two existing residences to help prevent flooding. The concrete channel is to be 2.5' high x 6.5' wide and is directly over the 18" RCP pipe below. The total flow at DP-8 is 3.5 cfs and 24.8 cfs for the 5-year and 100-year storm respectively.

Design Point O4 (DP-O4) represents flows generated from Basin OS-4. A proposed public at-grade 15' Type R inlet is to be installed on existing Pecos Dr/Widefield Dr. knuckle. This inlet will not be able to capture all of the flows generated from this subdivision, but will capture some and improve the flooding experienced by the residents in this area. The total flow at DP-O4 is 39.6 cfs and 82.3 cfs for the 5-year and 100-year storm respectively. The street capacity of Pecos Dr. can handle the 100-yr flows, but not the 5-yr flows.

Design Point J4 (DP-J4) represents flows generated from Basins H, OS-4 and the flows released from the proposed EDB. This design point is located at a proposed junction with a Type I manhole in Basin OS-4. The flows leave this manhole via a proposed public 34"x 53" elliptical RCP storm pipe and are carried south where they will outlet via a 25' Type R inlet to be used as a bubbler in Widefield Drive and continue to the south along historic drainage routes. The total flow at DP-J4 is 43.0 cfs and 107.1 cfs for the 5-year and 100-year storm respectively.

None of the streets exceed capacity, see Appendix for Street Capacity Charts. See also inlet capacity charts for inlet sizing in the Appendix.

6.0 PROPOSED DETENTION/WATER QUALITY FACILITIES

The proposed public full spectrum Extended Detention Basin (EDB) is located southwest of the project site within a 1.29 acre drainage easement. This detention pond will fulfill on-site detention needs as well as providing detention for upstream properties, since there is a lack up detention facilities upstream which has caused chronic flooding issues between the two residences that the flows currently pass between on their way to Widefield Dr. The 1.29 acre easement is proposed to be dedicated as a public drainage/detention easement and the pond to be maintained by El Paso County. The Security DBPS does not address the need for a pond in this area, rather if shows roughly 188 cfs (100-year storm) passing between the two houses with only a 24" storm sewer and

no swale to convey the flow. The developed peak 100-year flow calculated in this report is 152.1 cfs at this location. The difference in flow is attributed to the DBPS bypassing Elm Grove Pond. The proposal shown in the DBPS does not work and will flood the two residences. Even though the DBPS does not adequately address flooding issues in this area, we are proposing to construct a facility nearly three times the size of a facility necessary to detain runoff from our project site alone.

The proposed detention facility has been designed to capture flows from Basins OS-1, OS-2, OS-3 and Basins A through G. A total of 41.47 acres is tributary to this EDB with a composite imperviousness of 57.8%. The required pond volume for 100-year detention is 4.409 acre-feet. The actual pond volume will be 4.542 acre-feet. Concrete forebays with energy dissipaters will be placed where the flows enter the pond on the northeast and the east sides of the pond. The combined volume of the two forebays will be 3% of the WQCV volume for the pond and will be divided proportionally. The flows will exit the forebays through a notch and into the concrete trickle channel at the bottom of the pond that conveys the flows to the micropool. It will capture then release the flows at a reduced flow rate with the use of a plate with orifice holes into a proposed 18" pipe with a restrictor plate. The 18" pipe continues to the south, between the two existing residences, and outfalls into a bubbler in Widefield Dr. where they continue in historic patterns to the south.

In accordance with El Paso County criteria, the modified Type C outlet structure with a permanent micropool will release the WQCV over a 40-hour period. The outlet structure will result in release rates of 0.9 cfs and 17.6 cfs for the 5-year and 100-year storm respectively.

A 30-ft wide riprap emergency spillway will be located on the south side of the pond. In the event that water overtops the spillway, flow will discharge into a 2.5' high x 6.5' wide concrete channel between the two residences before discharging into Widefield Dr. curb and gutter and continuing to the south.

Pond calculations are provided in the appendix as well as forebay volumes, micropool sizing, outlet structure design, dishcharge pipe and spillway design.

The pond will have a 10' wide maintenance access that will provide access to the pond bottom. Private maintenance agreements and O&M manuals will be established for this pond as required by the County.

7.0 FOUR-STEP PROCESS

This project conforms to the City of Colorado Springs/El Paso County Four Step Process. The process focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls.

1. ***Employ Runoff Reduction Practices:*** Proposed impervious areas on this site (roofs, asphalt/sidewalk) will sheet flow across landscaped ground as much as possible to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets and storm sewer system. This will minimize directly

connected impervious areas within the project site.

2. ***Implement BMP's that provide a Water Quality Capture Volume with slow release:*** Runoff from this project will be treated through capture and slow release of the WQCV in a permanent Extended Detention Basin facility designed per current City of Colorado Springs/El Paso County drainage criteria.

3. ***Stabilize Drainage Ways:*** Flows from the pond are released into Widefield Dr. curb and gutter and no stabilization will be necessary.

4. ***Implement Site Specific and Other Source Control BMP's:*** The site is proposed as a residential development, and as such standard household source control will be utilized in order to minimize potential pollutants entering the storm system. Example source control measures consist of: garages for storage of household chemicals, trash receptacles for individual households and in common areas for pet waste. The need for Industrial and Commercial BMP's was considered, however per ECM I.7.2.A the need for industrial and commercial BMPs are not applicable for this project.

8.0 GEOTECHNICAL HAZARDS

In accordance with geotechnical recommendations, the project design is intended to direct runoff away from structures at a minimum slope of six inches over ten feet, and into the receiving water quality basin. This will be accomplished by a variety of means, i.e. curb and gutter and storm sewer.

9.0 DRAINAGE & BRIDGE FEES

Drainage and Bridge Fees

The project lies within the Security Drainage Basin and is previously un-platted. The following fees are required at time of plat recordation:

Impervious area = 11.768 acres x 58.1% = 6.84 acres

Drainage Fees
$19,752 x 6.84 Impervious Acres = $135,103.68

Bridge Fees
None

Full reimbursement for construction of the drainage facility for Haven Valley and outfall in accordance with DCM Section 3.3, is anticipated. Construction costs are listed below and the drainage fee is requested to be adjusted accordingly.

10.0 CONSTRUCTION COST ESTIMATE

Private (Non-Reimbursable)

Description	Quantity	Unit Cost	Cost
Type C Area Inlet	1 EA	$4,800/EA	$4,800
Type D Area Inlet	1 EA	$5,900/EA	$5,900
5' Type R Inlet	2 EA	$5,700/EA	$11,400
15' Type R Inlet	2 EA	$10,300/EA	$20,600
Type II Manhole	3 EA	$5,000/EA	$15,000
18" RCP storm	865 LF	$67/LF	$57,955
24" RCP storm	180 LF	$81/LF	$14,580
36" RCP storm	385 LF	$124/LF	$47,740
		Subtotal	$177,975
		Engineering & Contingency (10%)	$17,798
		TOTAL	$195,773

Public (Reimbursable)

Description	Quantity	Unit Cost	Cost
Type D Area Inlet	1 EA	$5,900/EA	$5,900
15' Type R Inlet	1 EA	$10,300/EA	$10,300
25' Type R Inlet	1 EA	$15,000/EA	$15,000
Type I Manhole	3 EA	$7,000/EA	$21,000
18" RCP storm	130 LF	$67/LF	$8,710
24" RCP storm	105 LF	$81/LF	$8,505
48" RCP storm	15 LF	$184/LF	$2,760
34"x53" elliptical RCP	330 LF	$184/LF	$60,720
Water Quality/Detention Ponds	1 EA	$50,000/LS	$50,000
		Subtotal	$182,895
		Engineering & Contingency (10%)	$18,290
		TOTAL	$201,185

11.0 CONCLUSIONS

The Haven Valley project has been designed in accordance with El Paso County criteria. The detention pond and water quality basin have been designed to limit the release of storm runoff to historic flows. This development will not negatively impact the downstream facilities.

12.0 REFERENCES

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs/El Paso County Drainage Criteria Manual, May 2014.

2. Urban Storm Drainage Criteria Manuals, Urban Drainage and Flood Control District. June 2001, Revised April 2008.

3. Preliminary & Final Drainage Report for Patriot Village. Prepared by Core Engineering Group, LLC, December 2013.

4. Natural Resources Conservation Service (NRCS) Web Soil Survey

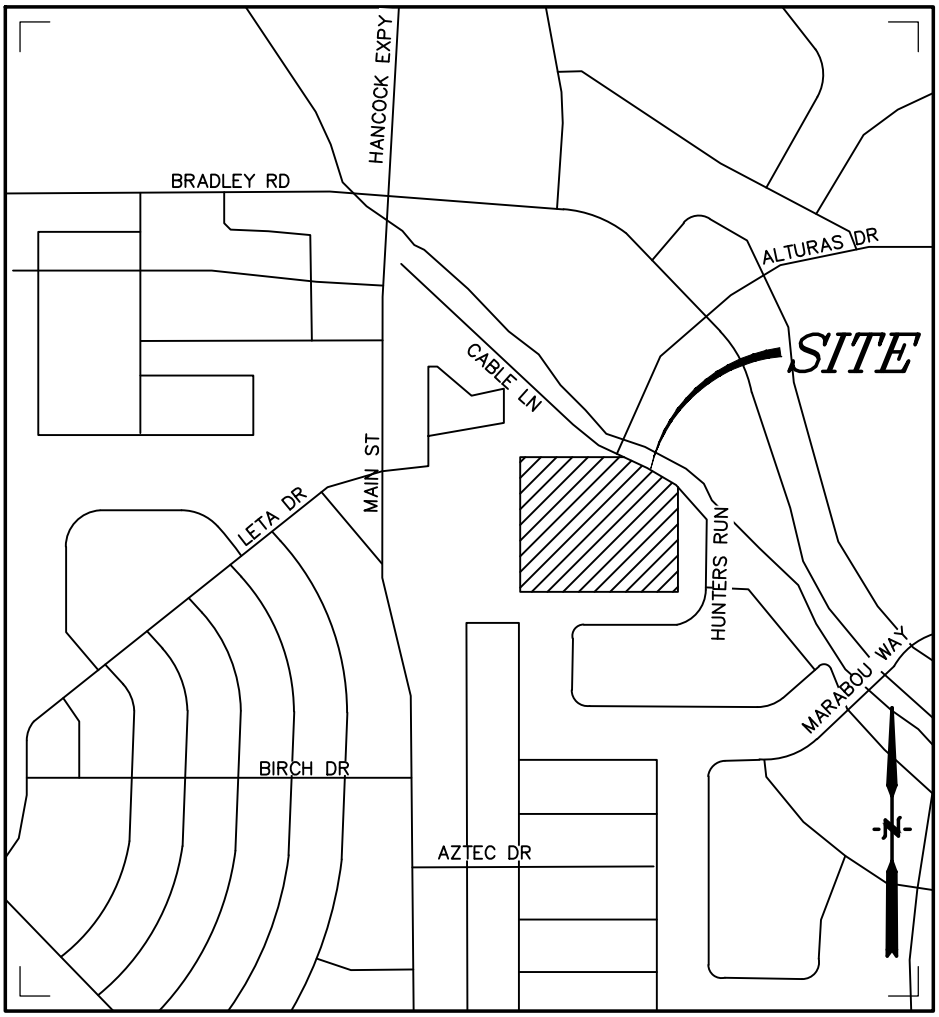
5. Federal Emergency Management Agency, Flood Insurance Rate Map, El Paso County, Colorado and Unincorporated Areas, Map Number 08041C0763G, Effective Date December 7, 2018

6. EL Paso County Board Resolution No 15-042: El Paso County adoption of Chapter 6 and Section 3.2.1, Chapter 13 of the City of Colorado Springs Drainage Criteria Manual, May 2014.

7. Little Johnson/Security Drainage Basin Planning Study. Prepared by Simons Li & Associates, Inc., 1988.

8. Soil Investigation Report for Patriot Village. Prepared by Colorado Enginering & Geotechnical Group, Inc., November 15, 2004.

APPENDIX



Vicinity Map
Not to scale

HAVEN HILLS
COLORADO SPRINGS, CO
VICINITY MAP

Drexel, Barrell & Co.
Engineers • Surveyors

DATE:

JOB NO: 21085-03CSCV

DWG. NO. VMAP

SHEET 1 OF 1

Hydrologic Soil Group—El Paso County Area, Colorado

Map Scale: 1:1,860 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

Streams and Canals

Transportation

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

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

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

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

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	12.7	100.0%
Totals for Area of Interest			**12.7**	**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

National Flood Hazard Layer FIRMette

FEMA

104°44'26"W 38°46'14"N

104°43'49"W 38°45'46"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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

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

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

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

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

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/8/2021 at 1:19 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.

PROJECT INFORMATION

Drexel, Barrell & Co.

PROJECT:	Haven Valley
PROJECT NO:	21085-03
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	City of Colorado Springs
REPORT TYPE:	Final
DATE:	4/29/2021
Soil Type: A	

	C2*	C5*	C10*	C100*	% IMPERV
Pasture/Meadow		0.08		0.35	0
Commercial		0.81		0.88	95
1/8 Acre Residential		0.45		0.59	65
Asphalt/Sidewalk		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 5-1, City of Colorado Springs "Drainage Criteria Manual"

EXISTING

SUB-BASIN	SURFACE DESIGNATION	AREA	COMPOSITE RUNOFF COEFFICIENTS				% IMPERV
		ACRE	C2	C5	C10	C100	
OS-1	Pasture/Meadow	0.00		0.08		0.35	0
	Commercial	8.10		0.81		0.88	95
	1/8 Acre Residential	7.20		0.45		0.59	65
	Asphalt/Sidewalk	1.60		0.90		0.96	100
	WEIGHTED AVERAGE			0.67		0.76	83%
TOTAL OS-1		16.90					
OS-2	Pasture/Meadow	0.00		0.08		0.35	0
	Commercial	2.85		0.81		0.88	95
	1/8 Acre Residential	0.00		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.81		0.88	95%
TOTAL OS-2		2.85					
OS-3	Pasture/Meadow	4.93		0.08		0.35	0
	Commercial	4.05		0.81		0.88	95
	1/8 Acre Residential	0.76		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.41		0.59	45%
TOTAL OS-3		9.74					
OS-4	Pasture/Meadow	0.00		0.08		0.35	0
	Commercial	4.20		0.81		0.88	95
	1/8 Acre Residential	15.84		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.53		0.65	71%
TOTAL OS-4		20.04					
H-1	Pasture/Meadow	12.03		0.08		0.35	0
	Commercial	0.00		0.81		0.88	95
	1/8 Acre Residential	0.39		0.45		0.59	65
	Asphalt/Sidewalk	1.02		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.40	9%
TOTAL H-1		13.44					
TOTAL SITE		**62.97**		**0.48**		**0.63**	**58.1%**

PROJECT INFORMATION

PROJECT:	Haven Valley
PROJECT NO:	21085-03
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	City of Colorado Springs
REPORT TYPE:	Final
DATE:	4/29/2021

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

EXISTING TIME OF CONCENTRATION STANDARD FORM SF-2

SUB-BASIN DATA					INITIAL/OVERLAND TIME (t_i)				TRAVEL TIME (t_t)					TIME OF CONC. t_c		FINAL t_c
BASIN	DESIGN PT:	C_5	C_{100}	AREA	LENGTH	HT	SLOPE	t_i	LENGTH	HT	SLOPE	VEL.	t_t	COMP.	MINIMUM	
				Ac	Ft	FT	%	Min	Ft	FT	%	FPS	Min	t_c	t_c	**Min**
OS-1		0.67	0.76	16.90	100	2	2.0	6.5	1600	26	1.6	7.4	3.6	10.1	5	**10.1**
OS-2		0.81	0.88	2.85	100	2	2.0	4.3	400	13	3.3	10.6	0.6	4.9	5	**5.0**
	A	0.69	0.78	19.75										10.1	5	**10.1**
OS-3		0.41	0.59	9.74	100	2.5	2.5	9.5	1200	34	2.8	9.8	2.0	11.5	5	**11.5**
H-1		0.15	0.40	13.44	100	2	2.0	14.1	1600	73	4.6	12.5	2.1	16.2	5	**16.2**
	B	0.32	0.52	26.03					700	20	2.9	5.28	2.2	16.2	5	**16.2**
OS-4		0.53	0.65	20.04	100	2	2.0	8.5	2000	41	2.1	8.48	3.9	12.5	5	**12.5**
	C	0.41	0.58	46.07					100	1	1	3.10	0.5	16.7	5	**16.7**

PROJECT INFORMATION

PROJECT:	Haven Valley
PROJECT NO:	21085-03
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	City of Colorado Springs
REPORT TYPE:	Final
DATE:	4/29/2021

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

EXISTING **RUNOFF** **5 YR STORM** **P1=** **1.50**

			DIRECT RUNOFF				
BASIN (S)	**DESIGN POINT**	**AREA (AC)**	**RUNOFF COEFF**	**t_c (MIN)**	**C * A**	**I (IN/HR)**	**Q (CFS)**
OS-1		16.90	0.67	10.1	11.24	4.09	**46.0**
Exist. Elm Grove Pond Release							**18.1**
OS-2		2.85	0.81	5.0	2.31	5.10	**11.8**
	A						**29.9**
OS-3		9.74	0.41	11.5	4.02	3.88	**15.6**
H-1		13.44	0.15	16.2	2.06	3.34	**6.9**
	B	26.03	0.32	16.2	8.38	3.34	**46.1**
OS-4		20.04	0.53	12.5	10.53	3.76	**39.6**
	C	46.07	0.41	16.7	18.91	3.29	**80.3**

PROJECT INFORMATION

PROJECT:	Haven Valley
PROJECT NO:	21085-03
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	City of Colorado Springs
REPORT TYPE:	Final
DATE:	4/29/2021

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

EXISTING **RUNOFF** **100 YR STORM** **P1=** **2.52**

			DIRECT RUNOFF				
BASIN (S)	**DESIGN POINT**	**AREA (AC)**	**RUNOFF COEFF**	**t_c (MIN)**	**C * A**	**I (IN/HR)**	**Q (CFS)**
OS-1		16.90	0.76	10.1	12.91	6.88	**88.8**
Exist. Elm Grove Pond Release							**52.3**
OS-2		2.85	0.88	5.0	2.51	8.58	**21.5**
	A						**73.8**
OS-3		9.74	0.59	11.5	5.74	6.52	**37.4**
H-1		13.44	0.40	16.2	5.42	5.62	**30.4**
	B	26.03	0.52	16.2	13.67	5.62	**129.0**
OS-4		20.04	0.65	12.5	13.04	6.31	**82.3**
	C	46.07	0.58	16.7	26.71	5.53	**200.0**

PROJECT INFORMATION

PROJECT:	Haven Valley
PROJECT NO:	21085-03
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	City of Colorado Springs
REPORT TYPE:	Final
DATE:	4/29/2021
Soil Type: A	

Drexel, Barrell & Co.

	C2*	C5*	C10*	C100*	% IMPERV
Pasture/Meadow		0.08		0.35	0
1/8 acre Residential		0.45		0.59	65
Asphalt/Sidewalk		0.90		0.96	100

*C-Values and Basin Imperviousness based on Table 5-1, City of Colorado Springs "Drainage Criteria Manual"

PROPOSED

SUB-BASIN	SURFACE DESIGNATION	AREA	COMPOSITE RUNOFF COEFFICIENTS				% IMPERV
		ACRE	C2	C5	C10	C100	
A	Pasture/Meadow	0.20		0.08		0.35	0
	1/8 acre Residential	0.24		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.28		0.48	35%
TOTAL A		0.44					
B	Pasture/Meadow	0.00		0.08		0.35	0
	1/8 acre Residential	1.11		0.45		0.59	65
	Asphalt/Sidewalk	0.31		0.90		0.96	100
	WEIGHTED AVERAGE			0.55		0.67	73%
TOTAL B		1.42					
C	Pasture/Meadow	0.32		0.08		0.35	0
	1/8 acre Residential	2.69		0.45		0.59	65
	Asphalt/Sidewalk	0.42		0.90		0.96	100
	WEIGHTED AVERAGE			0.47		0.61	63%
TOTAL C		3.43					
D	Pasture/Meadow	0.43		0.08		0.35	0
	1/8 acre Residential	0.55		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.29		0.48	36%
TOTAL D		0.98					
E	Pasture/Meadow	0.12		0.08		0.35	0
	1/8 acre Residential	1.27		0.45		0.59	65
	Asphalt/Sidewalk	0.20		0.90		0.96	100
	WEIGHTED AVERAGE			0.48		0.62	64%
TOTAL E		1.59					
F	Pasture/Meadow	0.00		0.08		0.35	0
	1/8 acre Residential	3.29		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
TOTAL F		3.29					
G	Pasture/Meadow	0.39		0.08		0.35	0
	1/8 acre Residential	0.44		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.28		0.48	34%
TOTAL G		0.83					
H	Pasture/Meadow	0.50		0.08		0.35	0
	1/8 acre Residential	1.27		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.35		0.52	47%
TOTAL H		1.77					
TOTAL		**13.75**		**0.43**		**0.58**	**58.1%**
TOTAL POND TRIBUTARY		**24.57**		**0.47**		**0.62**	**57.8%**

PROJECT INFORMATION

PROJECT: Haven Valley
PROJECT NO: 21085-03
DESIGN BY: SBN
REV. BY: TDM
AGENCY: City of Colorado Springs
REPORT TYPE: Final
DATE: 4/29/2021

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF
PROPOSED TIME OF CONCENTRATION STANDARD FORM SF-2

SUB-BASIN DATA					INITIAL/OVERLAND TIME (t_i)				TRAVEL TIME (t_t)					PIPE TRAVEL TIME (t_p)				TIME OF CONC. t_c		FINAL t_c
BASIN	DESIGN PT:	C_5	C_{100}	AREA	LENGTH	HT	SLOPE	t_i	LENGTH	HT	SLOPE	VEL.	t_t	LENGTH	SLOPE	VEL.	t_t	COMP.	MINIMUM	
				Ac	Ft	FT	%	Min	Ft	FT	%	FPS	Min	Ft	%	FPS	Min	t_c	t_c	**Min**
A	1	0.28	0.48	0.44	100	8	8.0	7.7	350	14	4.0	6.2	0.9					8.6	5	**8.6**
OS-1		0.67	0.76	16.90	100	2	2	6.5	1600	26	1.6	7.4	3.6					10.1	5	**10.1**
OS-2		0.81	0.88	2.85	100	2	2	4.3	400	13	3.3	10.6	0.6					4.9	5	**5.0**
B	2	0.55	0.67	1.42	100	2	2.0	8.2	1300	57.0	4.4	12.3	1.8					10.0	5	**10.0**
C	3	0.47	0.61	3.43	100	2	2.0	9.3	250	11	4.4	6.5	0.6	600	3.3	10.6	0.9	10.9	5	**10.9**
	J1	0.49	0.63	4.85										5	0.5	3.4	0.0	10.9	5	**10.9**
D	4	0.29	0.48	0.98	100	7	7.0	7.9	250	9	3.6	5.9	0.7					8.6	5	**8.6**
E	5	0.48	0.62	1.59	100	2	2.0	9.2	600	22	3.7	11.3	0.9					10.1	5	**10.1**
	J2	0.41	0.57	2.57										5	0.5	3.4	0.0	10.1	5	**10.1**
	J3	0.46	0.61	7.42										450	2.2	7.2	1.0	11.2	5	**11.2**
F		0.45	0.59	3.29	100	10	10.0	5.6	600	14	2.3	8.9	1.1					6.8	5	**6.8**
	6	0.46	0.60	10.71										110	2.7	12.6	0.1	11.3	5	**11.3**
G	7	0.28	0.48	0.83	100	9	9.0	7.4										7.4	5	**7.4**
OS-3		0.41	0.59	9.74	100	2.5	2.5	9.5	1200	34	2.8	9.8	2.0					11.5	5	**11.5**
	P1	0.47	0.62	24.57														11.5	5	**11.5**
H	8	0.35	0.52	1.77	100	5	5.0	8.3	800	16	2.0	4.4	3.0					11.3	5	**11.3**
OS-4	O4	0.53	0.65	20.04	100	2	2	8.5	2000	41	2.1	8.5	3.9					12.5	5	**12.5**

PROJECT INFORMATION

PROJECT:	Haven Valley
PROJECT NO:	21085-03
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	City of Colorado Springs
REPORT TYPE:	Final
DATE:	4/29/2021

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

PROPOSED **RUNOFF** **5 YR STORM** **P1=** **1.50**

BASIN (S)	DESIGN POINT	AREA (AC)	DIRECT RUNOFF RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)
A		0.44	0.28	8.6	0.12	4.34	**0.5**
OS-1		16.90	0.67	10.1	11.24	4.09	**46.0**
Exist. Elm Grove Pond Release							**18.1**
OS-2		2.85	0.81	5.0	2.31	5.10	**11.8**
	1	3.29	0.74	10.1	2.43	4.09	**28.1**
B	2	1.42	0.55	10.0	0.78	4.11	**3.2**
C	3	3.43	0.47	10.9	1.61	3.96	**6.4**
	J1	4.85	0.49	10.9	2.39	3.96	**9.5**
D	4	0.98	0.29	8.6	0.28	4.33	**1.2**
E	5	1.59	0.48	10.1	0.76	4.08	**3.1**
	J2	2.57	0.41	10.1	1.04	4.08	**4.3**
	J3	7.42	0.46	11.2	3.44	3.93	**13.5**
F		3.29	0.45	6.8	1.48	4.69	**6.9**
	6	10.71	0.46	11.3	4.92	3.91	**19.2**
G	7	0.83	0.28	7.4	0.23	4.56	**1.0**
OS-3		9.74	0.41	11.5	4.02	3.88	**15.6**
	P1	24.57	0.47	11.5	11.59	3.88	**63.1**
POND RELEASE							**0.9**
H		1.77	0.35	11.3	0.61	3.91	**2.4**
	8						**3.3**
OS-4	O4	20.04	0.53	12.5	10.53	3.76	**39.6**
	J4						**42.8**

PROJECT INFORMATION

PROJECT:	Haven Valley
PROJECT NO:	21085-03
DESIGN BY:	SBN
REV. BY:	TDM
AGENCY:	City of Colorado Springs
REPORT TYPE:	Final
DATE:	4/29/2021

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

PROPOSED **RUNOFF** **100 YR STORM** **P1=** **2.52**

			DIRECT RUNOFF					PIPE SIZING		
BASIN (S)	**DESIGN POINT**	**AREA (AC)**	**RUNOFF COEFF**	**t_c (MIN)**	**C * A**	**I (IN/HR)**	**Q (CFS)**	**n**	**Slope (ft/ft)**	**Pipe Diameter (in)**
A		0.44	0.48	8.6	0.21	7.29	**1.5**			
OS-1		16.90	0.76	10.1	12.91	6.88	**88.8**			
Exist. Elm Grove Pond Release							**52.3**			
OS-2		2.85	0.88	5.0	2.51	8.58	**21.5**			
	1	3.29	0.83	10.1	2.72	6.88	**71.0**	0.016	0.038	36
B	2	1.42	0.67	10.0	0.95	6.90	**6.6**	0.016	0.035	18
C	3	3.43	0.61	10.9	2.10	6.66	**14.0**	0.016	0.005	24
	J1	4.85	0.63	10.9	3.05	6.65	**20.3**	0.016	0.035	24
D	4	0.98	0.48	8.6	0.48	7.27	**3.5**	0.016	0.023	18
E	5	1.59	0.62	10.1	0.98	6.86	**6.7**	0.016	0.005	18
	J2	2.57	0.57	10.1	1.46	6.86	**10.0**	0.016	0.023	18
	J3	7.42	0.61	11.2	4.51	6.60	**29.8**	0.016	0.023	24
F		3.29	0.59	6.8	1.94	7.88	**15.3**			
	6	10.71	0.60	11.3	6.45	6.56	**42.4**	0.016	0.125	24
G	7	0.83	0.48	7.4	0.40	7.66	**3.0**			
OS-3		9.74	0.59	11.5	5.74	6.52	**37.4**			
	P1	24.57	0.62	11.5	15.31	6.52	**152.1**			
POND RELEASE							**17.6**	0.016	0.006	18
H		1.77	0.52	11.3	0.92	6.57	**6.1**			
	8						**23.7**	0.016	0.029	24
OS-4	O4	20.04	0.65	12.5	13.04	6.31	**82.3**	0.016	0.005	48
	J4						**106.0**	0.016	0.006	34"x53" elpt

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	North Swale
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.030	
Slope	030000	ft/ft
Left Side Slope	0.33	V : H
Right Side Slope	0.25	V : H
Bottom Width	4.00	ft
Discharge	23.00	cfs

Results		
Depth	0.68	ft
Flow Area	4.3	ft²
Wetted Perim	8.97	ft
Top Width	8.78	ft
Critical Depth	0.80	ft
Critical Slope	0.016380	ft/ft
Velocity	5.29	ft/s
Velocity Head	0.44	ft
Specific Energ	1.12	ft
Froude Numb	1.33	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	West Swale
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.030	
Slope	030000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	10.00	ft
Discharge	3.00	cfs

Results		
Depth	0.13	ft
Flow Area	1.4	ft²
Wetted Perim	11.09	ft
Top Width	11.06	ft
Critical Depth	0.14	ft
Critical Slope	0.025903	ft/ft
Velocity	2.15	ft/s
Velocity Head	0.07	ft
Specific Energ	0.20	ft
Froude Numb	1.07	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	East Swale
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.030	
Slope	030000	ft/ft
Left Side Slope	0.25	V : H
Right Side Slope	0.25	V : H
Bottom Width	2.00	ft
Discharge	3.50	cfs

Results		
Depth	0.33	ft
Flow Area	1.1	ft²
Wetted Perim	4.70	ft
Top Width	4.62	ft
Critical Depth	0.36	ft
Critical Slope	0.021252	ft/ft
Velocity	3.23	ft/s
Velocity Head	0.16	ft
Specific Energ	0.49	ft
Froude Numb	1.17	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

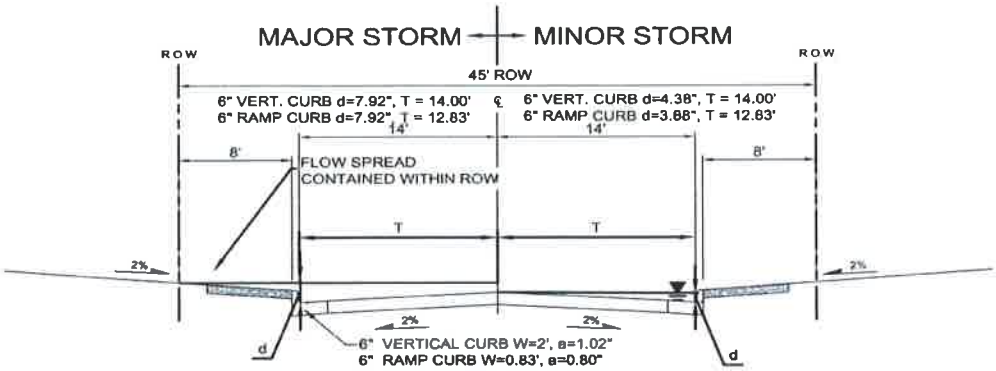
Project Description	
Worksheet	South Swale
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

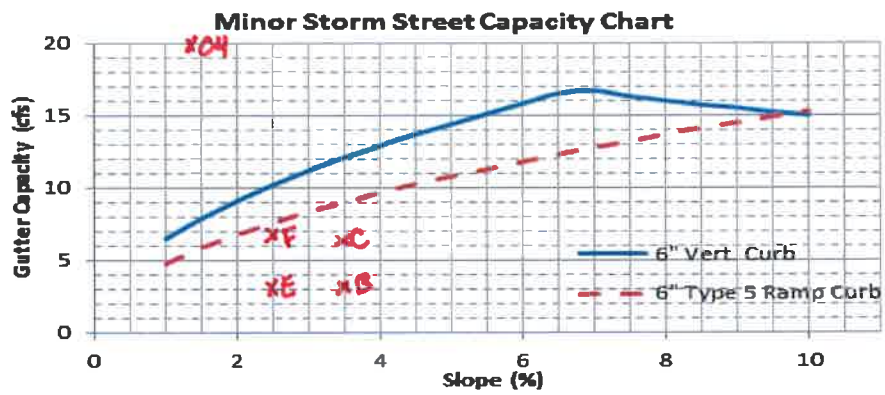
Input Data		
Mannings Coeffic	0.016	
Slope	013000	ft/ft
Left Side Slope	0.20	V : H
Right Side Slope	0.20	V : H
Bottom Width	4.00	ft
Discharge	6.10	cfs

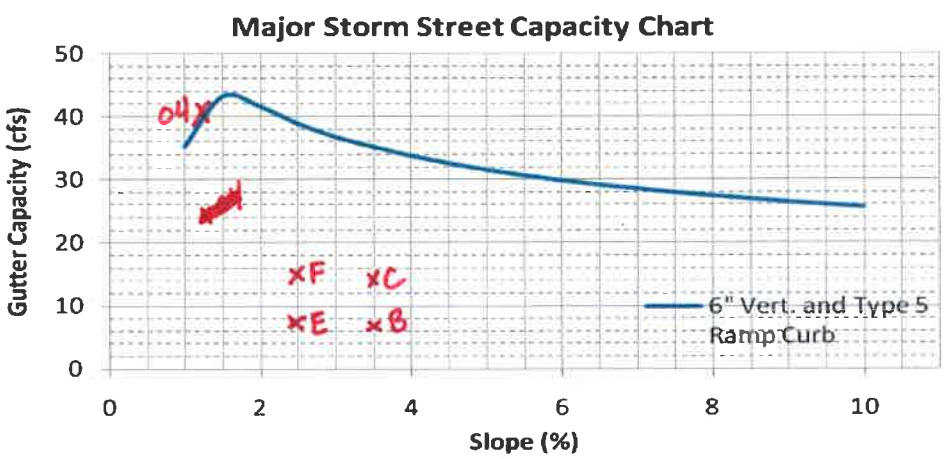
Results		
Depth	0.29	ft
Flow Area	1.6	ft²
Wetted Perim	6.92	ft
Top Width	6.87	ft
Critical Depth	0.36	ft
Critical Slope	0.005826	ft/ft
Velocity	3.92	ft/s
Velocity Head	0.24	ft
Specific Energ	0.53	ft
Froude Numb	1.45	
Flow Type	Supercritical	

Figure 7-9. Street Capacity Charts Minor Residential (Attached Sidewalk)

TYPICAL CROSS SECTION



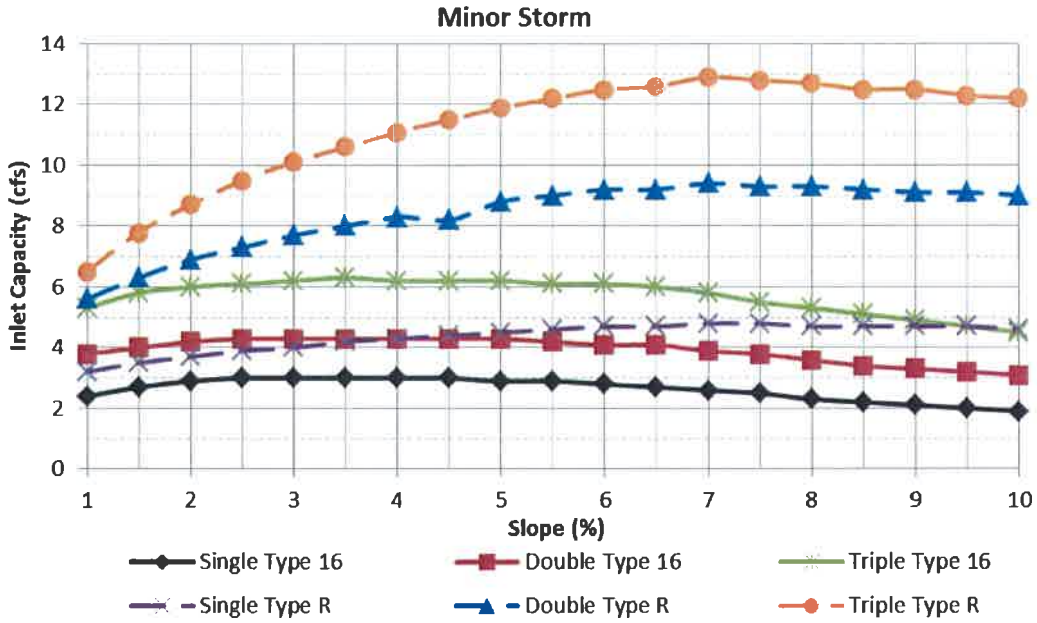


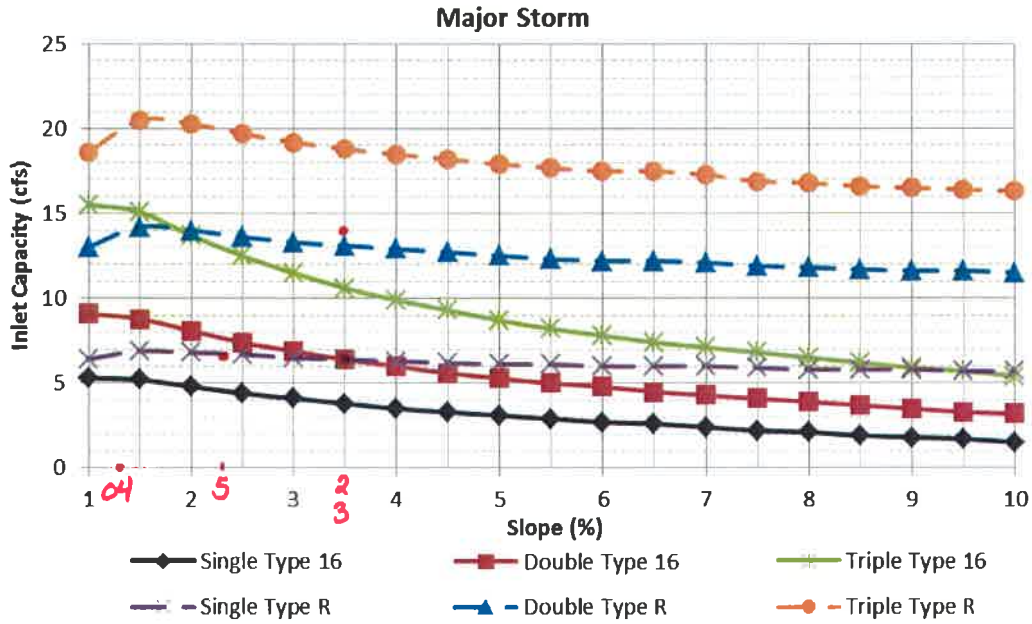


These charts shall only be used for the standard street sections as shown. The capacity shown is based on ½ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being containing within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

Figure 8-9. Inlet Capacity Chart Continuous Grade Conditions, Minor Residential (Local)
(Attached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 28'
Type of Curb and Gutter = 6" vertical

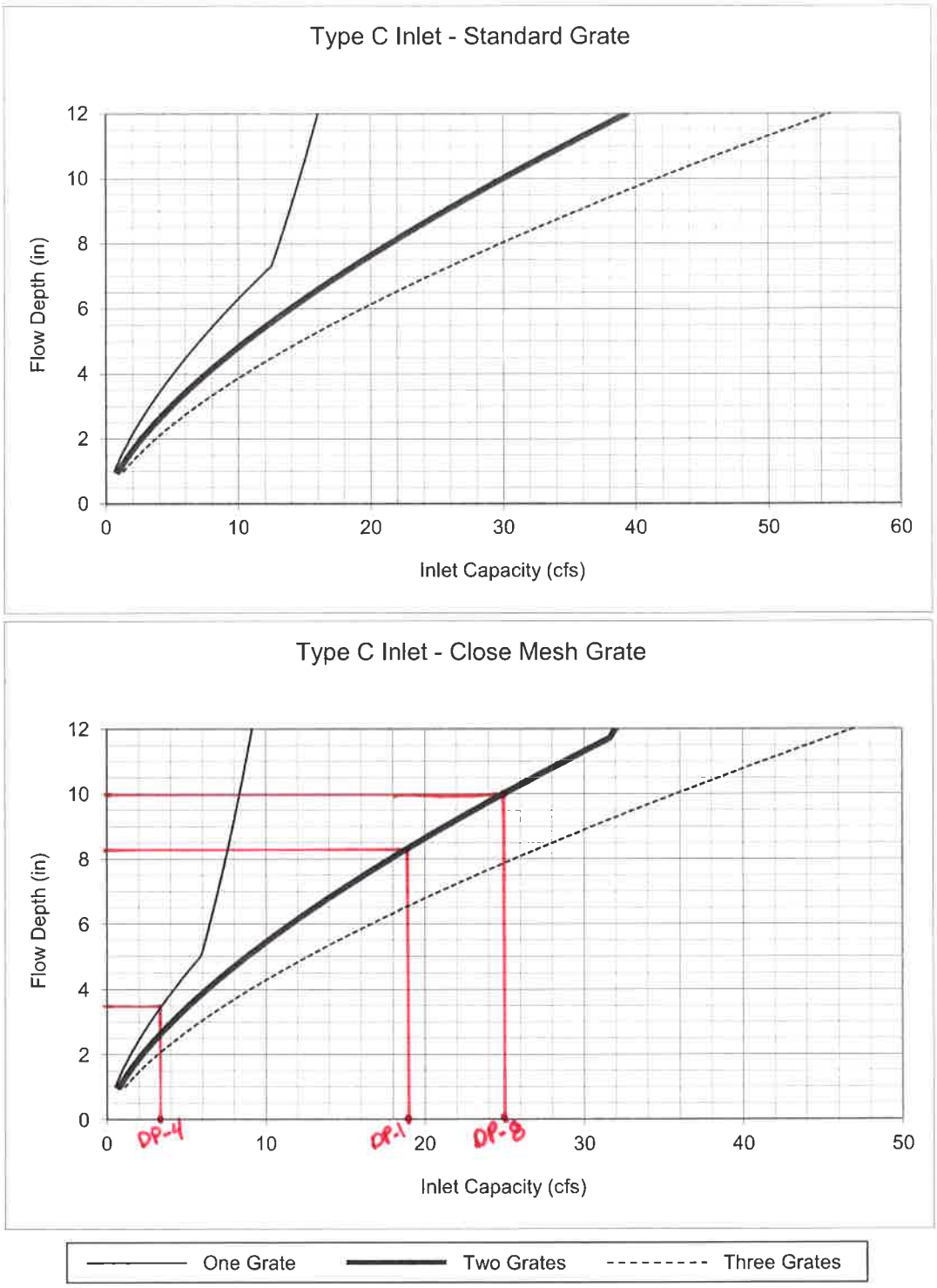




DP-2: Q_{100} = 6.6 cfs → Single Type R
DP-3: Q_{100} = 14.0 cfs → Triple Type R
DP-5: Q_{100} = 6.7 cfs → Single Type R
DP-04: Q_{100} = 41.1 cfs → Triple Type R

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

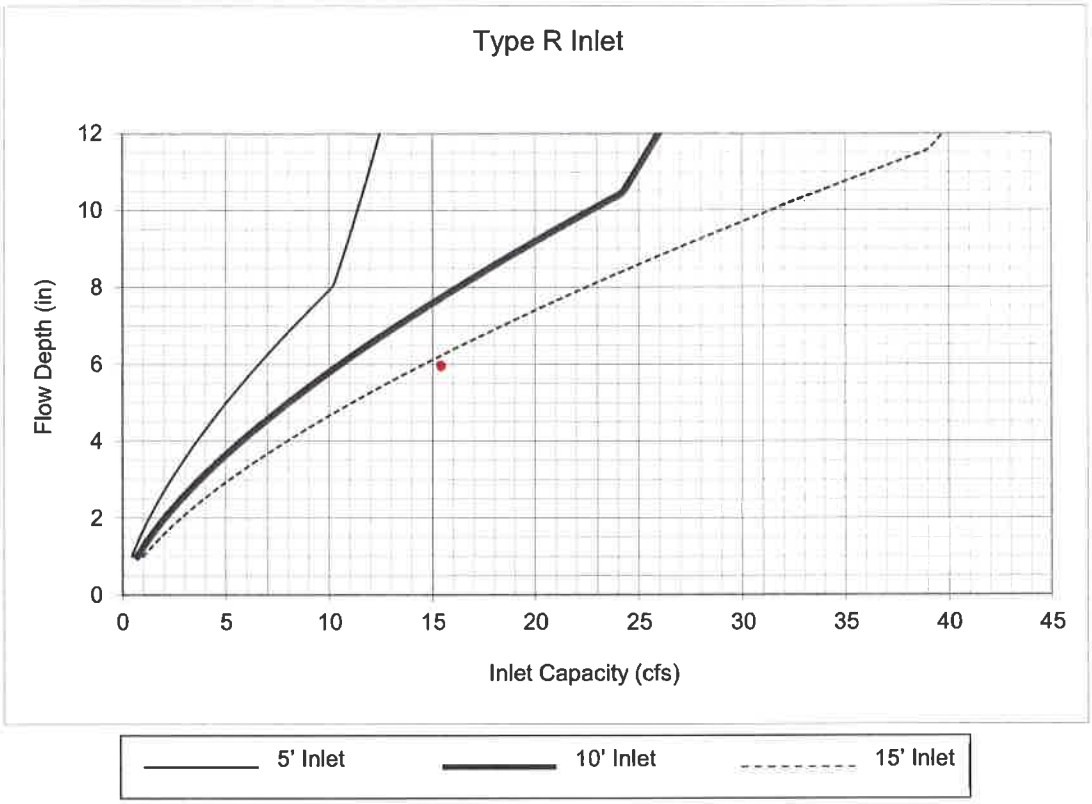
Figure 8-10. Inlet Capacity Chart Sump Conditions, Area (Type C) Inlet



DP-4: Q_{100} = 3.5 cfs
DP-1: Q_{100} = 18.7 cfs (does not include exist. pond release)
DP-8: Q_{100} = 21.8 cfs

Notes:
1. The standard inlet parameters must apply to use these charts.

Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet



DP-6: Q_{100} = 15.3 cfs → 15' inlet

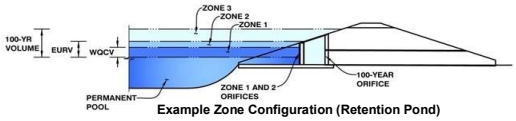
Notes:
1. The standard inlet parameters must apply to use this chart.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Haven Valley

Basin ID:



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	41.47	acres		
Watershed Length =	2,000	ft		
Watershed Slope =	0.023	ft/ft		
Watershed Imperviousness =	57.80%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.791	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	2.878	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	1.972	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.583	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.161	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.877	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.717	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.696	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.49 in.) =	8.827	acre-feet	3.49	inches
Approximate 2-yr Detention Volume =	1.863	acre-feet		
Approximate 5-yr Detention Volume =	2.443	acre-feet		
Approximate 10-yr Detention Volume =	2.961	acre-feet		
Approximate 25-yr Detention Volume =	3.589	acre-feet		
Approximate 50-yr Detention Volume =	3.976	acre-feet		
Approximate 100-yr Detention Volume =	4.409	acre-feet		

Stage-Storage Calculation

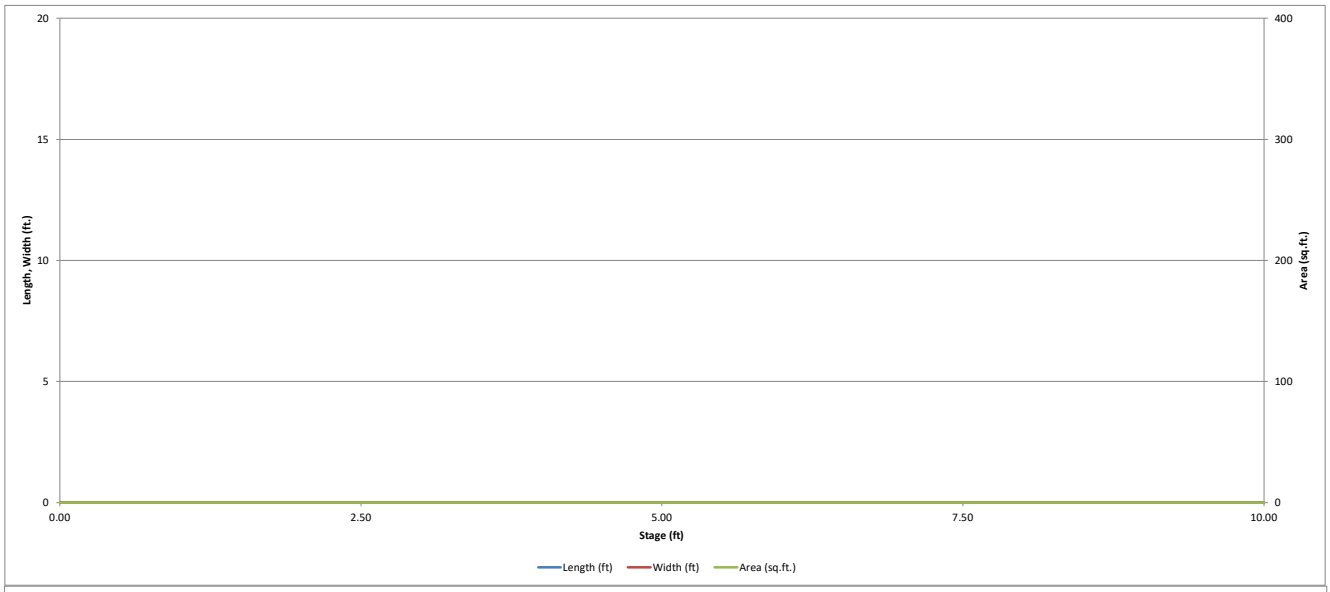
Zone 1 Volume (WQCV) =	0.791	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.087	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.531	acre-feet
Total Detention Basin Volume =	4.409	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

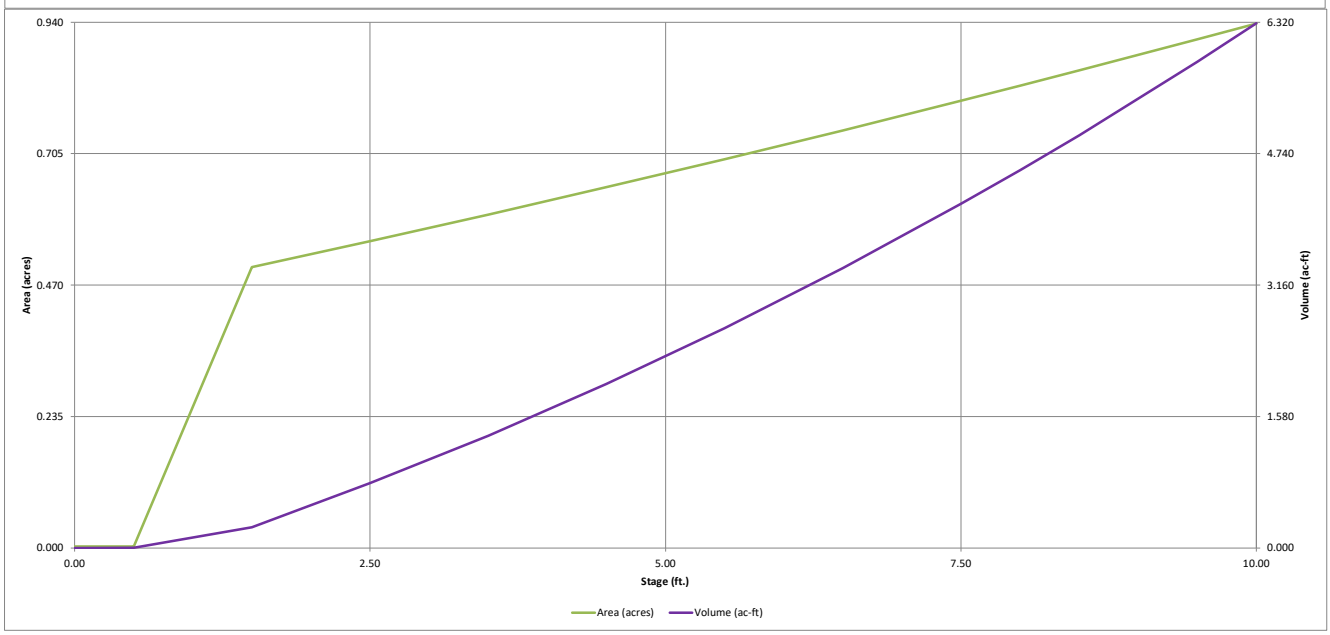
Depth Increment = ft

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	--	--	--	120	0.003		
12	--	0.50	--	--	--	120	0.003	59	0.001
13	--	1.50	--	--	--	21,871	0.502	10,837	0.249
14	--	2.50	--	--	--	23,886	0.548	33,934	0.779
15	--	3.50	--	--	--	25,960	0.596	58,857	1.351
16	--	4.50	--	--	--	28,090	0.645	85,882	1.972
17	--	5.50	--	--	--	30,279	0.695	115,066	2.642
18	--	6.50	--	--	--	32,525	0.747	146,468	3.362
19	--	7.50	--	--	--	34,829	0.800	180,145	4.136
19.5-Spillway	--	8.00	--	--	--	36,003	0.827	197,853	4.542
20	--	8.50	--	--	--	37,191	0.854	216,152	4.962
21	--	9.50	--	--	--	39,611	0.909	254,553	5.844
21.5	--	10.00	--	--	--	40,842	0.938	274,666	6.305

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



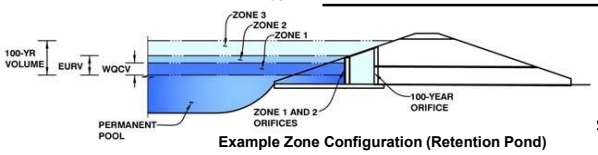


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Haven Valley

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.53	0.791	Orifice Plate
Zone 2 (EURV)	5.84	2.087	Orifice Plate
Zone 3 (100-year)	7.84	1.531	Weir&Pipe (Restrict)
		4.409	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 =	6.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	27.00	inches
Orifice Plate: Orifice Area per Row =	5.22	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	3.625E-02	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	2.00	4.00					
Orifice Area (sq. inches)	5.22	5.22	5.22					

	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 =	6.90	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	0.00	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 =	6.90	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.69	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	11.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.60	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	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 =	11.20		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.16	N/A	ft^2
Outlet Orifice Centroid =	0.53	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.82	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

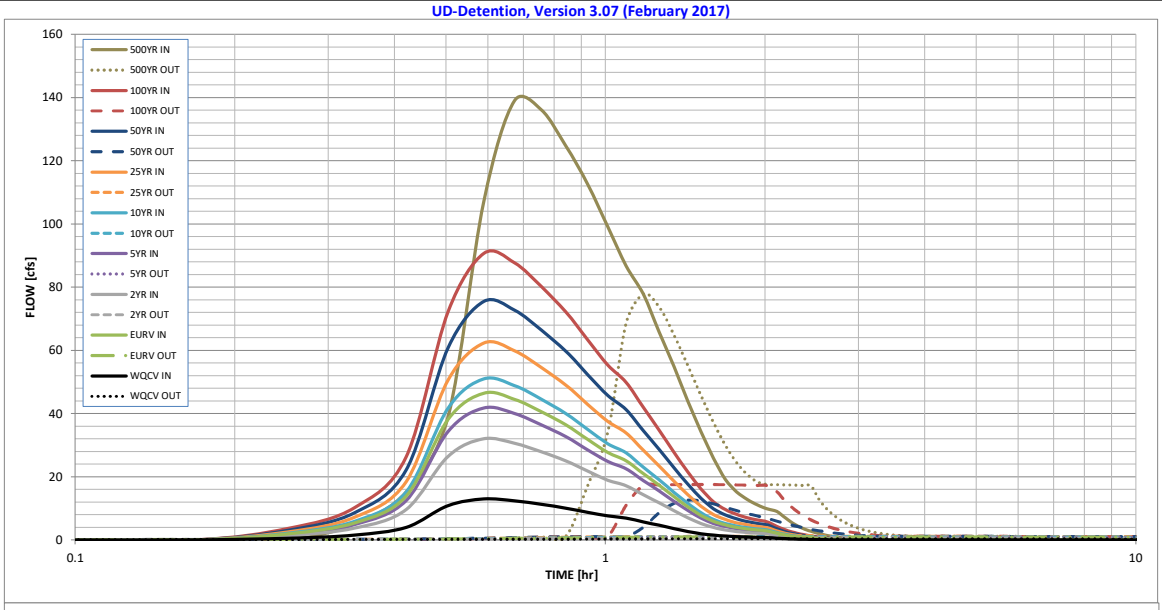
Spillway Design Flow Depth=	0.94	feet
Stage at Top of Freeboard =	9.94	feet
Basin Area at Top of Freeboard =	0.93	acres

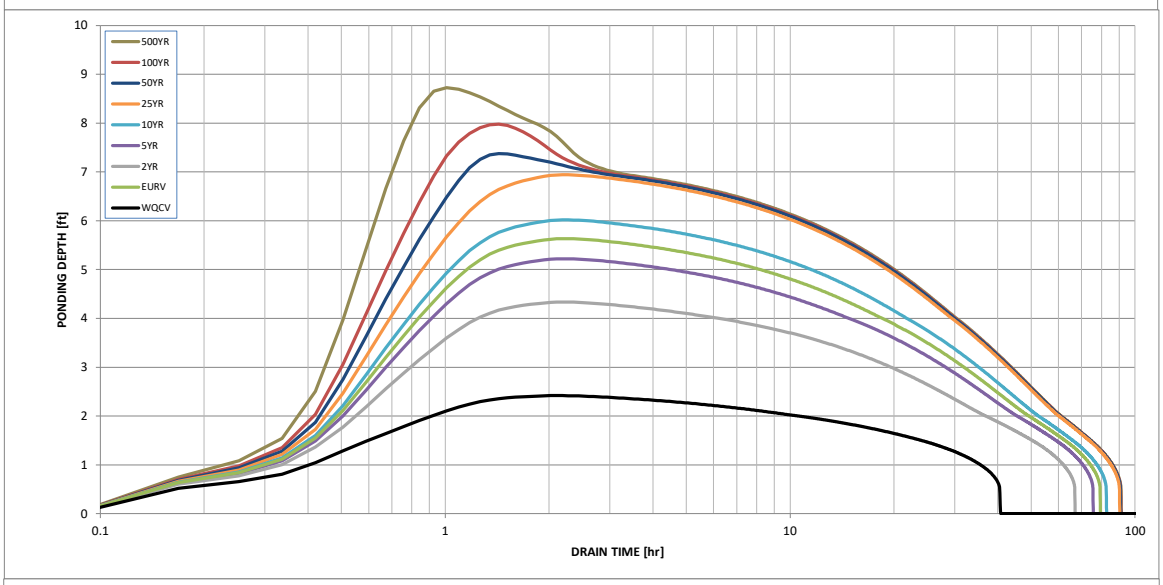
Routed Hydrograph Results

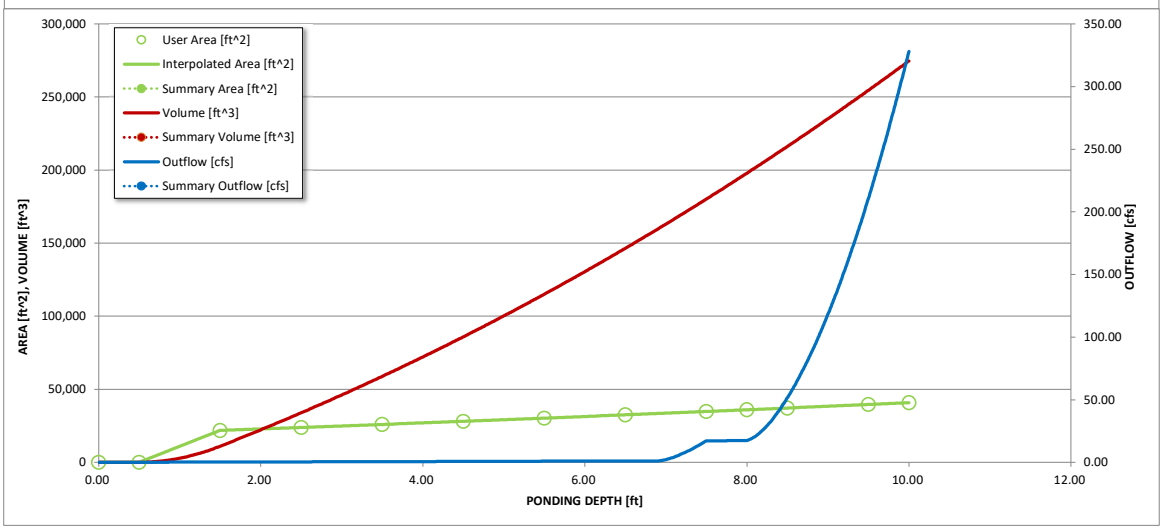
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.49
Calculated Runoff Volume (acre-ft) =	0.791	2.878	1.972	2.583	3.161	3.877	4.717	5.696	8.827
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.791	2.877	1.971	2.582	3.161	3.876	4.716	5.691	8.825
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.01	0.03	0.19	0.47	1.18
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.2	0.5	1.1	8.0	19.5	49.0
Peak Inflow Q (cfs) =	13.0	46.4	32.0	41.7	50.9	62.3	75.5	90.7	139.0
Peak Outflow Q (cfs) =	0.4	1.0	0.7	0.9	1.0	1.4	12.6	17.6	77.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	4.3	2.1	1.3	1.6	0.9	1.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	1.0	1.5	1.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	73	63	70	76	82	81	79	74
Time to Drain 99% of Inflow Volume (hours) =	40	77	65	74	80	87	87	87	85
Maximum Ponding Depth (ft) =	2.42	5.63	4.34	5.22	6.02	6.94	7.38	7.98	8.72
Area at Maximum Ponding Depth (acres) =	0.54	0.70	0.64	0.68	0.72	0.77	0.79	0.82	0.87
Maximum Volume Stored (acre-ft) =	0.730	2.732	1.863	2.449	3.003	3.696	4.032	4.517	5.151

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]
5.05 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:15:09	0.57	1.97	1.38	1.78	2.15	2.60	3.10	3.64	5.23
0.990	0:20:12	1.54	5.42	3.76	4.88	5.93	7.20	8.65	10.28	15.23
	0:25:15	3.97	13.91	9.65	12.53	15.23	18.49	22.21	26.40	39.12
	0:30:18	10.90	38.17	26.48	34.38	41.77	50.70	60.87	72.33	106.98
	0:35:21	12.97	46.44	31.98	41.73	50.94	62.27	75.46	90.67	138.96
	0:40:24	12.39	44.53	30.63	40.01	48.88	59.86	72.75	87.74	136.05
	0:45:27	11.28	40.53	27.88	36.41	44.48	54.49	66.32	80.11	124.77
	0:50:30	10.08	36.45	25.03	32.73	40.03	49.08	59.76	72.21	112.57
	0:55:33	8.72	31.79	21.76	28.52	34.94	42.91	52.32	63.32	99.03
	1:00:36	7.59	27.70	18.90	24.83	30.45	37.45	45.71	55.35	86.70
	1:05:39	6.88	25.06	17.14	22.48	27.54	33.82	41.22	49.84	77.77
	1:10:42	5.69	20.94	14.29	18.77	23.03	28.33	34.60	41.93	65.86
	1:15:45	4.65	17.31	11.78	15.51	19.05	23.47	28.69	34.80	54.77
	1:20:48	3.60	13.65	9.24	12.20	15.03	18.57	22.77	27.71	43.91
	1:25:51	2.69	10.47	7.04	9.35	11.56	14.33	17.62	21.50	34.25
	1:30:54	1.94	7.77	5.18	6.92	8.59	10.69	13.19	16.15	25.90
	1:35:57	1.50	5.86	3.93	5.23	6.47	8.03	9.87	12.05	19.18
	1:41:00	1.23	4.74	3.20	4.23	5.22	6.46	7.92	9.64	15.24
	1:46:03	1.05	3.99	2.70	3.57	4.40	5.44	6.66	8.10	12.77
	1:51:06	0.92	3.48	2.36	3.12	3.84	4.73	5.79	7.03	11.06
	1:56:09	0.83	3.12	2.12	2.79	3.43	4.23	5.18	6.28	9.85
	2:01:12	0.76	2.86	1.94	2.56	3.15	3.88	4.74	5.74	8.99
	2:06:15	0.56	2.12	1.43	1.89	2.34	2.89	3.55	4.32	6.88
	2:11:18	0.41	1.54	1.04	1.38	1.69	2.09	2.56	3.12	4.96
	2:16:21	0.30	1.14	0.77	1.02	1.25	1.55	1.90	2.31	3.68
	2:21:24	0.22	0.84	0.57	0.75	0.93	1.15	1.41	1.72	2.73
	2:26:27	0.16	0.61	0.41	0.55	0.68	0.84	1.03	1.26	2.02
	2:31:30	0.11	0.44	0.29	0.39	0.49	0.60	0.74	0.91	1.46
	2:36:33	0.08	0.32	0.21	0.28	0.35	0.44	0.54	0.66	1.06
	2:41:36	0.05	0.22	0.15	0.20	0.24	0.31	0.38	0.46	0.75
	2:46:39	0.03	0.14	0.09	0.12	0.16	0.20	0.25	0.30	0.50
	2:51:42	0.02	0.08	0.05	0.07	0.09	0.11	0.14	0.18	0.29
	2:56:45	0.01	0.03	0.02	0.03	0.04	0.05	0.07	0.08	0.14
	3:01:48	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.05
	3:06:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:11:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:16:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:07:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:12:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:17:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:27:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:32:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:13:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:18:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:23:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:28:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:33:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:38:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:43:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:48:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:53:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:58:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:03:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TOTAL FOREBAY VOLUME

V=3% x WQCV

WQCV=	0.92	ac-ft
V=	0.0276	ac-ft

Qin NE=	75.3	cfs
Qin E=	42.4	cfs
Qtotal=	117.7	cfs

NORTHEAST FOREBAY VOLUME

$$\frac{75.3 \text{ cfs}}{117.7 \text{ cfs}} = \frac{x \text{ ac-ft}}{0.0276 \text{ ac-ft}}$$

x = 0.0177 ac-ft

= 769.2 ft^3

FOREBAY RELEASE NOTCH WIDTH

$Q=CLH^{2/3}$

Q_{100}=	75.3	cfs
2% of Q=	1.51	cfs
C=	2.6	
H (height of forebay wall)=	1	ft
L=	7.0	in

EAST FOREBAY VOLUME

$$\frac{42.4 \text{ cfs}}{117.7 \text{ cfs}} = \frac{x \text{ ac-ft}}{0.0276 \text{ ac-ft}}$$

x = 0.0099 ac-ft

= 433.1 ft^3

FOREBAY RELEASE NOTCH WIDTH

$Q=CLH^{2/3}$

Q_{100}=	42.4	cfs
2% of Q=	0.85	cfs
C=	2.6	
H (height of forebay wall)=	1	ft
L=	4	in

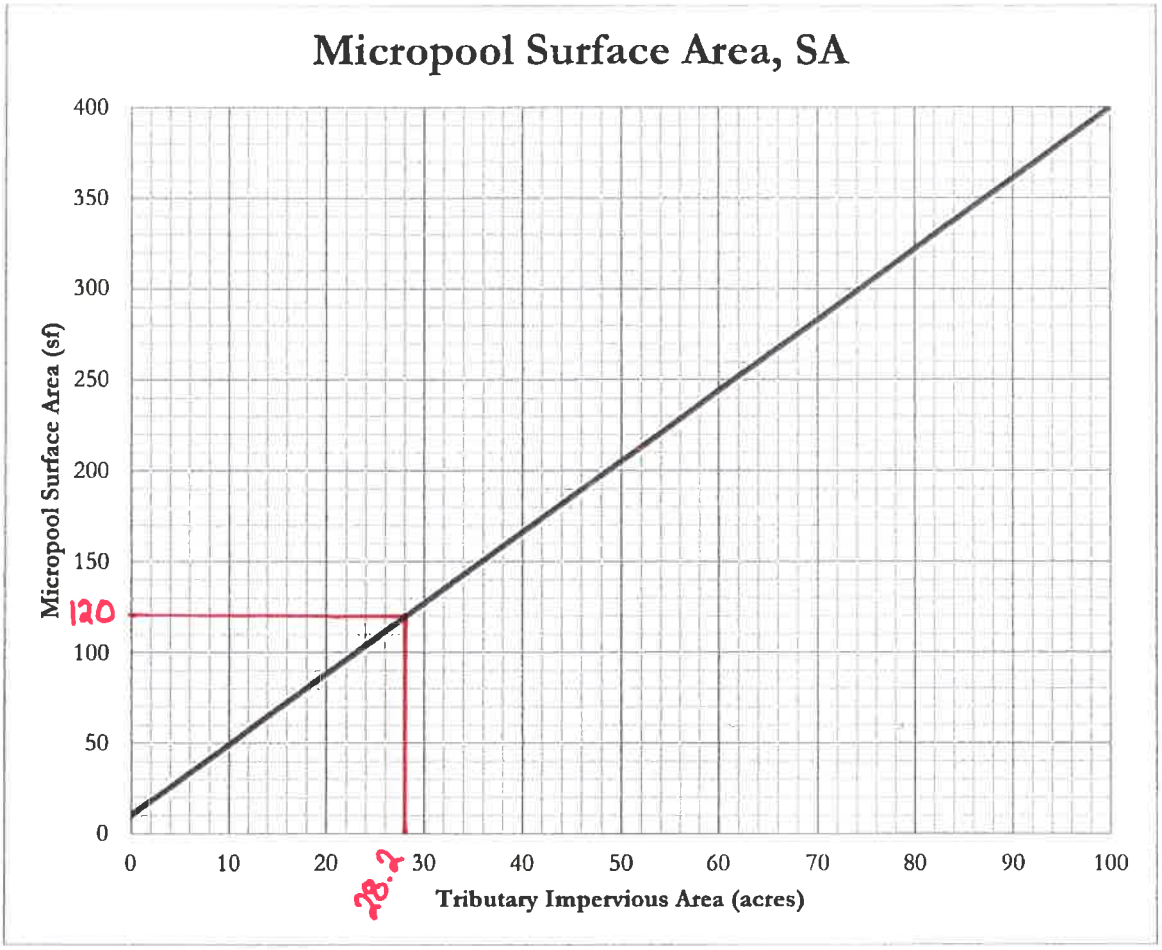


Figure 1 – Micropool surface area (SA) determination chart

The tributary impervious area is the effective number of impervious acres that will be treated by the extended detention basin (EDB). It is calculated by multiplying the tributary area to be treated by the impervious fraction of that area.

$$TIA = I \times A$$

$\frac{68}{100} \times 41.47 = 28.2$ ac

TIA = Tributary impervious area (acres)
I = Imperviousness (fraction)
A = Tributary catchment area upstream (acres)

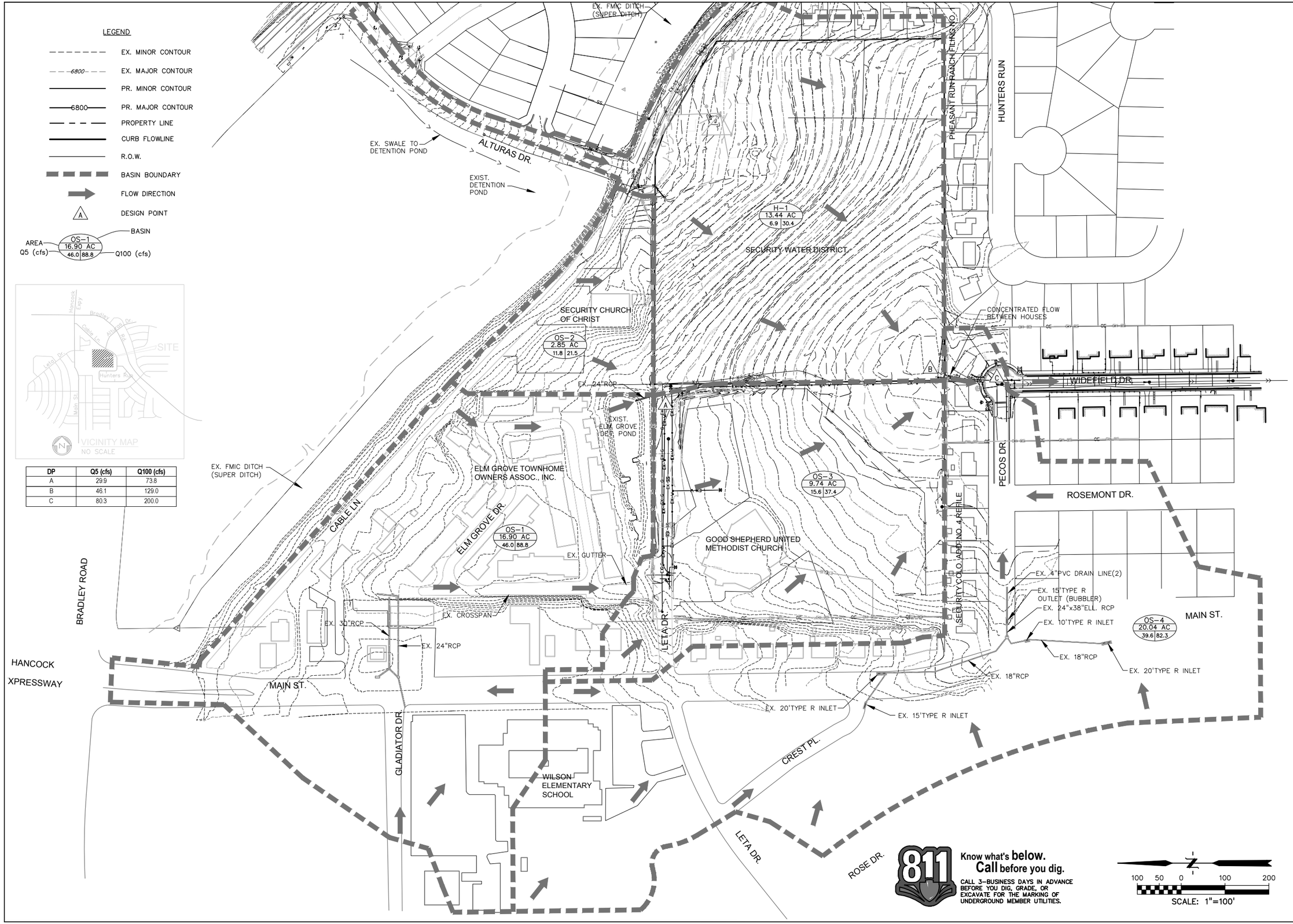
For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is thus calculated by multiplying the micropool surface area by 4 inches.

$$ISV = SA \times 4\ inches$$

ISV = Initial surcharge volume (cf)
SA = Surface area (from Figure 1, sf)

LEGEND

- EX. MINOR CONTOUR
- EX. MAJOR CONTOUR (6800)
- PR. MINOR CONTOUR
- PR. MAJOR CONTOUR (6800)
- PROPERTY LINE
- CURB FLOWLINE
- R.O.W.
- BASIN BOUNDARY
- FLOW DIRECTION
- DESIGN POINT (A)
- BASIN: OS-1; AREA: 16.90 AC; Q5 (cfs): 46.0; Q100 (cfs): 88.8



DP	Q5 (cfs)	Q100 (cfs)
A	29.9	73.8
B	46.1	129.0
C	80.3	200.0

PREPARED BY:

DREXEL, BARRELL & CO.
Engineers • Surveyors
3 SOUTH 7TH STREET
COLORADO SPGS, COLORADO 80905
CONTACT: TIM D. McCONNELL, P.E.
(719)260-0887
BOULDER • COLORADO SPRINGS • GREELEY

CLIENT:

RICHMOND AMERICAN HOMES
4350 S. MONACO ST.
DENVER, CO 80237
CONTACT: MATTHEW JENKINS
(720) 977-3686

DRAINAGE PLANS FOR:

HAVEN VALLEY

(LETA DR.) BRADLEY RD/ALTURAS DR.
SECURITY, EL PASO COUNTY, COLORADO

ISSUE	DATE
INITIAL ISSUE	4/29/21

DESIGNED BY:	TDM
DRAWN BY:	GES
CHECKED BY:	TDM
FILE NAME:	21085-03DR01

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1" = 100'
VERTICAL: N/A

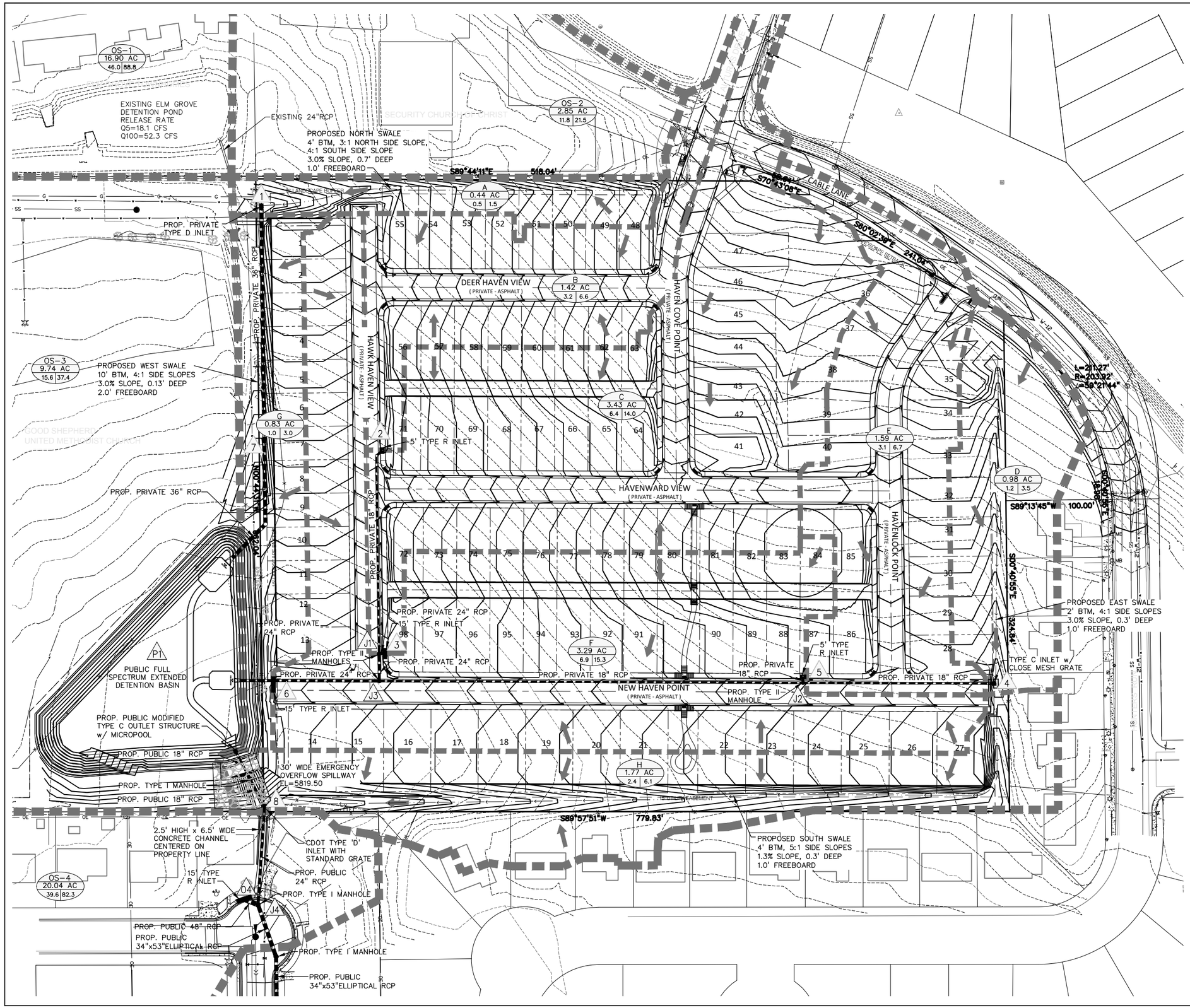
EXISTING CONDITIONS DRAINAGE PLAN

PROJECT NO. 21085-03CSCV

DRAWING NO.

DR01

SHEET: 1 OF 2



LEGEND

- EX. MINOR CONTOUR
- EX. MAJOR CONTOUR (6800)
- PR. MINOR CONTOUR
- PR. MAJOR CONTOUR (6800)
- PROPERTY LINE
- CURB FLOWLINE
- R.O.W.
- BASIN BOUNDARY
- FLOW DIRECTION
- DESIGN POINT (A)
- BASIN (OS-1) / AREA (16.90 AC) / Q5 (cfs) (46.0) / Q100 (cfs) (88.8)

DP	Q5 (cfs)	Q100 (cfs)
1	28.1	71.0
2	3.2	6.6
3	6.4	14.0
J1	9.5	20.3
4	1.2	3.5
5	3.1	6.7
J2	4.3	10.0
J3	13.5	29.8
6	19.2	42.4
7	1.0	3.0
P1	63.1	152.1
8	3.3	23.7
O4	39.6	82.3
J4	42.8	106.0

N

50 20 0 50 100

SCALE: 1"=50'

811 Know what's **below.** **Call** before you dig.

CALL 3-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

PREPARED BY:

DREXEL, BARRELL & CO.
Engineers • Surveyors
3 SOUTH 7TH STREET
COLORADO SPGS, COLORADO 80905
CONTACT: TIM D. McCONNELL, P.E.
(719)260-0887
BOULDER • COLORADO SPRINGS • GREELEY

CLIENT:

RICHMOND AMERICAN HOMES
4350 S. MONACO ST.
DENVER, CO 80237
CONTACT: MATTHEW JENKINS
(720) 977-3686

DRAINAGE PLANS FOR:

HAVEN VALLEY

(LETA DR.) BRADLEY RD/ALTURAS DR.
SECURITY, EL PASO COUNTY, COLORADO

ISSUE	DATE
INITIAL ISSUE	4/29/21

DESIGNED BY:	TDM
DRAWN BY:	SBN
CHECKED BY:	TDM
FILE NAME:	21085-03DR02

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1" = 50'
VERTICAL: N/A

CONDITIONS
DRAINAGE
DRAINAGE PLAN

PROJECT NO. 21085-03CSCV

DRAWING NO.

DR02

SHEET: 2 OF 2