AMENDMENT TO THE

PRELIMINARY DRAINAGE REPORT

for

WINDERMERE

Colorado Springs, CO

February 2019

Prepared for:

Windsor Ridge Homes
4164 Austin Bluffs Pkwy #361
Colorado Springs, CO 80918
Contact: James Todd Stephens
(719) 200-9594

Prepared by:

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

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APPENDICES

PRELIMINARY DRAINAGE REPORT

for

WINDERMERE

Colorado Springs, 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: Windsor Ridge Homes

By:

James Todd Stephens Date
Title: President
Address: 4164 Austin Bluffs Pkwy #361
Colorado Springs, CO 80918

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:

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

2.0 PURPOSE

This report is prepared by Drexel, Barrel & Co in support of the Windermere Preliminary Plan Amendment. 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

East half?

The site is located at the northwest corner of N. Carefree Cir. and Marksheffel Rd. - the SE 1/4 of Section 29, Township 13 S, Range 65 W of the 6th P.M., El Paso County, Colorado.

The site is bound on the west by Antelope Ridge Dr., on the north by the Chateau at Antelope Ridge subdivision, on the east by Marksheffel Rd., and on the south by N. Carefree Cir.

Site Conditions

The site is approximately 52.07 acres in size and is proposed as a single family home subdivision. The proposed site development includes approximately 201 single-family residences and will be developed in two filings. The site is currently undeveloped and is covered with native grass and vegetation. The site is located within the Sand Creek Drainage Basin. Historically, this site drains in all directions with a large hill in the southern half of the site and an existing temporary detention facility located at the northern end. There is a large roadside ditch adjacent to Marksheffel Road (M.D.D.P. DP-1x) that routes off-site (non-tributary to site facilities) runoff to the existing 24" CMP storm culvert under Marksheffel Road. This site has been previously studied as part of the previously approved "Master Development Drainage Plan for Hilltop Subdivision El Paso County, Colorado" by URS Greiner, Inc. last revised February 1998.

Provide excerpts.

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 Truckton sandy loam, a type 'A' hydrologic soil. See appendix for 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.

update

Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel #08041C0543 F (March 17, 1997) the project site is within a designated Zone X area described as "areas determined to be outside 500-year floodplain". A firmette map is included in the appendix.

4.0 PROPOSED HYDROLOGY (RATIONAL METHOD) & HYDRAULIC SUMMARY

For the purposes of site specific analysis, the project site has been divided into several grouped drainage basins as shown on the proposed drainage plan. Twenty three (23) Design Points have been analyzed for sizing of the drainage facilities.

The Rational Method was used to determine runoff quantities for the 5- and 100-year storm recurrence intervals. Urban Drainage UD-Detention, UD-Inlet and Flowmaster were also used to identify pond and storm system sizing (see appendix for calculations). See below for a summary runoff table.

Rational Method Runoff Summary

BASIN	AREA (AC)	Q5 (cfs)	Q100 (cfs)
A1	2.16	4.9	11.4
A2	4.70	9.0	20.9
A3	1.63	4.6	9.9
A4	1.01	1.7	4.0
A5	1.98	4.3	10.1
A6	3.75	7.0	16.4
A7	0.77	1.6	3.8
A8	2.96	6.1	14.2
A9	1.86	4.0	9.2
A10	4.00	7.5	17.5
A11	2.53	5.1	11.8
A12	9.75	9.4	41.0
B1	3.62	7.9	18.4
B2	2.94	6.2	14.6
B3	2.53	5.0	11.6
B4	0.53	0.4	2.4
B5	0.99	1.5	4.4
C1	5.10	6.3	21.8
C2	2.28	3.6	10.1
C3	0.13	0.1	0.6

DP	AREA (AC)	Q5 (cfs)	Q100 (cfs)
A	2.16	4.9	11.4
8	14.19	26.4	54.1
B	4.70	9.0	20.9
C	20.52	34.4	73.7
D	21.53	35.6	76.5
E	1.98	4.3	10.1
F	27.26	43.2	94.2
G	0.77	1.6	3.8
H	2.96	6.1	14.2
I	1.86	4.0	9.2
J	5.59	11.1	25.9
K	32.85	50.2	110.7
L	36.85	55.3	122.5
M	39.38	58.5	130.1
N	49.13	174.7	353.5
O	3.62	7.9	18.4
P	2.94	6.2	14.6
Q	2.53	5.0	11.6
R	9.62	18.1	43.5
S	10.61	10.7	27.7
T	5.10	192.7	641.5

Provide total contributing area

U	2.28	3.6	10.1
V	0.13	0.1	0.6

A-group basins represent on-site flows that are captured by the pond on the north end of the site. The pond is a proposed Full Spectrum EDB with an outfall via a 30" pipe.

DP-A are the flows from Basin A1, which flow off-site into Antelope Ridge Dr. where they are picked up by the existing inlet at Design Point 8.

DP-8 is an existing design point in Antelope Ridge Dr. at a 10' sump inlet. This design point reflects all of the flows from Basin A1 as well as the offsite flows from Basins D-13, D-14 and D-15. More information can be found on these offsite flows in the "Preliminary Drainage Report for Windermere and Final Drainage Report for Windermere Filing No. 1," October 2014.

DP-B is located at the two proposed at-grade Double Type R inlets in Basin A2. The flows leave this inlet via a 24" storm pipe. This design point captures all of the flows from Basin A2.

Provide total flows and intercepted/bypassed for each basin/DP.

DP-C is located at the proposed at-grade Double Type R inlet in Basin A3. The flows leave this inlet via a 36" storm pipe. This design point reflects all of the flows from Basins A1 through A3 and offsite Basins D-13 through D-15.

DP-D is located at the proposed at-grade Single Type R inlet in Basin A4. The flows leave this inlet via a 36" storm pipe. This design point reflects all of the flows from Basins A1 through A4 and offsite Basins D-13 through D-15.

DP-E is located at the proposed at-grade Double Type R inlet in Basin A5. The flows leave this inlet via an 18" storm pipe. This design point reflects all of the flows from Basin A5.

DP-F is located at the proposed at-grade Triple Type R inlet in Basin A6. The flows leave this inlet via a 36" storm pipe. This design point reflects all of the flows from Basins A1 through A6 and offsite Basins D-13 through D-15.

DP-G is located at the proposed at-grade Single Type R inlet in Basin A7. The flows leave this inlet via an 18" storm pipe. This design point reflects all of the flows from Basin A7.

DP-H is located at the proposed at-grade Triple Type R inlet in Basin A8. The flows leave this inlet via a 24" storm pipe. This design point reflects all of the flows from Basin A7 and A8.

DP-I is located at the proposed at-grade Double Type R inlet in Basin A9. The flows leave this inlet via an 18" storm pipe. This design point reflects all of the flows from Basin A9.

DP-J is located at the proposed 18"x30" wye in Basin A10. The flows leave this wye via a 30" storm pipe. This design point reflects all of the flows from Basins A7 through A9.

DP-K is located at the proposed manhole in Basin A10. The flows leave this manhole via a 48" storm pipe. This design point reflects all of the flows from Basins A1 through A9 and

Provide the level of detail in the previous report for all DPs.

offsite Basins D-13 through D-15.

DP-L is located at the two proposed sump 10' Type R inlets in Basin A10. The flows leave this inlet via a 48" storm pipe. This design point reflects all of the flows from Basins A1 through A10 and offsite Basins D-13 through D-15.

DP-M is located at the proposed sump 15' Type R inlet in Basin A11. The flows leave this inlet via a 48" storm pipe. This design point reflects all of the flows from Basins A1 through A11 and offsite Basins D-13 through D-15.

DP-N is located at the bottom of the north proposed Full Spectrum EDB pond in Basin A12. The flows leave the pond via an outlet structure and a 30" storm pipe. This design point reflects all of the flows from all "A" basins, offsite basins D-13 through D-15, and offsite flows entering the pond from offsite Basins CT and WS. More information can be found on offsite flows from Basins CT and WS in the "Preliminary Drainage Report for Windermere and Final Drainage Report for Windermere Filing No. 1," October 2014.

B-group basins represent on-site flows that are captured by the pond on the south end of the site. The pond is a proposed Full Spectrum EDB with an outfall via an 18" pipe.

DP-O is located at the proposed at-grade Triple Type R inlet in Basin B1. The flows leave this inlet via a 24" storm pipe. This design point reflects all of the flows from Basin B1.

DP-P is located at the proposed sump 15' Type R inlet in Basin B2. The flows leave this inlet via a 24" storm pipe. This design point reflects all of the flows from Basins B1 and B2.

DP-Q is located at the proposed sump 10' Type R inlet in Basin B3. The flows leave this inlet via a 24" storm pipe. This design point reflects all of the flows from Basins B1 through B3.

DP-R is located at the bottom of the south proposed Full Spectrum EDB pond in Basin B4. The flows leave the pond via an outlet structure and an 18" storm pipe. This design point reflects all of the flows from Basins B1 through B4.

DP-S is located at the existing area inlet in Basin B5. The flows leave this inlet via an existing 24" storm pipe that connects to the existing storm system in N. Carefree Cir., which carries the flows to the south. This design point reflects all of the flows from Basins B1 through B5, offsite Basin EXR, and offsite Basin D-16. More information can be found on offsite flows from Basins EXR and D-16 in the "Preliminary Drainage Report for Windermere and Final Drainage Report for Windermere Filing No. 1," October 2014.

C-group basins represent flows that leave the project site and are captured by existing storm system.

DP-T is located at the existing 24" CMP Marksheffel Rd. culvert crossing. This design point reflects all of the flows from Basin C1, the flows released from the pond at DP-N, and the flows from MDDP DP-1X. More information can be found on the MDDP flows in the "Preliminary Drainage Report for Windermere and Final Drainage Report for Windermere Filing No. 1," October 2014.

DP-U are the flows from Basin C2, which flow off-site into N. Carefree Cir. where they are picked up by the existing 15' at-grade inlet at Design Point 19 in offsite Basin NC2. The flows leave this inlet via an existing 18" storm pipe where the flows converge with the flows from DP-S at an existing manhole. The flows leave this existing manhole via an existing 24" storm pipe and are carried to the existing 10' sump inlet at DP-20 in offsite Basin NC1. The flows leave this existing inlet via an existing 30" storm pipe and are then carried to the south. More information for these design points and offsite basins can be found in the "Preliminary Drainage Report for Windermere and Final Drainage Report for Windermere Filing No. 1," October 2014.

DP-V is located at the north end of the site on Antelope Ridge Dr. This design point reflects all of the flows from Basin C2 that exit the site and flow to the north along the curb and gutter in Antelope Ridge Dr. before being captured by existing storm system.

5.0 PROPOSED DETENTION/WATER QUALITY FACILITIES

North Pond

The proposed on-site north pond is a 17.29 ac-ft extended detention basin (EDB). The required pond volume for 100-yr detention is 11.03 acre-feet. The actual pond volume is 17.29 acre-feet. It will capture then release the flows at a reduced flow rate into a proposed 30" pipe, which will release into a ditch that conveys the flows to a 24" CMP culvert under Marksheffel Rd. after which the flows continue in historic patterns to the east. In accordance with El Paso County criteria, a modified Type C outlet structure with a permanent micropool will release the WQCV over a 40-hour period. A spillway has been placed on the east side of the pond. In the event that water overtops the spillway, it will flow to the ditch along Marksheffel Rd.

South Pond

The proposed on-site south pond is a 1.31 ac-ft extended detention basin (EDB). The required pond volume for 100-yr detention is 1.27 acre-feet. The actual pond volume is 1.31 acre-feet. It will capture then release the flows at a reduced flow rate into a proposed 18" pipe, which connects to the existing storm system and is then carried to the south. In accordance with El Paso County criteria, a modified Type C outlet structure with a permanent micropool will release the WQCV over a 40-hour period. A spillway has been placed on the south side of the pond. In the event that water overtops the spillway, it will flow to the curb and gutter in N. Carefree Cir., then picked up by the existing storm system.

Calculations are provided in the appendix for the on-site ponds, forebay volumes, micropool surface areas, outlet structures, discharge pipes and spillways.

Private maintenance agreements and O&M manuals will be established for these ponds as required by the County.

Provide the level of detail in the previous report for both ponds. Address maintenance access, overflow paths and spillway protection.

6.0 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 two permanent Extended Detention Basin facilities designed per current City of Colorado Springs/El Paso County drainage criteria.

3. ***Stabilize Drainage Ways:*** Flows from the north pond are released into the ditch alongside Marksheffel Rd. This ditch has previously been stabilized with rip-rap to handle the MDDP flows of 600 cfs. Our release rate is 19.7 cfs and therefore no additional stabilization will be necessary. Flows from the south pond are released directly into the existing storm sewer system and no stabilization will be necessary.

4. ***Implement Site Specific and Other Source Control BMP's:*** A site specific storm water quality and erosion control plan and narrative will be submitted and approved by El Paso County Engineering prior to any disturbance within the project area. Details such as site specific source control construction BMP's as well as permanent BMP's will be detailed in this plan and narrative to protect receiving waters.

7.0 GEOTECHNICAL HAZARDS

In accordance with geotechnical recommendations, the project design is intended to direct runoff away from structures, and into the receiving storm sewer system and water quality/detention basins. This will be accomplished by a variety of means, i.e. curb and gutter and storm sewer.

8.0 DRAINAGE/BRIDGE FEES

For information; to be calculated at time of each final plat submittal.

The project lies within the Sand Creek Drainage Basin.

The percent imperviousness for the project is calculated as follows:

Site imperviousness = 50.3%

52.07 Acres at 50.3% Impervious = 26.2 Impervious Acres

Revise to address ECM I.7.2.A - Step 4: Consider Need for Industrial and Commercial BMPs (not applicable).

The following calculations are based on the 2019 drainage/bridge fees for the Sand Creek Drainage Basin:

Drainage Fee
$18,940 x 26.2 Impervious Ac = $496,228.00

Bridge Fee
$5,559 x 26.2 Impervious Ac. = $145,645.80

Description	Quantity	Unit Cost	Cost
5' Type R Inlet	2 EA	$5,500/EA	$11,000
10' Type R Inlet	8 EA	$7,600/EA	$60,800
15' Type R Inlet	5 EA	$10,000/EA	$50,000
18" storm	137 LF	$50/LF	$6,850
24" storm	658 LF	$70/LF	$46,060
30" storm	28 LF	$85/LF	$2,380
36" storm	1,039 LF	$110/LF	$114,290
48" storm	329 LF	$195/LF	$64,155
Water Quality/Detention Ponds	2 EA	$90,000/LS	$180,000
		Subtotal	$535,535
		Engineering & Contingency (10%)	$53,554
		TOTAL	$589,089

9.0 CONCLUSIONS

The Windermere project has been designed in accordance with El Paso County criteria. The EDB/water quality ponds have been designed to limit the release of storm runoff. This development will not negatively impact the downstream facilities.

10.0 REFERENCES

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

1. City of Colorado Springs "Drainage Criteria Manual", 2016.

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

3. Soil Survey for Colorado Springs and El Paso County, Colorado, U.S. Department of Agriculture, Soil Conservation Service, June 1980.

4. "Flood Insurance Studies for Colorado Springs and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), 1997.

verify

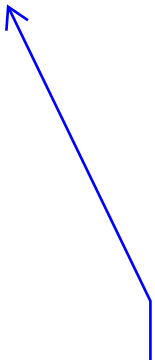
2018

5. "Preliminary Subsurface Soil Investigation", prepared by RMG - Rocky Mountain Group, February 5, 2019.

6. "Final Drainage Report for Pronghorn Meadows, Filing 2," prepared by URS, July 2004.

7. "Final Drainage Report and Erosion Control Amendment for Chateau at Antelope Ridge," prepared by URS, September 9, 2002.

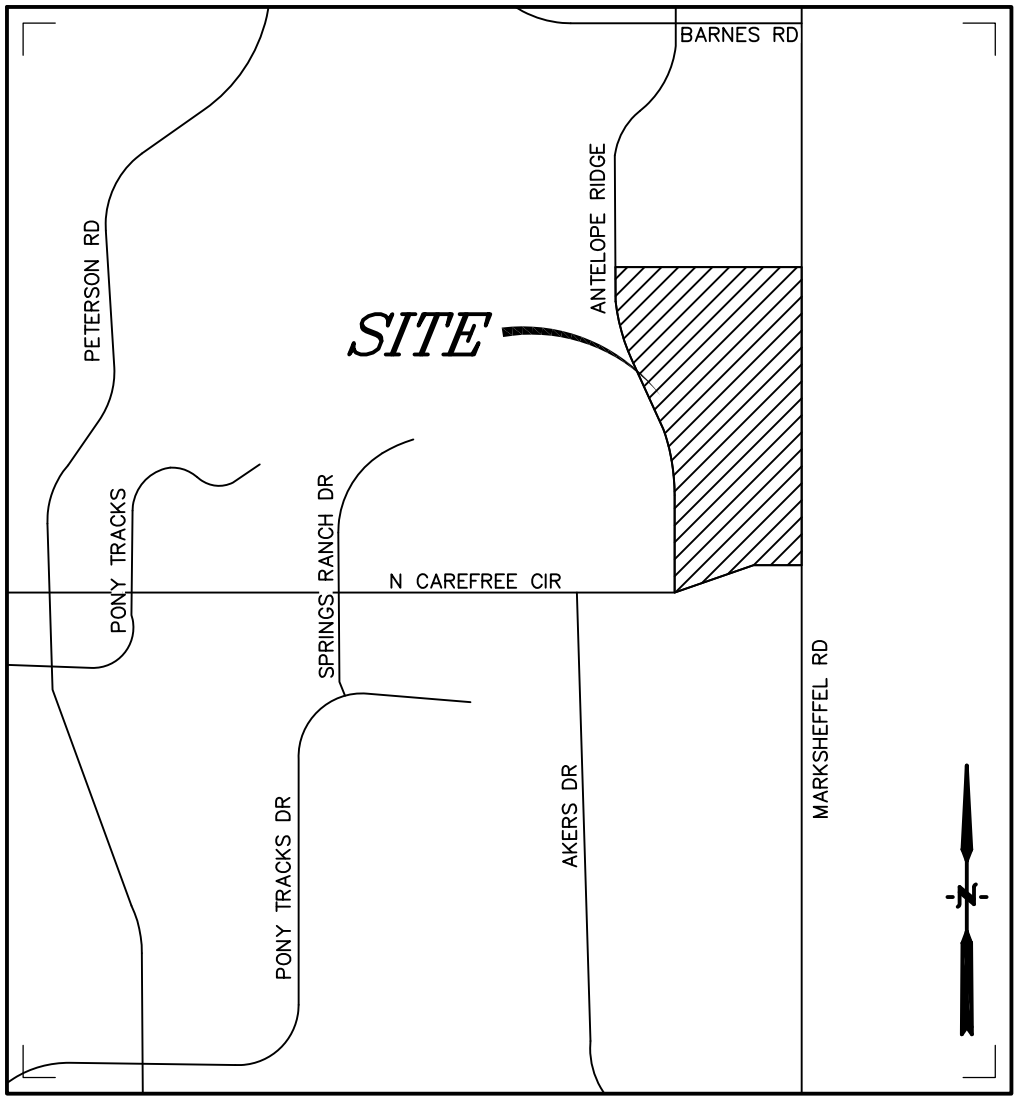
8. "Preliminary Drainage Report for Windermere & Final Drainage Report for Windermere Filing No. 1," prepared by Classic Consulting Engineers & Surveyors, October 2014.



Include this report in appendix.

There is a report done by CH2M Hill and CDs by Wilson & Co. for the Marksheffel Road project that we are trying to locate. Reference previous report's references.

APPENDIX



Vicinity Map
Not to scale

WINDERMERE
COLORADO SPRINGS, CO
VICINITY MAP

Drexel, Barrell & Co.
Engineers • Surveyors

DATE:

JOB NO: 21187-00CSCV

DWG. NO. VMAP

SHEET 1 OF 1

Map Scale: 1:4,170 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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 15, Oct 10, 2017

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

Date(s) aerial images were photographed: Apr 15, 2011—Jun 17, 2014

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
97	Truckton sandy loam, 3 to 9 percent slopes	A	56.4	100.0%
Totals for Area of Interest			**56.4**	**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.

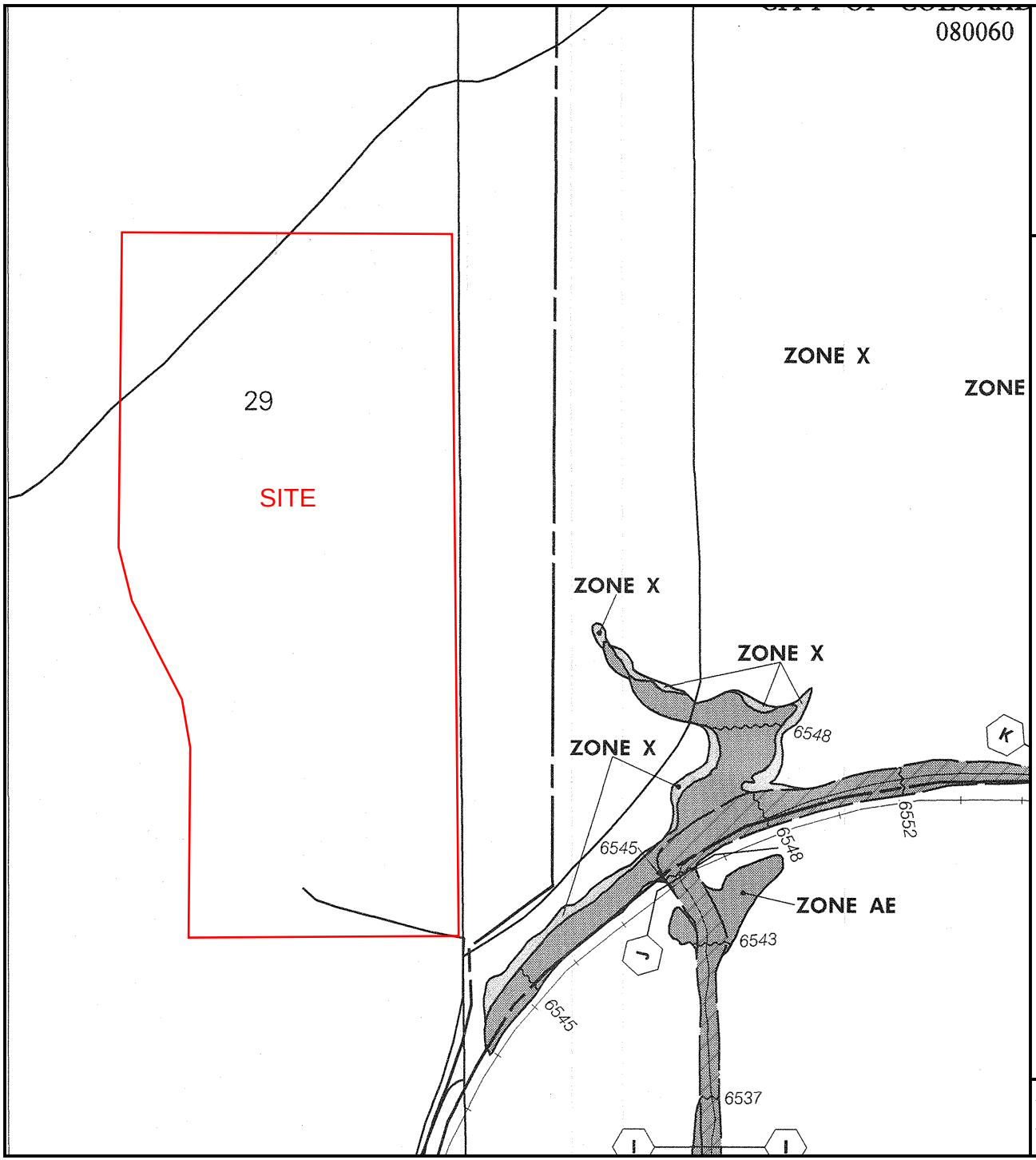
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over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



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 543 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0543	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0543	F

MAP NUMBER
08041C0543 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

Update

PROJECT INFORMATION								
PROJECT:	Windermere							
PROJECT NO:	21187-01							
DESIGN BY:	SBN						Drexel, Barrell & Co.	
REV. BY:	TDM							
AGENCY:	City of Colorado Springs							
REPORT TYPE:	Final							
DATE:	2/21/2019							
Soil Type: A								
				C2*	C5*	C10*	C100*	% IMPERV
Landscape/Lawn					0.15		0.50	0
Residential (<1/8 acre)					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 and El Paso County "Drainage Criteria Manual"								
PROPOSED								
SUB-BASIN	SURFACE DESIGNATION		AREA	COMPOSITE RUNOFF COEFFICIENTS				% IMPERV
			ACRE	**C2**	**C5**	**C10**	**C100**	
A1	Landscape/Lawn		0.00		0.15		0.50	0
	Residential (<1/8 acre)		2.16		0.45		0.59	65
	Asphalt/Sidewalk		0.00		0.90		0.96	100
	WEIGHTED AVERAGE				0.45		0.59	65%
TOTAL A1			2.16					
A2	Landscape/Lawn		0.00		0.15		0.50	0
	Residential (<1/8 acre)		4.70		0.45		0.59	65
	Asphalt/Sidewalk		0.00		0.90		0.96	100
	WEIGHTED AVERAGE				0.45		0.59	65%
TOTAL A2			4.70					
A3	Landscape/Lawn		0.00		0.15		0.50	0
	Residential (<1/8 acre)		1.63		0.45		0.59	65
	Asphalt/Sidewalk		0.00		0.90		0.96	100
	WEIGHTED AVERAGE				0.45		0.59	65%
TOTAL A3			1.63					
A4	Landscape/Lawn		0.00		0.15		0.50	0
	Residential (<1/8 acre)		1.01		0.45		0.59	65
	Asphalt/Sidewalk		0.00		0.90		0.96	100
	WEIGHTED AVERAGE				0.45		0.59	65%
TOTAL A4			1.01					
A5	Landscape/Lawn		0.00		0.15		0.50	0
	Residential (<1/8 acre)		1.98		0.45		0.59	65
	Asphalt/Sidewalk		0.00		0.90		0.96	100
	WEIGHTED AVERAGE				0.45		0.59	65%
TOTAL A5			1.98					
A6	Landscape/Lawn		0.00		0.15		0.50	0
	Residential (<1/8 acre)		3.75		0.45		0.59	65
	Asphalt/Sidewalk		0.00		0.90		0.96	100
	WEIGHTED AVERAGE				0.45		0.59	65%
TOTAL A6			3.75					
A7	Landscape/Lawn		0.00		0.15		0.50	0
	Residential (<1/8 acre)		0.77		0.45		0.59	65
	Asphalt/Sidewalk		0.00		0.90		0.96	100
	WEIGHTED AVERAGE				0.45		0.59	65%
TOTAL A7			0.77					
A8	Landscape/Lawn		0.00		0.15		0.50	0
	Residential (<1/8 acre)		2.96		0.45		0.59	65
	Asphalt/Sidewalk		0.00		0.90		0.96	100
	WEIGHTED AVERAGE				0.45		0.59	65%
TOTAL A8			2.96					

A9	Landscape/Lawn	0.00		0.15		0.50	0
	Residential (<1/8 acre)	1.86		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
TOTAL A9		1.86					
A10	Landscape/Lawn	0.00		0.15		0.50	0
	Residential (<1/8 acre)	4.00		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
TOTAL A10		4.00					
A11	Landscape/Lawn	0.00		0.15		0.50	0
	Residential (<1/8 acre)	2.53		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
TOTAL A11		2.53					
A12	Landscape/Lawn	7.79		0.15		0.50	0
	Residential (<1/8 acre)	1.96		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.21		0.52	13%
TOTAL A12		9.75					
B1	Landscape/Lawn	0.00		0.15		0.50	0
	Residential (<1/8 acre)	3.62		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
TOTAL B1		3.62					
B2	Landscape/Lawn	0.00		0.15		0.50	0
	Residential (<1/8 acre)	2.94		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
TOTAL B2		2.94					
B3	Landscape/Lawn	0.00		0.15		0.50	0
	Residential (<1/8 acre)	2.53		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.45		0.59	65%
TOTAL B3		2.53					
B4	Landscape/Lawn	0.53		0.15		0.50	0
	Residential (<1/8 acre)	0.00		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL B4		0.53					
B5	Landscape/Lawn	0.40		0.15		0.50	0
	Residential (<1/8 acre)	0.59		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.33		0.55	39%
TOTAL B5		0.99					
C1	Landscape/Lawn	2.96		0.15		0.50	0
	Residential (<1/8 acre)	2.14		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.28		0.54	27%
TOTAL C1		5.10					
C2	Landscape/Lawn	0.70		0.15		0.50	0
	Residential (<1/8 acre)	1.58		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.36		0.56	45%
TOTAL C2		2.28					
C3	Landscape/Lawn	0.13		0.15		0.50	0
	Residential (<1/8 acre)	0.00		0.45		0.59	65
	Asphalt/Sidewalk	0.00		0.90		0.96	100
	WEIGHTED AVERAGE			0.15		0.50	0%
TOTAL C3		0.13					
TOTAL SITE		55.22		0.38		0.57	50.3%

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REPORT TYPE:	Final
DATE:	2/21/2019

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
A1	A	0.45	0.59	2.16	100	12	12.0	5.3	20	5	25.0	15.5	0.0					5.3	5	5.3
	8	0.61	0.71	14.19																18.7
A2	B	0.45	0.59	4.70	100	5	5.1	7.1	1051	21	2.0	8.3	2.1					9.2	5	9.2
A3		0.56	0.67	1.63	35	1	3.5	4.0	600	16	2.6	9.4	1.1					5.0	5	5.0
	C	0.56	0.67	20.52										450	0.5	5.4	1.4	20.1	5	20.1
A4		0.45	0.59	1.01	100	1	1.0	12.2	205	10	4.8	12.8	0.3					12.4	5	12.4
	D	0.55	0.67	21.53										220	4.0	15.3	0.2	20.3	5	20.3
A5	E	0.45	0.59	1.98	100	12	11.9	5.3	385	9	2.4	9.1	0.7					6.0	5	6.0
A6		0.45	0.59	3.75	100	3	3.0	8.4	790	32	4.0	11.7	1.1					9.6	5	9.6
	F	0.53	0.65	27.26										90	3.5	14.3	0.1	20.4	5	20.4
A7	G	0.45	0.59	0.77	40	1	3.1	5.3	610	9	1.4	6.9	1.5					6.7	5	6.7
A8	H	0.45	0.59	2.96	100	10	10.4	5.6	740	11	1.5	7.2	1.7					7.3	5	7.3
A9	I	0.45	0.59	1.86	100	10	10.5	5.6	460	8	1.6	7.4	1.0					6.6	5	6.6
	J	0.45	0.59	5.59										300	1.0	5.9	0.9	8.1	5	8.1
	K	0.52	0.64	32.85										275	3.5	12.7	0.4	20.8	5	20.8
A10		0.45	0.59	4.00	100	3	3.0	8.4	770	25	3.2	10.5	1.2					9.7	5	9.7
	L	0.51	0.64	36.85										115	1.0	9.3	0.2	21.0	5	21.0
A11		0.45	0.59	2.53	40	1	1.5	6.7	945	40	4.2	12.0	1.3					8.0	5	8.0
	M	0.51	0.63	39.38										35	1.0	9.3	0.1	21.1	5	21.1
A12		0.21	0.52	9.75	100	30	29.6	5.4	1005	18	1.8	8.3	2.0					7.4	5	7.4
	N	0.45	0.61	49.13					260	4	1.4	8.3	0.5	180	3.5	14.3	0.2	21.8	5	21.8
B1	O	0.45	0.59	3.62	35	1	3.5	4.7	885	30	3.4	10.8	1.4					6.1	5	6.1
B2	P	0.45	0.59	2.94	50	2	4.0	5.4	725	20	2.8	9.8	1.2					6.6	5	6.6
B3	Q	0.45	0.59	2.53	100	5	5.3	7.0	825	21	2.5	9.3	1.5					8.4	5	8.4
B4		0.15	0.50	0.53	85	24	28.5	5.4	75	4	5.3	14.3	0.1					5.5	5	5.5
	R	0.43	0.59	9.62					75	4	5.3	14.3	0.1	70	25.0	29.3	0.0	8.6	5	8.6
B5		0.33	0.55	0.99	100	11	10.8	6.5	455	15	3.3	5.6	1.3					7.9	5	7.9

	S	0.42	0.58	10.61										105	2.0	8.3	0.2	8.8	5	8.8
C1	T	0.28	0.54	5.10	100	8	7.7	7.8	80	11	13.8	11.5	0.1					7.9	5	7.9
C2	U	0.36	0.56	2.28	100	5	5.5	7.9	75	2	2.1	4.5	0.3					8.2	5	8.2
C3	V	0.15	0.50	0.13	35	6	15.9	4.2										4.2	5	5.0

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Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

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

			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)	Calculated Pipe Dia	Used Pipe
A1	A	2.16	0.45	5.3	0.97	5.02	4.9				
	8	14.19	0.61	18.7	8.60	3.12	26.8				
A2	B	4.70	0.45	9.2	2.12	4.23	9.0				
A3		1.63	0.56	5.0	0.91	5.10	4.6				
	C	20.52	0.56	20.1	11.45	3.01	34.4				
A4		1.01	0.45	12.4	0.45	3.76	1.7				
	D	21.53	0.55	20.3	11.90	2.99	35.6				
A5	E	1.98	0.45	6.0	0.89	4.85	4.3				
A6		3.75	0.45	9.6	1.69	4.17	7.0				
	F	27.26	0.53	20.4	14.48	2.98	43.2				
A7	G	0.77	0.45	6.7	0.35	4.70	1.6				
A8	H	2.96	0.45	7.3	1.33	4.58	6.1				
A9	I	1.86	0.45	6.6	0.84	4.73	4.0				
	J	5.59	0.45	8.1	2.52	4.42	11.1				
	K	32.85	0.52	20.8	17.00	2.96	50.2				
A10		4.00	0.45	9.7	1.80	4.16	7.5				
	L	36.85	0.51	21.0	18.80	2.94	55.3				
A11		2.53	0.45	8.0	1.14	4.45	5.1				
	M	39.38	0.51	21.1	19.93	2.94	58.5				
A12		9.75	0.21	7.4	2.05	4.56	9.4				
	N	49.13	0.45	21.8	21.98	2.88	174.7				
North Pond Release							1.4				
B1	O	3.62	0.45	6.1	1.63	4.84	7.9				
B2	P	2.94	0.45	6.6	1.32	4.72	6.2				
B3	Q	2.53	0.45	8.4	1.14	4.36	5.0				
B4		0.53	0.15	5.5	0.08	4.99	0.4				
	R	9.62	0.43	8.6	4.17	4.34	18.1				
South Pond Release							0.3				
B5		0.99	0.33	7.9	0.33	4.47	1.5				
	S						10.7				
C1		5.10	0.28	7.9	1.41	4.46	6.3				
	T						192.7				
C2	U	2.28	0.36	8.2	0.82	4.42	3.6				
C3	V	0.13	0.15	5.0	0.02	5.10	0.1				

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REPORT TYPE:	Final
DATE:	2/21/2019

Drexel, Barrell & Co.

RATIONAL METHOD CALCULATIONS FOR STORM WATER RUNOFF

PROPOSED RUNOFF 100 YR STORM P1= 2.67

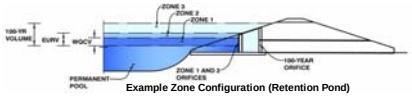
			DIRECT RUNOFF					PIPE SIZING			
BASIN (S)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C * A	I (IN/HR)	Q (CFS)	n	Slope (ft/ft)	Calculated Pipe Dia (ft)	Used Pipe (in)
A1	A	2.16	0.59	5.3	1.27	8.94	11.4				
	8	14.19	0.71	18.7	10.04	5.55	55.7	0.016	0.005	3.4	36
A2	B	4.70	0.59	9.2	2.77	7.54	20.9	0.016	0.01	2.1	24
A3		1.63	0.67	5.0	1.09	9.08	9.9				
	C	20.52	0.67	20.1	13.77	5.35	73.7	0.016	0.04	2.6	36
A4		1.01	0.59	12.4	0.60	6.69	4.0				
	D	21.53	0.67	20.3	14.37	5.32	76.5	0.016	0.035	2.7	36
A5	E	1.98	0.59	6.0	1.17	8.64	10.1	0.016	0.01	1.6	18
A6		3.75	0.59	9.6	2.21	7.43	16.4				
	F	27.26	0.65	20.4	17.75	5.31	94.2	0.016	0.035	2.9	36
A7	G	0.77	0.59	6.7	0.45	8.36	3.8	0.016	0.01	1.1	18
A8	H	2.96	0.59	7.3	1.75	8.16	14.2	0.016	0.008	1.9	24
A9	I	1.86	0.59	6.6	1.10	8.42	9.2	0.016	0.01	1.6	18
	J	5.59	0.59	8.1	3.30	7.87	25.9	0.016	0.009	2.3	30
	K	32.85	0.64	20.8	21.04	5.26	110.7	0.016	0.01	3.9	48
A10		4.00	0.59	9.7	2.36	7.40	17.5				
	L	36.85	0.64	21.0	23.40	5.23	122.5	0.016	0.01	4.1	48
A11		2.53	0.59	8.0	1.49	7.91	11.8				
	M	39.38	0.63	21.1	24.90	5.23	130.1	0.016	0.035	3.3	48
A12		9.75	0.52	7.4	5.05	8.12	41.0				
	N	49.13	0.61	21.8	29.95	5.13	353.5				
North Pond Release							19.7	0.016	0.02	2.0	30
B1	O	3.62	0.59	6.1	2.14	8.61	18.4	0.016	0.02	1.8	24
B2	P	2.94	0.59	6.6	1.73	8.40	14.6	0.016	0.006	2.0	24
B3	Q	2.53	0.59	8.4	1.49	7.77	11.6	0.016	0.25	0.9	24
B4		0.53	0.50	5.5	0.27	8.88	2.4				
	R	9.62	0.59	8.6	5.63	7.73	43.5				
South Pond Release							5.3	0.016	0.02	1.1	18
B5		0.99	0.55	7.9	0.55	7.95	4.4				
	S						27.7	0.016	0.005	2.7	24
C1		5.10	0.54	7.9	2.74	7.94	21.8				
	T						641.5				
C2	U	2.28	0.56	8.2	1.28	7.86	10.1				
C3	V	0.13	0.50	5.0	0.07	9.09	0.6				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Windermere

Basin ID: North pond



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	132.63	acres
Watershed Length =	4,000	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	45.40%	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 =	Denver - Capitol Building	
Water Quality Capture Volume (WQCV) =	2.144	acre-feet
Excess Urban Runoff Volume (EURV) =	6.758	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.596	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	6.058	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	7.492	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	9.433	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	11.977	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	15.026	acre-feet
500-yr Runoff Volume (P1 = 3.49 in.) =	24.558	acre-feet
Approximate 2-yr Detention Volume =	4.327	acre-feet
Approximate 5-yr Detention Volume =	5.711	acre-feet
Approximate 10-yr Detention Volume =	7.001	acre-feet
Approximate 25-yr Detention Volume =	8.617	acre-feet
Approximate 50-yr Detention Volume =	9.670	acre-feet
Approximate 100-yr Detention Volume =	11.030	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
3.49	inches

Stage-Storage Calculation

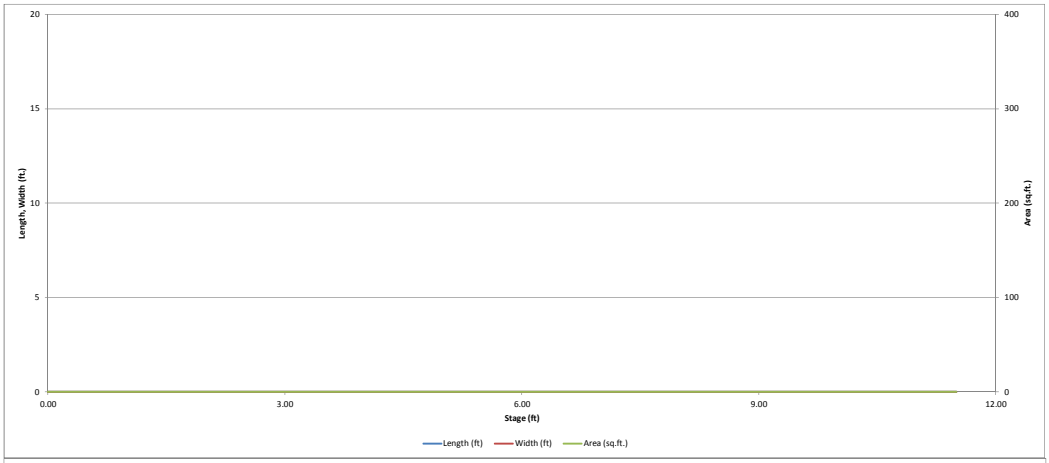
Zone 1 Volume (WQCV) =	2.144	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.614	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.272	acre-feet
Total Detention Basin Volume =	11.030	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

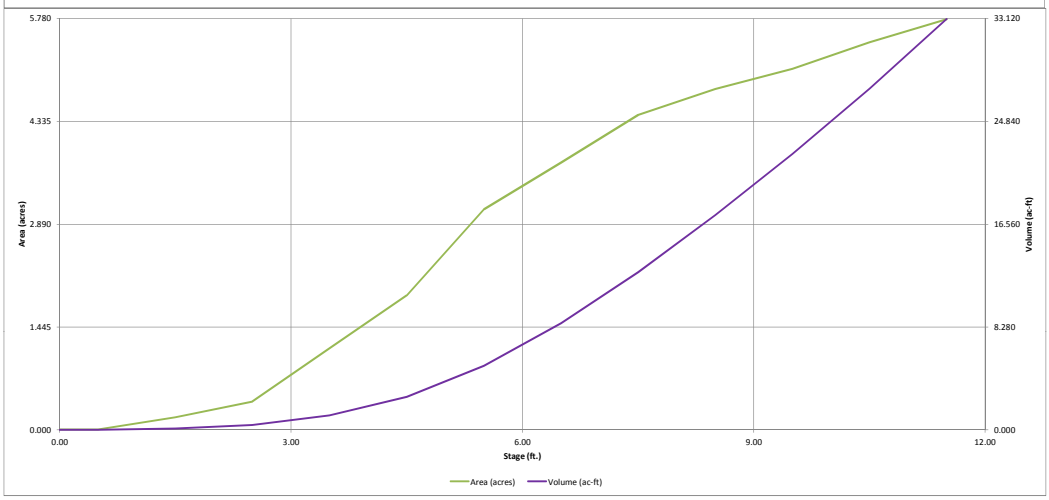
Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	250	0.006		
6571	--	0.50	--	--	--	250	0.006	123	0.003
6572	--	1.50	--	--	--	7,586	0.174	3,967	0.091
6573	--	2.50	--	--	--	17,267	0.396	16,469	0.378
6574	--	3.50	--	--	--	49,754	1.142	49,980	1.147
6575	--	4.50	--	--	--	82,355	1.891	116,034	2.664
6576	--	5.50	--	--	--	135,090	3.101	224,757	5.160
6577	--	6.50	--	--	--	163,617	3.756	374,110	8.588
6578	--	7.50	--	--	--	192,865	4.428	552,351	12.680
6579-Spillway	--	8.50	--	--	--	208,824	4.794	753,195	17.291
6580	--	9.50	--	--	--	221,127	5.076	968,171	22.226
6581	--	10.50	--	--	--	237,413	5.450	1,197,441	27.489
6582-Embnkmnt	--	11.50	--	--	--	251,492	5.773	1,441,893	33.101

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



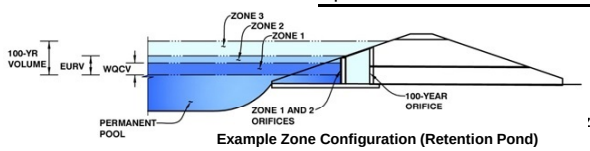


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Windermere

Basin ID: N pond



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.21	2.144	Orifice Plate
Zone 2 (EURV)	5.99	4.614	Orifice Plate
Zone 3 (100-year)	7.12	4.272	Weir&Pipe (Circular)
		11.030	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 Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	5.153E-02	ft^2
Depth at top of Zone using Orifice Plate =	7.00	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	24.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	7.42	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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)	7.42	7.42	7.42					

	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			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	7.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	7.00	N/A	feet
Overflow Weir Front Edge Length =	3.91	N/A	feet	Over Flow Weir Slope Length =	3.91	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	2.18	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	3.91	N/A	feet	Overflow Grate Open Area w/o Debris =	10.70	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	5.35	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Circular	Not Selected			Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	4.91	N/A	ft^2
Circular Orifice Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	1.25	N/A	feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.96	feet
Spillway Crest Length =	71.00	feet	Stage at Top of Freeboard =	10.46	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	5.44	acres
Freeboard above Max Water Surface =	1.00	feet			

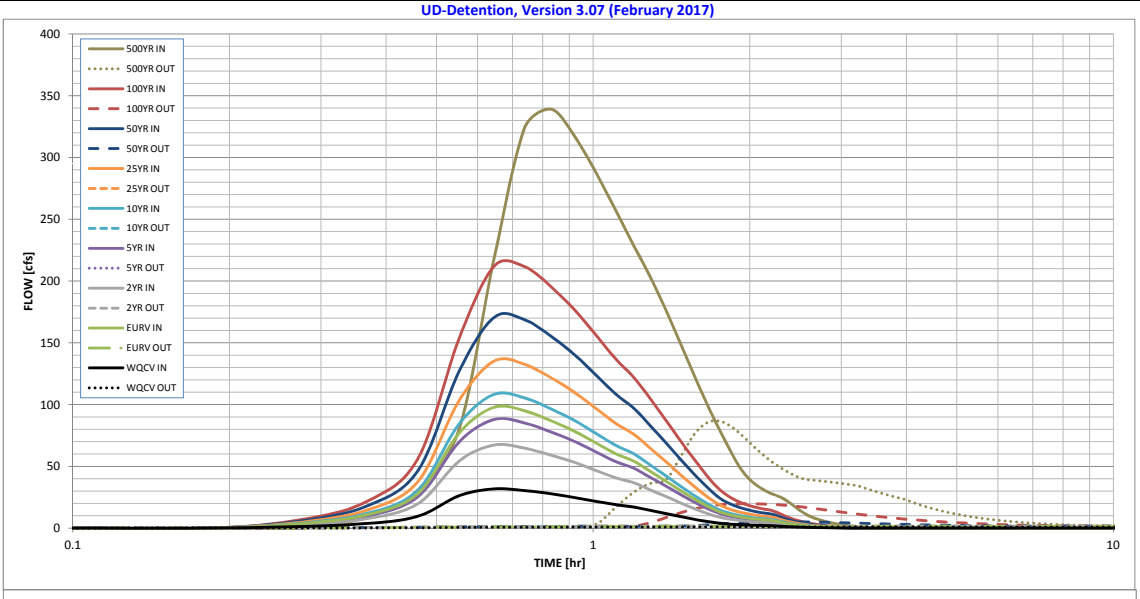
Calculated Parameters for Spillway

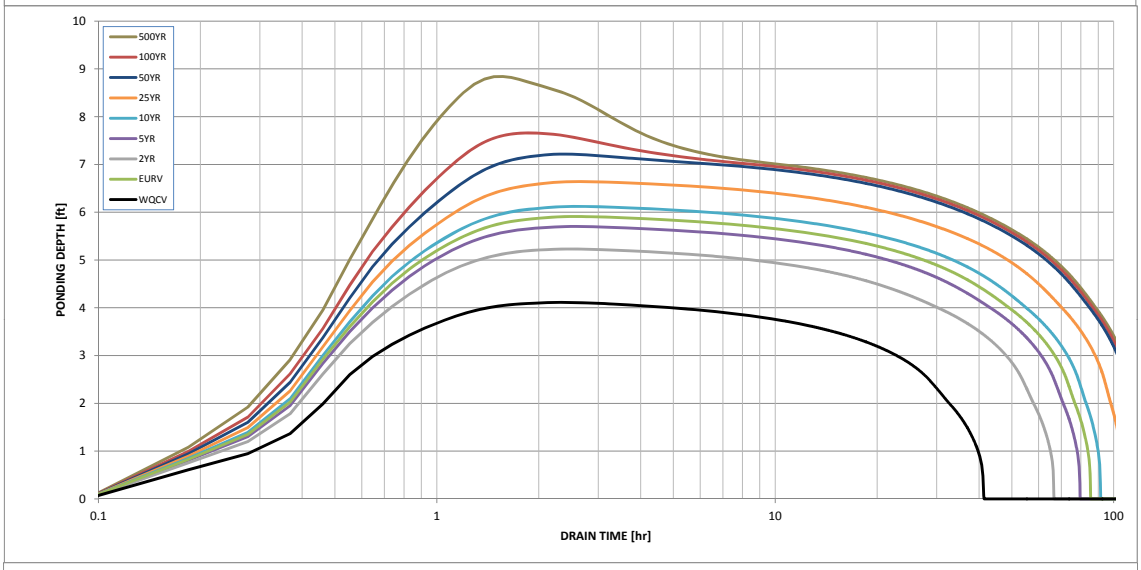
Routed Hydrograph Results

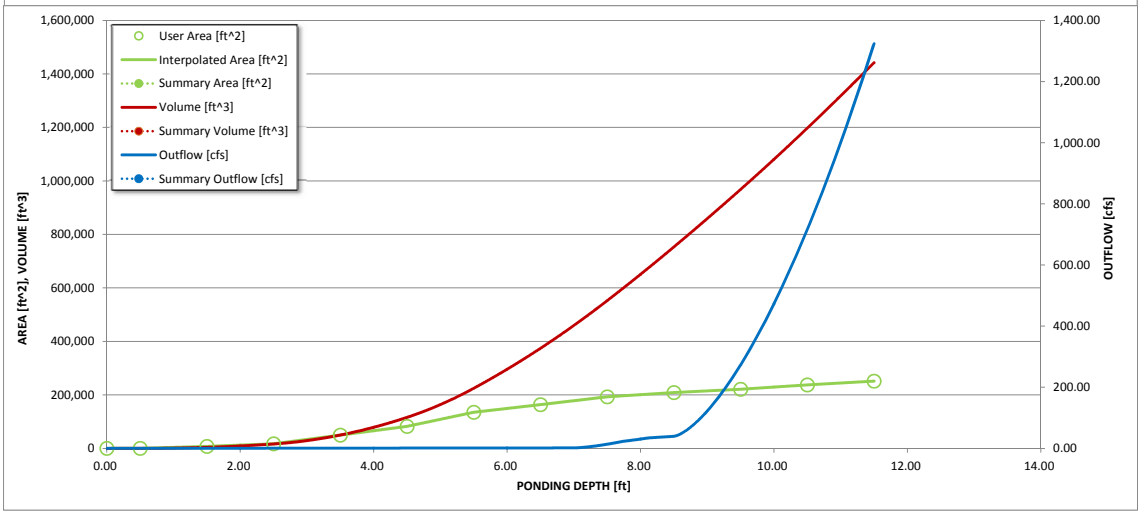
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.49
Calculated Runoff Volume (acre-ft) =	2.144	6.758	4.596	6.058	7.492	9.433	11.977	15.026	24.558
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	2.144	6.752	4.596	6.052	7.491	9.423	11.976	15.024	24.558
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.00	0.01	0.02	0.17	0.42	1.06
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.6	1.4	3.1	22.7	55.1	140.0
Peak Inflow Q (cfs) =	31.7	97.8	67.2	87.9	108.2	135.2	170.5	212.0	339.2
Peak Outflow Q (cfs) =	0.9	1.4	1.3	1.4	1.5	1.6	5.1	19.7	86.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.4	1.1	0.5	0.2	0.4	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	0.3	1.7	3.9
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	77	61	72	82	96	109	109	105
Time to Drain 99% of Inflow Volume (hours) =	**40**	82	64	77	88	102	116	117	115
Maximum Ponding Depth (ft) =	4.11	5.91	5.23	5.70	6.12	6.64	7.22	7.66	8.84
Area at Maximum Ponding Depth (acres) =	1.60	3.36	2.77	3.23	3.51	3.85	4.23	4.48	4.89
Maximum Volume Stored (acre-ft) =	1.983	6.453	4.366	5.793	7.208	9.121	11.424	13.348	18.937

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]
5.53 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:11:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:16:35	1.36	3.84	2.76	3.51	4.19	5.03	6.03	7.10	9.33
0.904	0:22:07	3.72	10.96	7.71	9.93	12.03	14.73	18.12	21.93	30.91
	0:27:39	9.56	28.15	19.80	25.50	30.90	37.84	46.57	56.43	80.51
	0:33:11	26.23	77.07	54.28	69.84	84.55	103.45	127.14	153.82	218.44
	0:38:43	31.73	97.82	67.19	87.93	108.23	135.24	170.52	212.01	323.32
	0:44:14	30.39	95.04	64.76	85.20	105.44	132.68	168.75	211.84	339.20
	0:49:46	27.66	86.92	59.02	77.84	96.53	121.77	155.34	195.62	317.23
	0:55:18	24.85	78.37	53.18	70.17	87.06	109.88	140.24	176.67	287.39
	1:00:50	21.62	68.80	46.55	61.55	76.49	96.71	123.67	156.08	257.29
	1:06:22	18.79	60.19	40.66	53.82	66.93	84.68	108.35	136.80	228.29
	1:11:53	17.03	54.12	36.68	48.44	60.13	75.91	96.89	122.03	203.01
	1:17:25	14.21	45.64	30.77	40.79	50.79	64.37	82.51	104.37	175.69
	1:22:57	11.72	37.91	25.51	33.86	42.21	53.54	68.70	86.98	148.72
	1:28:29	9.20	30.27	20.25	26.99	33.75	42.97	55.34	70.34	123.19
	1:34:01	7.02	23.53	15.66	20.95	26.27	33.54	43.30	55.18	99.71
	1:39:32	5.17	17.72	11.72	15.75	19.82	25.38	32.88	42.10	79.37
	1:45:04	3.92	13.18	8.77	11.74	14.72	18.78	24.24	31.16	61.29
	1:50:36	3.19	10.52	7.04	9.38	11.73	14.90	19.16	24.46	46.22
	1:56:08	2.69	8.83	5.93	7.88	9.84	12.49	16.03	20.38	37.18
	2:01:40	2.35	7.66	5.15	6.84	8.53	10.80	13.84	17.56	31.49
	2:07:11	2.11	6.83	4.61	6.11	7.60	9.62	12.31	15.59	27.57
	2:12:43	1.93	6.25	4.22	5.59	6.95	8.78	11.22	14.19	24.77
	2:18:15	1.43	4.73	3.15	4.21	5.28	6.73	8.70	11.13	20.06
	2:23:47	1.04	3.41	2.28	3.04	3.81	4.85	6.26	8.02	14.74
	2:29:19	0.77	2.53	1.69	2.25	2.82	3.60	4.65	5.95	10.72
	2:34:50	0.57	1.88	1.25	1.67	2.10	2.68	3.45	4.41	8.01
	2:40:22	0.41	1.38	0.92	1.23	1.55	1.98	2.56	3.27	6.01
	2:45:54	0.29	1.00	0.66	0.89	1.12	1.43	1.85	2.37	4.48
	2:51:26	0.21	0.72	0.48	0.64	0.81	1.03	1.34	1.71	3.29
	2:56:58	0.15	0.51	0.34	0.45	0.57	0.74	0.96	1.23	2.44
	3:02:29	0.09	0.34	0.22	0.30	0.38	0.49	0.64	0.83	1.75
	3:08:01	0.05	0.20	0.12	0.17	0.22	0.29	0.38	0.50	1.18
	3:13:33	0.02	0.09	0.06	0.08	0.11	0.14	0.19	0.26	0.72
	3:19:05	0.00	0.03	0.02	0.02	0.03	0.05	0.06	0.09	0.37
	3:24:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13
	3:30:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:35:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:41:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:03:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:08:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:14:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:19:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:36:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:58:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:09:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:26:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:31:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:42:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:48:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:53:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:59:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:04:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:10:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:16:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:21:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:27:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:32:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:38:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Windermere - Forebay volumes for North pond

3% of WQCV = 0.03 x 2.144 = 0.0643 ac-ft

Qin north = 199.7 cfs
Qin south = 130.0 cfs
Qtotal = 329.7 cfs

North forebay volume:

$$\frac{199.7 \text{ cfs}}{329.7 \text{ cfs}} = \frac{x}{0.0643} \text{ ac-ft}$$

x = 0.0390 ac-ft
= 1697.0 ft^3

South forebay volume:

$$\frac{130.0 \text{ cfs}}{329.7 \text{ cfs}} = \frac{x}{0.0643} \text{ ac-ft}$$

x = 0.0254 ac-ft
= 1104.7 ft^3

NORTH POND

FOREBAY RELEASE NOTCH WIDTH - NORTH

$Q=CLH^{2/3}$

Q_{100}=	199.7	cfs
2% of Q=	3.99	cfs
C=	2.6	
H (height of forebay wall)=	1	ft
L=	18	in

FOREBAY RELEASE NOTCH WIDTH - SOUTH

$Q=CLH^{2/3}$

Q_{100}=	130	cfs
2% of Q=	2.60	cfs
C=	2.6	
H (height of forebay wall)=	1	ft
L=	12	in

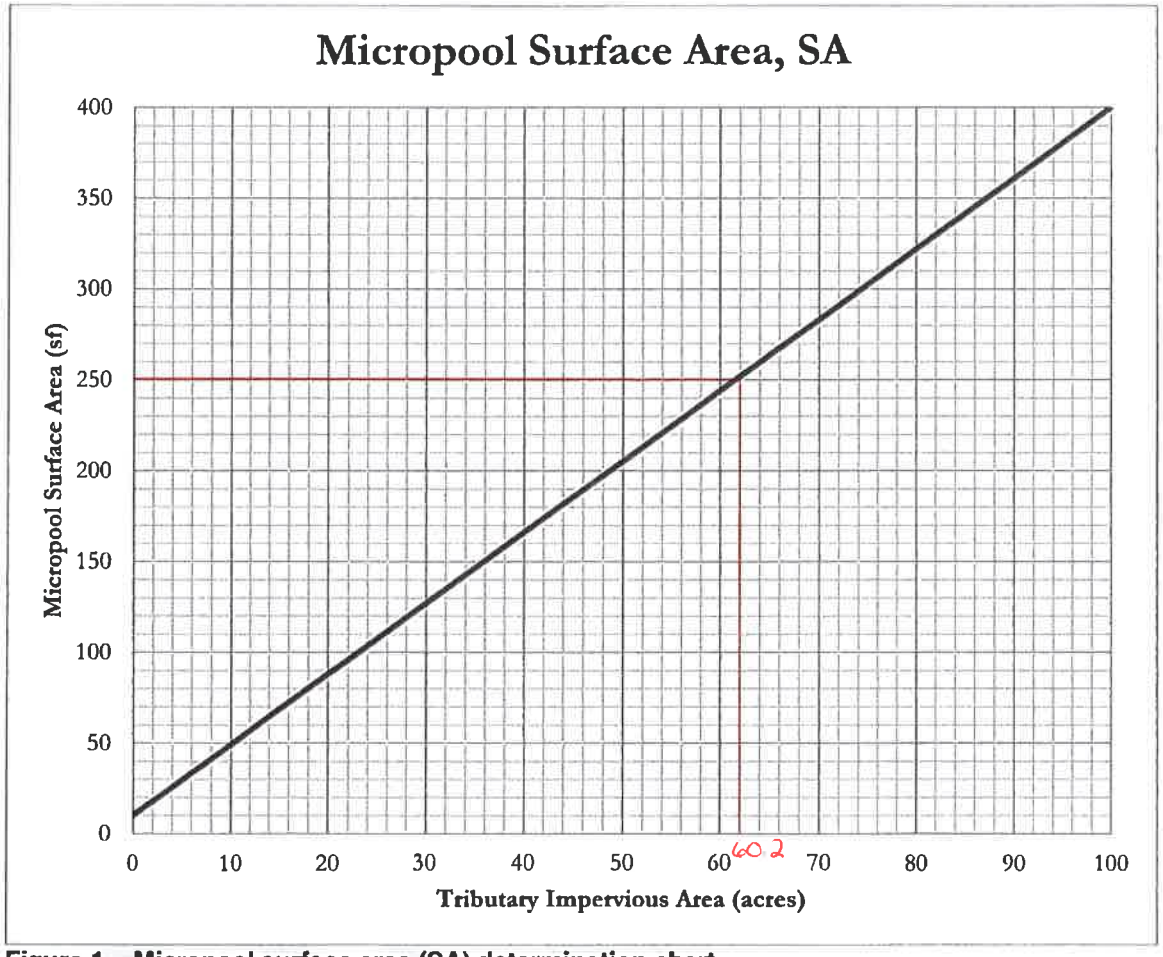


Figure 1 – Micropool surface area (SA) determination chart

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.

$$TIA = I \times A$$

$\frac{45.4}{100} \times 132.63 = 60.2$ 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.

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

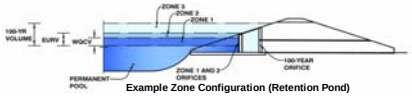
ISV = Initial surcharge volume (cf)
SA = Surface area (from Figure 1, sf)

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Windermere

Basin ID: South pond



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	9.31	acres
Watershed Length =	770	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	73.30%	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 =	Denver - Capitol Building	
Water Quality Capture Volume (WQCV) =	0.226	acre-feet
Excess Urban Runoff Volume (EURV) =	0.876	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.605	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.787	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.953	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.139	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.332	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	1.559	acre-feet
500-yr Runoff Volume (P1 = 3.49 in.) =	2.304	acre-feet
Approximate 2-yr Detention Volume =	0.573	acre-feet
Approximate 5-yr Detention Volume =	0.747	acre-feet
Approximate 10-yr Detention Volume =	0.895	acre-feet
Approximate 25-yr Detention Volume =	1.069	acre-feet
Approximate 50-yr Detention Volume =	1.171	acre-feet
Approximate 100-yr Detention Volume =	1.271	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
3.49	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.226	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.650	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.396	acre-feet
Total Detention Basin Volume =	1.271	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	

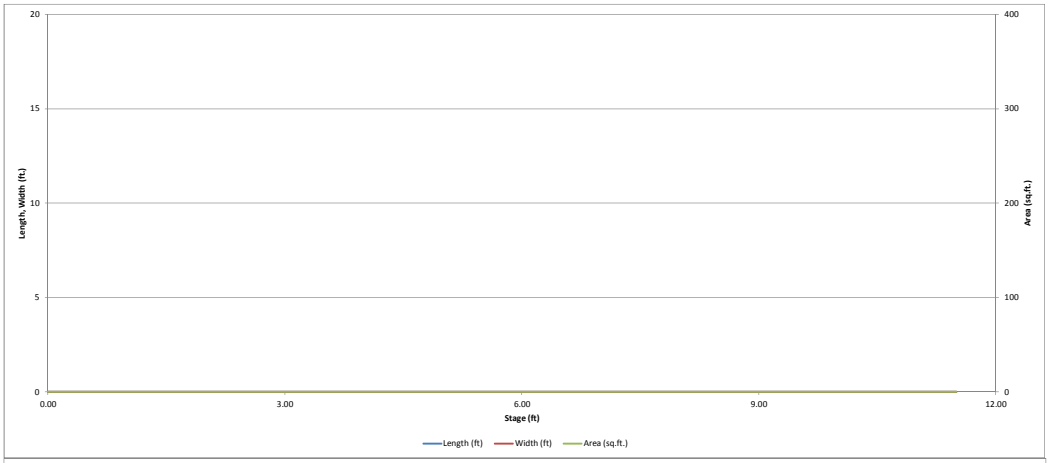
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

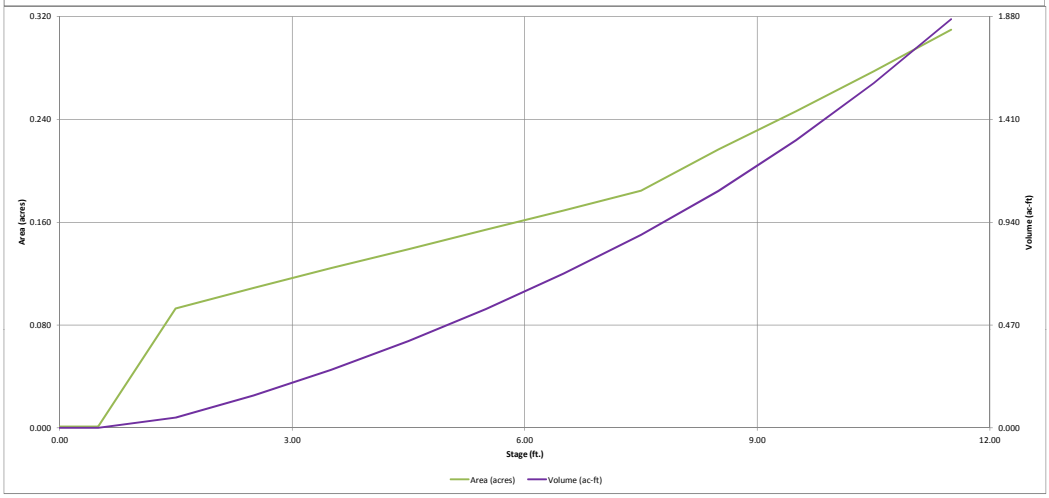
Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	40	0.001		
6563	--	0.50	--	--	--	40	0.001	20	0.000
6564	--	1.50	--	--	--	4,047	0.093	2,023	0.046
6565	--	2.50	--	--	--	4,744	0.109	6,459	0.148
6566	--	3.50	--	--	--	5,413	0.124	11,537	0.265
6567	--	4.50	--	--	--	6,058	0.139	17,273	0.397
6568	--	5.50	--	--	--	6,715	0.154	23,659	0.543
6569	--	6.50	--	--	--	7,370	0.169	30,702	0.705
6570	--	7.50	--	--	--	8,037	0.185	38,405	0.882
6571	--	8.50	--	--	--	9,445	0.217	47,146	1.082
6572-Spillway	--	9.50	--	--	--	10,731	0.246	57,234	1.314
6573	--	10.50	--	--	--	12,088	0.278	68,644	1.576
6574-Embnkmnt	--	11.50	--	--	--	13,493	0.310	81,434	1.869

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



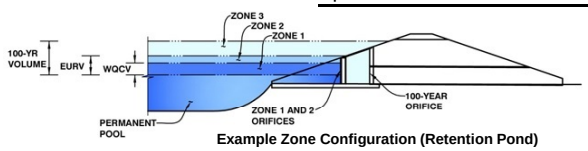


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Windermere

Basin ID: S pond



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.18	0.226	Orifice Plate
Zone 2 (EURV)	7.47	0.650	Orifice Plate
Zone 3 (100-year)	9.33	0.396	Weir&Pipe (Restrict)
		1.271	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 Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	8.611E-03	ft^2
Depth at top of Zone using Orifice Plate =	8.50	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	24.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.24	sq. inches (diameter = 1-1/4 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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)	1.24	1.24	1.24					

	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			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	8.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	8.50	N/A	feet
Overflow Weir Front Edge Length =	3.91	N/A	feet	Over Flow Weir Slope Length =	3.91	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	33.03	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	3.91	N/A	feet	Overflow Grate Open Area w/o Debris =	10.70	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	5.35	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			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 Orifice Area =	0.32	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.21	N/A	feet
Restrictor Plate Height Above Pipe Invert =	4.30		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.02	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.85	feet
Spillway Crest Length =	11.00	feet	Stage at Top of Freeboard =	11.35	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.30	acres
Freeboard above Max Water Surface =	1.00	feet			

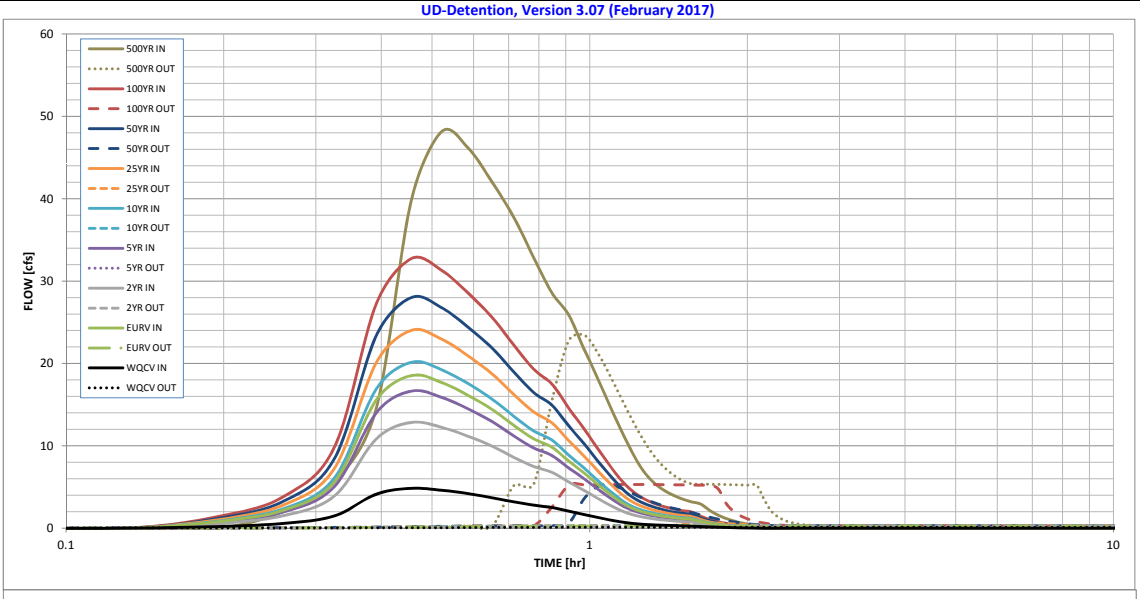
Calculated Parameters for Spillway

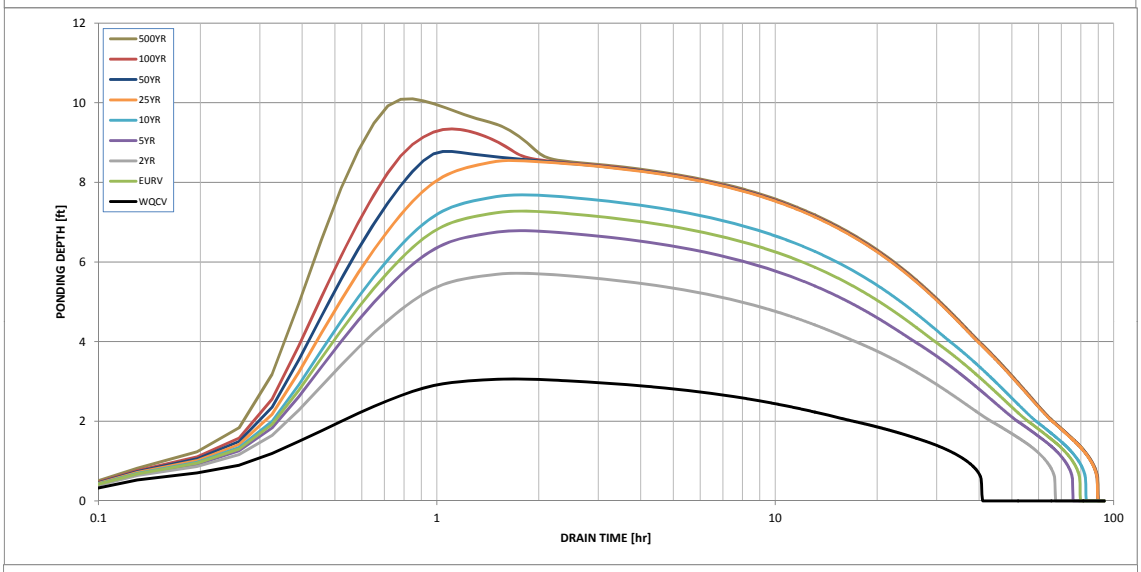
Routed Hydrograph Results

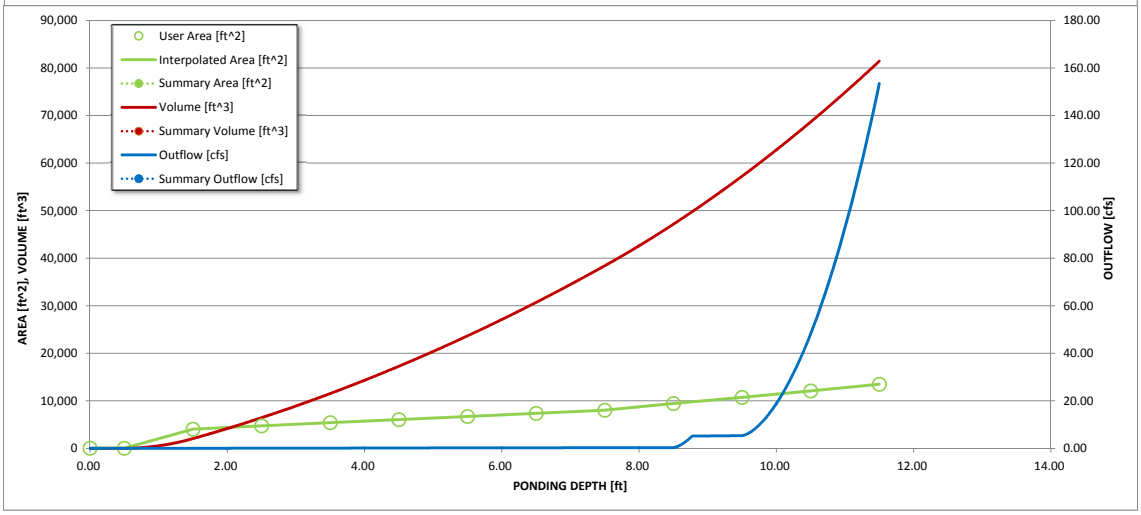
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.49
Calculated Runoff Volume (acre-ft) =	0.226	0.876	0.605	0.787	0.953	1.139	1.332	1.559	2.304
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.225	0.875	0.604	0.785	0.952	1.138	1.330	1.557	2.302
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.02	0.04	0.26	0.63	1.54
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.1	0.3	2.4	5.8	14.4
Peak Inflow Q (cfs) =	4.8	18.5	12.8	16.6	20.1	24.0	28.0	32.7	48.1
Peak Outflow Q (cfs) =	0.1	0.3	0.2	0.3	0.3	0.7	5.1	5.3	23.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	4.2	2.0	2.0	2.1	0.9	1.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.5	0.5	0.5
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	72	62	69	74	80	79	77	72
Time to Drain 99% of Inflow Volume (hours) =	**40**	77	65	73	80	86	85	85	83
Maximum Ponding Depth (ft) =	3.06	7.28	5.72	6.79	7.69	8.55	8.78	9.34	10.10
Area at Maximum Ponding Depth (acres) =	0.12	0.18	0.16	0.17	0.19	0.22	0.22	0.24	0.26
Maximum Volume Stored (acre-ft) =	0.212	0.840	0.576	0.753	0.915	1.091	1.142	1.275	1.465

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]
3.91 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:03:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:07:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:11:44	0.22	0.81	0.57	0.73	0.88	1.05	1.22	1.42	2.06
1.278	0:15:38	0.59	2.20	1.53	1.98	2.39	2.84	3.31	3.86	5.64
	0:19:33	1.50	5.65	3.94	5.09	6.14	7.31	8.50	9.91	14.48
	0:23:28	4.14	15.54	10.82	13.98	16.87	20.07	23.34	27.20	39.74
	0:27:22	4.85	18.52	12.83	16.64	20.13	24.01	28.00	32.72	48.13
	0:31:17	4.61	17.69	12.25	15.89	19.23	22.96	26.78	31.31	46.12
	0:35:11	4.19	16.10	11.15	14.47	17.51	20.90	24.38	28.50	41.98
	0:39:06	3.72	14.41	9.95	12.94	15.67	18.72	21.85	25.56	37.72
	0:43:01	3.19	12.46	8.59	11.18	13.56	16.22	18.95	22.18	32.83
	0:46:55	2.79	10.85	7.49	9.74	11.80	14.11	16.47	19.28	28.56
	0:50:50	2.52	9.83	6.78	8.82	10.70	12.79	14.94	17.48	25.87
	0:54:44	2.06	8.14	5.59	7.30	8.86	10.61	12.41	14.55	21.59
	0:58:39	1.67	6.66	4.56	5.97	7.26	8.71	10.20	11.97	17.82
	1:02:34	1.26	5.16	3.51	4.61	5.63	6.77	7.95	9.35	14.00
	1:06:28	0.92	3.86	2.61	3.45	4.22	5.10	6.01	7.09	10.70
	1:10:23	0.67	2.79	1.89	2.49	3.05	3.70	4.38	5.19	7.90
	1:14:17	0.53	2.15	1.47	1.92	2.35	2.84	3.35	3.96	5.98
	1:18:12	0.44	1.77	1.21	1.58	1.93	2.33	2.74	3.23	4.85
	1:22:07	0.37	1.50	1.03	1.34	1.64	1.97	2.32	2.73	4.10
	1:26:01	0.33	1.32	0.90	1.18	1.44	1.73	2.03	2.39	3.58
	1:29:56	0.30	1.18	0.81	1.06	1.29	1.55	1.82	2.14	3.20
	1:33:50	0.27	1.09	0.75	0.98	1.19	1.43	1.68	1.97	2.94
	1:37:45	0.20	0.80	0.55	0.72	0.87	1.05	1.23	1.45	2.17
	1:41:40	0.15	0.59	0.40	0.53	0.64	0.77	0.90	1.06	1.58
	1:45:34	0.11	0.43	0.30	0.39	0.47	0.56	0.66	0.78	1.17
	1:49:29	0.08	0.32	0.22	0.28	0.35	0.42	0.49	0.58	0.86
	1:53:23	0.06	0.23	0.16	0.20	0.25	0.30	0.35	0.42	0.63
	1:57:18	0.04	0.16	0.11	0.14	0.18	0.21	0.25	0.30	0.45
	2:01:13	0.03	0.12	0.08	0.10	0.13	0.15	0.18	0.21	0.33
	2:05:07	0.02	0.08	0.05	0.07	0.08	0.10	0.12	0.15	0.22
	2:09:02	0.01	0.05	0.03	0.04	0.05	0.06	0.08	0.09	0.14
	2:12:56	0.00	0.02	0.01	0.02	0.03	0.03	0.04	0.05	0.08
	2:16:51	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.03
	2:20:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:24:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:28:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:32:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:36:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:44:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:48:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:52:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:59:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:03:46	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
	3:11:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:23:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:31:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:54:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:58:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:14:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:21:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:33:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:37	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

SOUTH POND

FOREBAY VOLUME

V=3% x WQCV

WQCV=	0.226	ac-ft
V=	0.0068	ac-ft

FOREBAY RELEASE NOTCH WIDTH

$Q=CLH^{2/3}$

Q_{100}=	10.2	cfs
2% of Q=	0.20	cfs
C=	2.6	
H (height of forebay wall)=	1	ft
L=	1	in

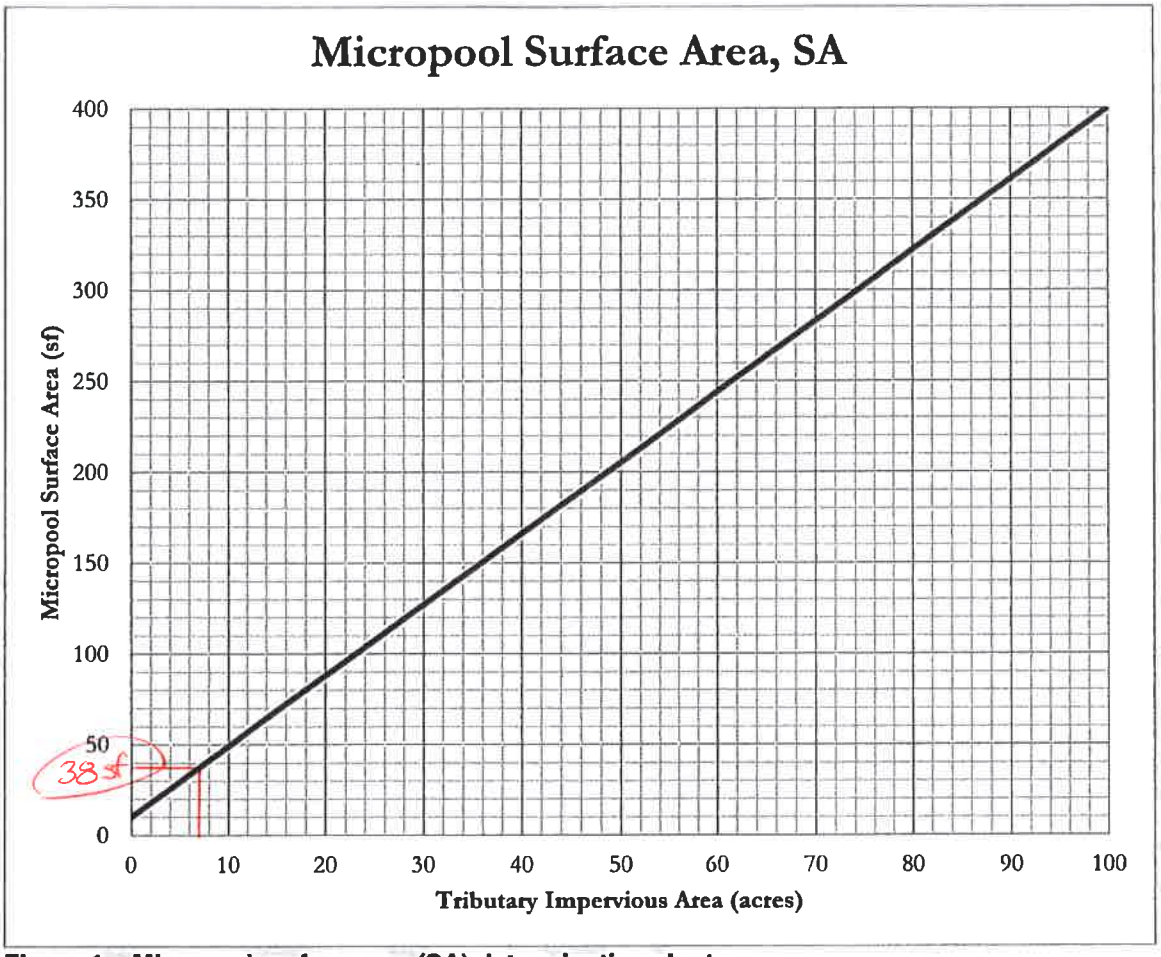


Figure 1 – Micropool surface area (SA) determination chart

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.

$$TIA = I \times A$$

$\frac{73.3}{100} \times 9.31 = 6.8$ ac

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

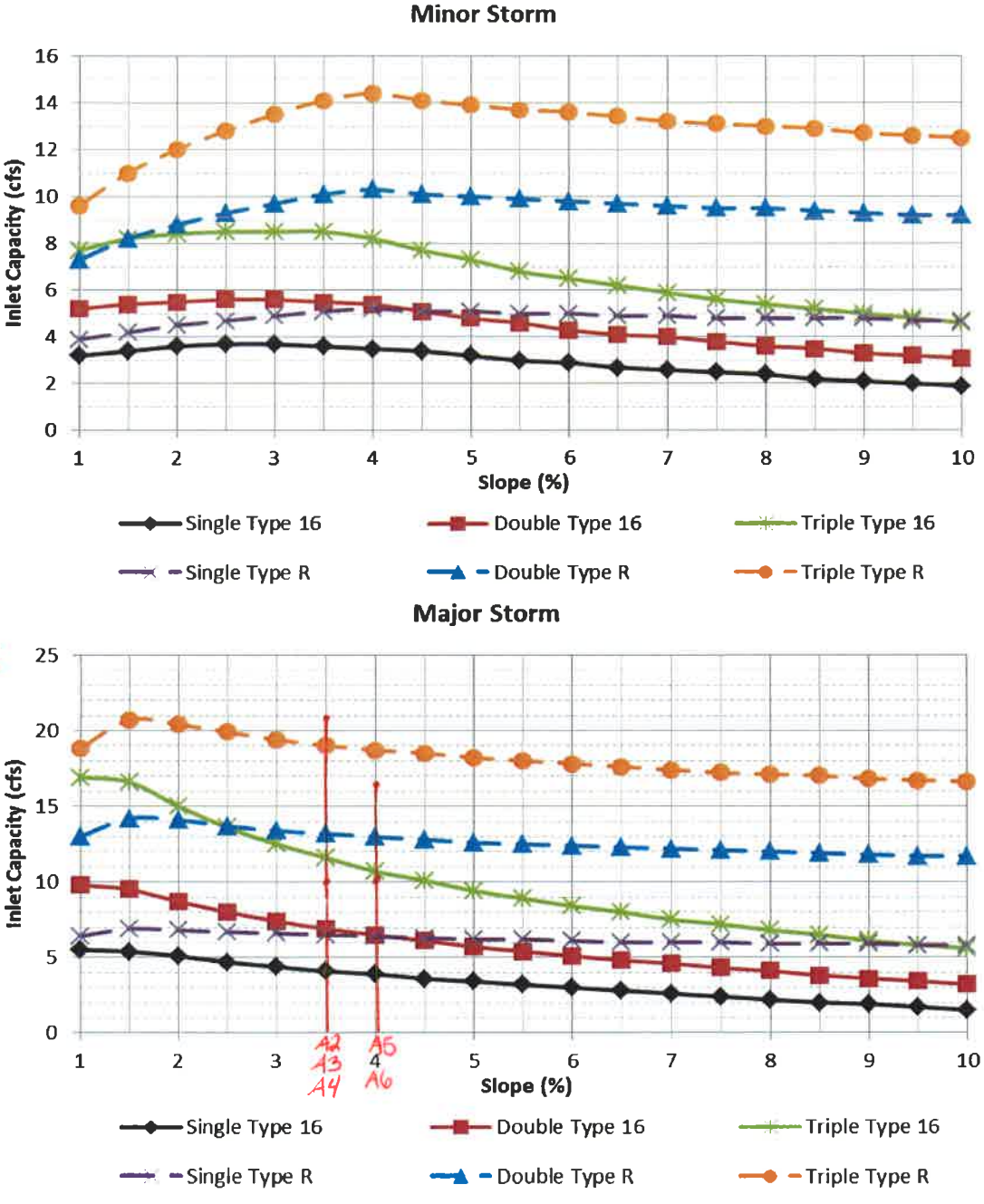
For EDBs with tributary impervious areas greater than 100 acres, the micropool surface area is 400 sf. The initial surcharge depth (ISD) is defined as the depth of the initial surcharge volume (ISV). The surface area determined using Figure 1 assumes an ISD of 4 inches. The initial surcharge volume is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

Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local)
(Attached and Detached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical

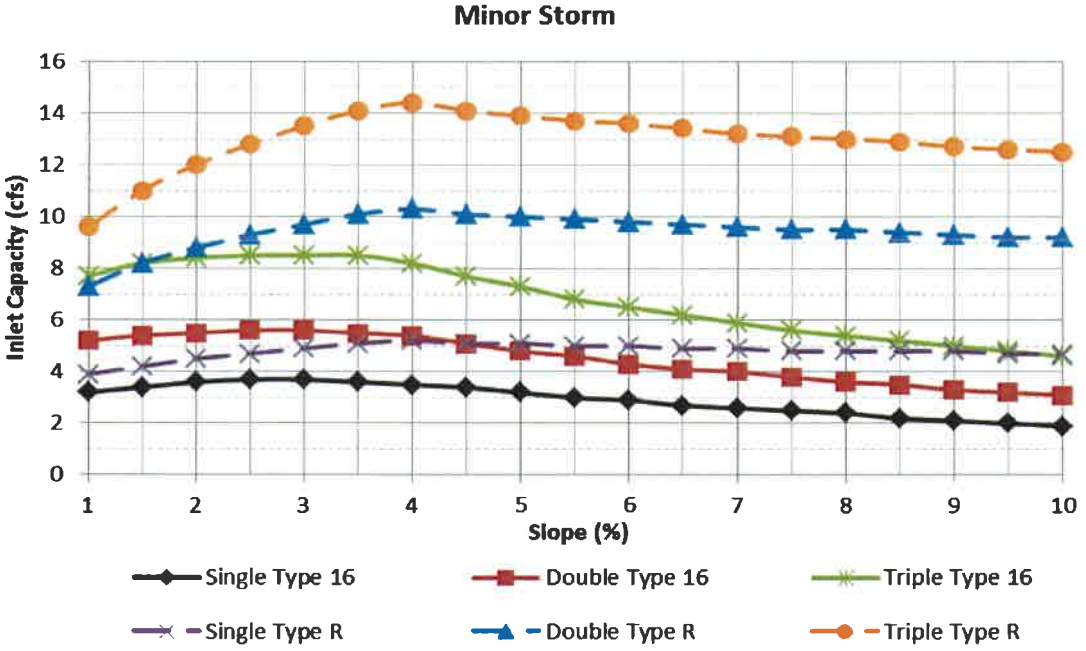


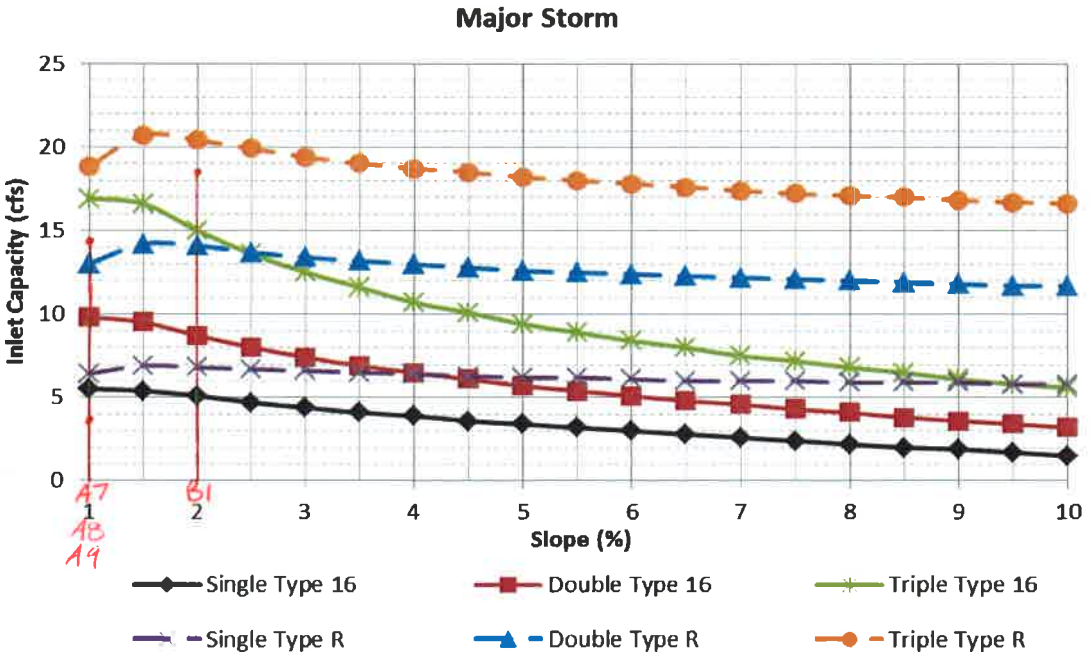
A2: Q100 = 20.9 cfs → (2) Double Type R
A3: Q100 = 9.9 cfs → Double Type R
A4: Q100 = 4.0 cfs → Single Type R
A5: Q100 = 10.1 cfs → Double Type R
A6: Q100 = 16.4 cfs → Triple Type R

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 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local)
(Attached and Detached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical

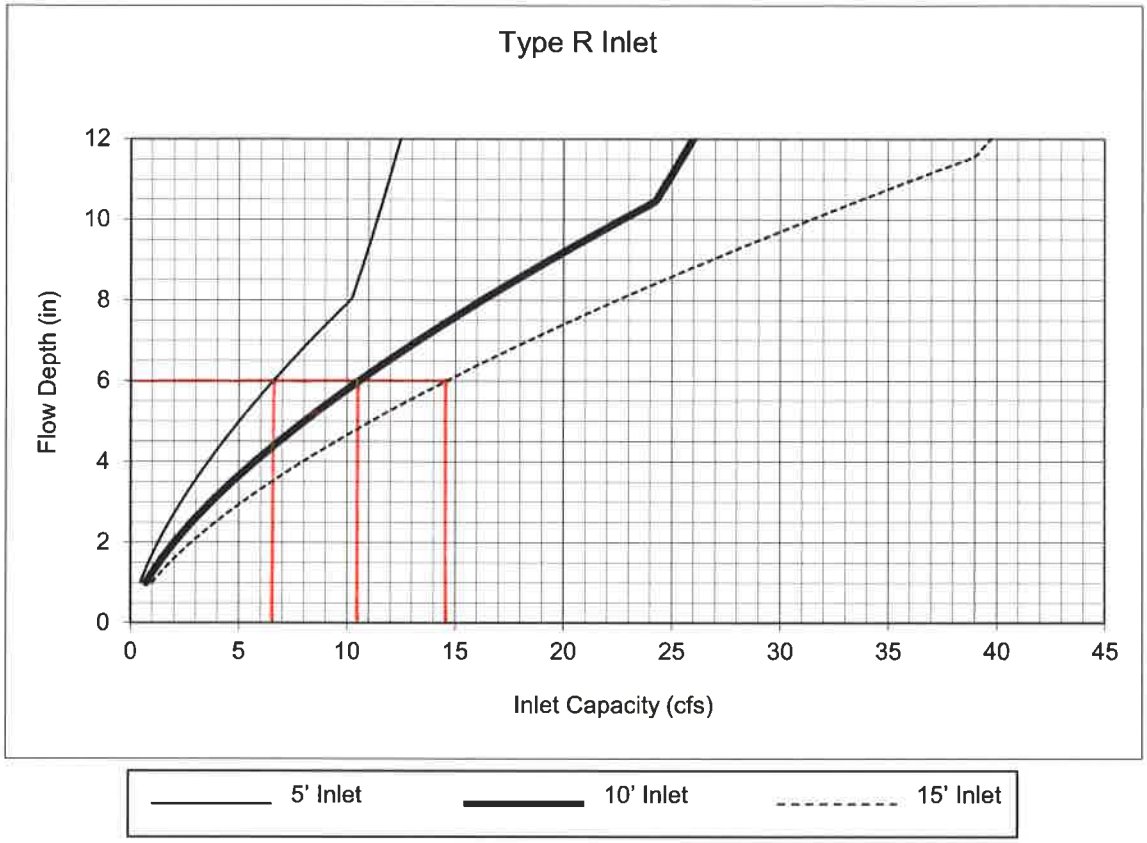




(A7: Q100 = 3.8 cfs → Single Type R
A8: Q100 = 14.2 cfs → Triple Type R
A9: Q100 = 9.2 cfs → Double Type R
B1: Q100 = 18.4 cfs → Triple Type R

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.

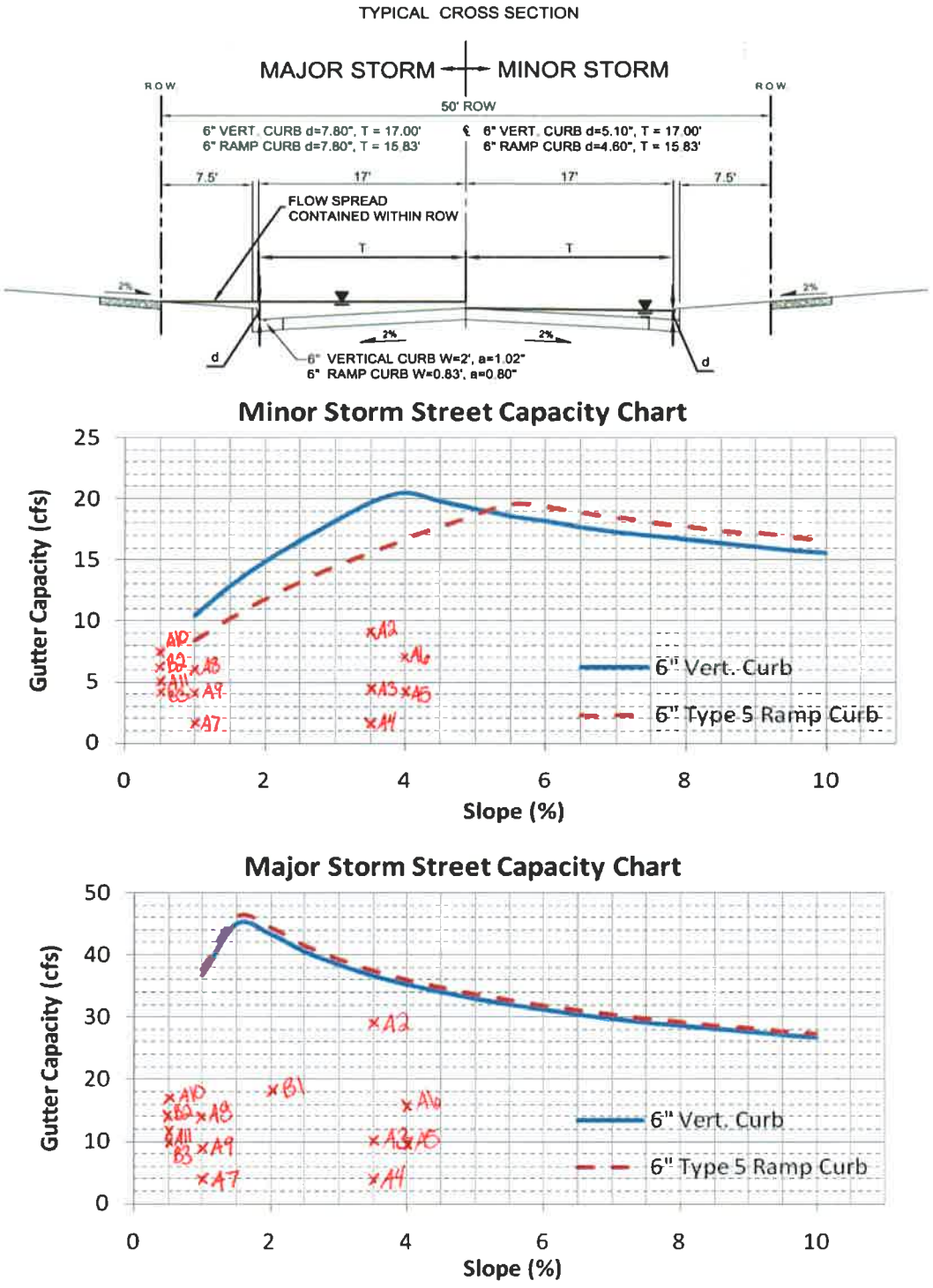
Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet



A10: Q_{100} = 17.5 cfs → (2) 10' inlets
A11: Q_{100} = 11.8 cfs → 15' inlet
B2: Q_{100} = 14.6 cfs → 15' inlet
B3: Q_{100} = 10.2 cfs → 10' inlet

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

Figure 7-7. Street Capacity Charts Residential (Detached Sidewalk)



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.

Show and label all easements.

Address this culvert.

Show and label ditch.

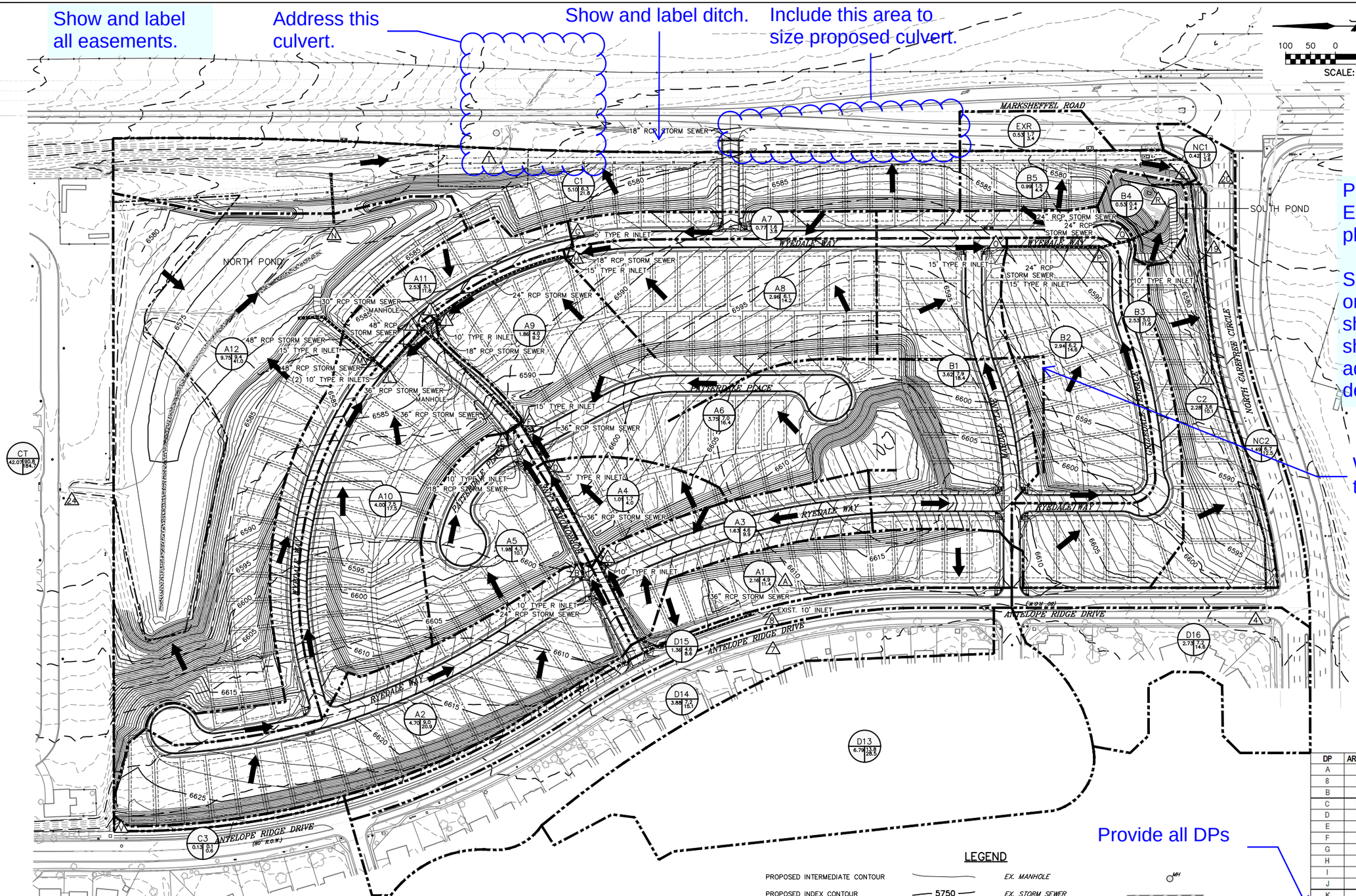
Include this area to size proposed culvert.

Provide Existing plan,

Split onto 2 or more sheets to show adequate detail.

What is this line?

Provide all DPs



DP	AREA (AC)	Q5 (cfs)	Q100 (cfs)
A	2.16	4.9	11.4
8	14.19	26.8	55.7
B	4.70	9.0	20.9
C	20.52	34.4	73.7
D	21.53	35.6	76.5
E	1.98	4.3	10.1
F	27.26	43.2	94.2
G	0.77	1.6	3.8
H	2.96	6.1	14.2
I	1.86	4.0	9.2
J	5.59	11.1	25.9
K	32.85	50.2	110.7
L	36.85	55.3	122.5
M	39.38	58.5	130.1
N	49.13	174.7	353.5
O	3.62	7.9	18.4
P	2.94	6.2	14.6
Q	2.53	5.0	11.6
R	9.62	18.1	43.5
S	10.61	10.7	27.7
T	5.10	192.7	641.5
U	2.28	3.6	10.1
V	0.13	0.1	0.6

LEGEND

- PROPOSED INTERMEDIATE CONTOUR
- PROPOSED INDEX CONTOUR — 5750 —
- EX. INTERMEDIATE CONTOUR
- EX. INDEX CONTOUR ----5750----
- PROPOSED STORM SEWER
- PROPOSED INLET
- PROPOSED FLARED END SECTION
- PROPOSED SITE LIGHTING
- PROPOSED PEDESTRIAN LIGHTING
- EX. MANHOLE (MH)
- EX. STORM SEWER
- BASIN BOUNDARY
- FLOW DIRECTION
- DESIGN POINT (1)
- A1 — BASIN; AREA (ACRE); Q5 (cfs); Q100 (cfs)

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:
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COLORADO SPGS, COLORADO 80905
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WINDERMERE PRELIMINARY PLAN
N. MARKSHEFFEL ROAD
EL PASO COUNTY, COLORADO

ISSUE	DATE
INITIAL ISSUE	2/6/18

DESIGNED BY:	SBN
DRAWN BY:	SBN
CHECKED BY:	TDM
FILE NAME:	DRAINAGE MAP

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

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

Proposed
DRAINAGE MAP

PROJECT NO. 21187-01CSCV
DRAWING NO.

DR

SHEET: 1 OF 1