FINAL DRAINAGE REPORT

MONUMENT HILL BUSINESS CENTER

LOT 3, GREATER EUROPE MISSION SUBDIVISION FILING NO. 1

1945 Deer Creek Road
El Paso County, Colorado

PREPARED FOR OWNER/DEVELOPER:

SIEVERS BUSINESS CENTER, LLC

16152 Old Forest Point, Unit 2-202
Monument, CO 80132
Phone:
Contact: Stan Sievers
Email: stansrco@aol.com

PREPARED BY:

KELLY DEVELOPMENT SERVICES, LLC

9301 Scrub Oak Drive
Lone Tree, Colorado 80124
Phone: 303-888-6338
Contact: Greg Kelly, PE
Email: greg@kellydev.com

PREPARED UNDER THE DIRECT SUPERVISION OF
GREGORY S. KELLY, PE COLORADO LIC. #15813
FOR AND ON BEHALF OF KELLY DEVELOPMENT SERVICES, LLC

September 20, 2017

PCD Project No. PPR-17-007

Design Engineer's Statement:

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

Greg Kelly ________________________ 11/30/2017

Greg S. Kelly, P.E. #15813 Date

Owner/Developer's Statement:

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

________________________ 12-1-2017

Stan Sievers, President Date

Sievers Business Center, LLC

16152 Old Forest Point, Unit 2-202

Monument, CO 80132

El Paso County:

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

________________________ ____________

Jennifer Irvine, P.E. Date

County Engineer / ECM Administrator

Conditions:

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FINAL DRAINAGE REPORT
MONUMENT HILL BUSINESS CENTER

I. GENERAL LOCATION AND DESCRIPTION

<u>Project Location</u>
The Monument Hill Business Center project is located at the northeast corner of the intersection of Monument Hill Road and Deer Creek Road in El Paso County, Colorado. The site address is 1945 Deer Creek Road. The site is located within the Southwest Quarter of Section 11, Township 11 South, Range 67 West of the 6th P. M., County of El Paso, State of Colorado. These property is platted as Lot 3, Greater Europe Missions Subdivision Filing No. 1.

The site is currently 3.27 acres bounded on the north by Deer Creek Road; on the east by an RV and Self-Storage facility on Lot18A, Woodmoor Business Technological Park 3; to the south by a church on Lot 20A Woodmoor Business Technological Park Filing No. 1A; and to the west by Monument Hill Road. The site will be reduced to 2.99 acres once a 30' wide right-of-way is acquired by El Paso County for improvements to Monument Hill Road and Deer Creek Road.

<u>Property Description</u>
The site is currently vacant and is covered by native grasses and weeds. Historically, the ground surface sloped to the southwest at approximately a 2.5 to 3 percent slope. The soil is classified as Tomah-Crowfoot loamy sands, which are considered as Hydrologic Soil Type B.

The site is not located within a floodplain as shown on the FEMA FIRM Map No. 08041CO276F dated March 17, 1997. The site is located within unshaded Zone X. This zone is described as "Areas determined to be outside the 0.2% annual chance floodplain".

The proposed development is a small office/warehouse facility consisting of two buildings of 14,000 SF and 17,500 SF with access drives, parking spaces and landscaped areas.

II. DRAINAGE BASINS AND SUB-BASINS

The site is located within the Crystal Creek basin within Monument Creek watershed. There are no major drainageways crossing or adjacent to the site.

The site is included within the limits of the *Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study* prepared by Kiowa Engineering in September, 1993. There are no drainage way facilities proposed in the study that are located within the limits of the site.

III. DRAINAGE DESIGN CRITERIA

<u>Regulations</u>
This drainage report is based upon the 1991 El Paso County *Drainage Criteria Manual* and adopted portions of the City of Colorado Springs *Drainage Criteria Manual Volumes 1*, dated

May 2014. The portions of the City of Colorado Springs *Drainage Criteria Manual* adopted by the County are Chapter 6 (Hydrology) and Chapter 13 Section 3.2.1 (Full Spectrum Detention).

Hydrology

The Rational Method was used to calculate runoff from this site in accordance with the *Drainage Criteria Manual Volumes 1 and 2*. The 5-year storm event is used to design the initial drainage system. The 100-year storm is used to design the major drainage system. All drainage improvements are designed to for the major storm. The 1-Hour Design Point Rainfall Values from the City of Colorado Springs *Drainage Criteria Manual Volume 1*, used in this this report are 1.50 inches for the 5-year storm and 2.52 inches for the 100-year event.

Hydraulics

Calculation methods for private improvements are based upon the Manning's Equation and the City of Colorado Springs *Drainage Criteria Manual Volumes 1 and 2*, dated May 2014. On-site storm drainage improvements are designed for the 5-year and 100-year storm events.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

Existing Stormwater Drainage

Currently, stormwater runoff flows from the northeast corner of the site towards the southwest corner. Approximately the eastern one-half of the site flows onto the property to the south. The proposed stormwater improvements will minimize the amount of runoff flowing onto the adjacent property. The northwest one-quarter of the site drains to the roadside swale next to Monument Hill Road, where it combines with the runoff from the Deer Creek Road swale and flows into a 24" RCP culvert under Monument Hill Road and Interstate 25 to the west. The southwest one-quarter of the site drains to the roadside swale along Monument Hill Road and then to the south.

Historically, runoff from the property to the east flowed onto the site. A self-storage facility was constructed and the drainage improvements diverted runoff to the east. Only a very small portion of the adjacent site (approximately the west 5') flows onto the site. Because this portion of the adjacent site is landscaped, these flows are very minor.

Stormwater Conveyance Facilities

The general concept for the site drainage will be for storm runoff to surface flow from the building roofs and pavement to the southwest to a series of inlets located along the curb and gutter of parking area and access drives. Runoff will be captured by these inlets and piped to a stormwater detention and water quality facility along the southerly property line of the site. This facility will be an Extended Detention Basin designed in accordance with City of Colorado Springs criteria. Discharge from the EDB will be controlled by a standard outlet structure. The discharge will be piped to the roadside drainage channel along Monument Hill Road, where is will flow under the road to the west. The on-site storm sewers and EDB will be private and will be maintained by the property owner.

Specifically, the site grading creates 7 sub-basins on-site. Each sub-basin is described as follows:

Sub-basin A is made up of building roof and pavement that is a large portion of the western one-half of the site. Runoff surface flows to the south and west to the parking area curb and gutter, then to a 10' Type R inlet in the southwest corner of the parking lot at Design Point 1. The area is 1.39 acres with a percent impervious of 96%. The runoff is calculated at 5.9 cfs in the 5-year storm and 10.8 cfs in the 100-year. The runoff is piped in an 18" RCP to the detention water quality pond.

Sub-basin B is 0.95 acres of building roof, pavement and landscaping in the eastern one-half of the site. Percent impervious is 81%. Runoff surface flow from the building roof and pavement south and west to a 10' Type R inlet at Design Point 2. Flow is then conveyed to the EDB. Sub-basin B flows in the 5-year event are 3.53 cfs and in the 100-year event are 6.72 cfs.

Sub-basin C contains 0.21 acres of building roof, pavement and landscaping at a percent impervious of 88%. It is in the southern portion of the site. Runoff surface flows to the south to a 5' Type R inlet at Design Point 3. The flow combines with the runoff from Sub-basin B and is then piped in an 18" RCP to the detention/water quality pond. The 5-year runoff is 0.83 cfs and the 100-year runoff is 1.55 cfs. The combined runoff from Sub-basins B and C in the 18" RCP flowing to the pond at Design Point 4 is 4.36 cfs in the 5-year storm and 8.27 cfs in the 100-year storm.

Sub-basin D is a small area (0.09 acres) adjacent to Deer Creek Road and Monument Hill Road. It is all landscaped with a percent impervious of 0%. Flows runs off to the existing swale next to the roadway. These minor flows are 0.03 cfs and 0.26 cfs in the 5-year and 100-year storms.

Sub-basin E contains the Extended Detention Basin providing stormwater detention and water quality for the site. It is 0.22 acres of landscaping. The flows generated within this sub-basin are 0.07 cfs and 0.55 cfs in the initial and major storm events.

The runoff from Sub-basins A, B, C and E all flow to the EDB. The total flows reaching the basib are 8.78 cfs in the 5-year event and 16.62 cfs in the 100-year event.

Sub-basin F is a landscaped area containing 0.15 acres. It is all landscape and slopes to the south, much in the same pattern that the site currently slopes. It is 0% impervious and the runoff is 0.06 cfs for the 5-year and 0.45 for the 100-year. This runoff flows onto the adjacent property, which is the same flow pattern as existing Sub-basin E3. The existing conditions runoff from sub-basin E3 is 0.61 cfs for the 5-year storm and 4.48 cfs in the 100-year. The proposed improvements will significantly reduce the runoff flowing onto the property to the south.

There is an off-site sub-basin that impact the design of the stormwater facilities for this development. Sub-basin OS2 is the south one-half of Deer Creek Road east of the entrance to the site. It flows westerly to the 18" RCP culvert under the entrance drive at Design Point 6. It is 0.17 acres. The 100-year runoff is calculated to be 0.65 cfs. The flow depth in the culvert is 0.3 feet or 3.6 inches. Riprap will be installed at both ends of the culvert to minimize erosion.

A summary of the Sub-basins' runoff is as follows:

DEVELOPED SUB-BASIN RUNOFF SUMMARY TABLE								
Sub-basin Designation	**Design Point**	**Sub-basin Area (ac)**	**Percent Impervious**	**C_5**	**C_{100}**	**T_c (min)**	**Q_5 (cfs)**	**Q_{100} (cfs)**
A	1	1.39	96%	0.86	0.93	5.5	5.95	10.77
B	2	0.95	81%	0.73	0.83	5.0	3.53	6.72
C	3	0.21	88%	0.78	0.87	5.0	0.83	1.55
D		0.07	0%	0.08	0.35	10.8	0.02	0.16
E		0.22	0%	0.08	0.35	9.0	0.07	0.55
F		0.15	0%	0.08	0.35	5.0	0.06	0.45
OS2	6	0.17	29%	0.32	0.53	8.6	0.23	0.65

EXISTING SUB-BASIN RUNOFF SUMMARY TABLE								
Sub-basin Designation	**Design Point**	**Sub-basin Area (ac)**	**Percent Impervious**	**C_5**	**C_{100}**	**T_c (min)**	**Q_5 (cfs)**	**Q_{100} (cfs)**
E1		0.51	0.0%	0.08	0.35	11.3	0.16	1.16
E2		0.68	0.0%	0.08	0.35	11.1	0.21	1.56
E3		2.08	0.0%	0.08	0.35	12.8	0.61	4.48
E4	E4	0.50	37.8%	0.39	0.58	13.7	0.70	1.73

A summary of the Design Points' flows is as follows:

DESIGN POINT RUNOFF SUMMARY TABLE					
Design Point	**Contributing Sub-basins**	**Contributing Area (acres)**	**T_c (min)**	**Q_5 (cfs)**	**Q_{100} (cfs)**
1	A	1.39	5.5	5.95	10.77
2	B	0.95	5.0	3.53	6.72
3	C	0.95	5.0	0.83	1.55
4	B, C	1.16	5.0	4.36	8.27
5	A, B, C, E	2.77	9.0	8.78	16.62
6	OS2	0.17	8.6	0.23	0.65
E4	E4	0.50	13.7	0.70	1.73

Stormwater Quality and Storage Facilities

El Paso County requires the Four Step Process be followed for the selection and siting of structural BMPs for new development to provide water quality for stormwater runoff being discharged into State Waters. The Four Steps are employ runoff reduction practices, stabilize drainageways, provide water quality capture volume (WQCV) and implement permanent BMPs. The design of the site has followed this process as much as possible. Pavement has been minimized to meet only the parking spaces as required by the county and landscaped areas are included to assist in reducing runoff. There are no major drainageways on site. The drainageways adjacent to the site are being improved with riprap protection where concentrated flows may cause erosion. The WQCV is being provided in the permanent BMP, which is an Extended Detention Basin designed in accordance with county regulations.

Stormwater detention and water quality enhancement is provided on-site in an Extended Detention Basin stormwater facility. This basin is designed using the Full Spectrum Method. Based upon the area of the site that contributes to the EDB of 2.77 acres and a percent impervious of 83%, the pond is required to provide 0.384 acre-feet or 16,727 cubic feet of detention storage, which includes the water quality capture volume and the excess urban runoff volume. The pond will have a maximum storage depth of 6.23 feet. The pond bottom will be at an elevation of 7113.80 feet and the 100-year water surface elevation will be 7120.03feet. The EURV is 0.0.175 acre-feet or 7,623 cubic feet and the EURV water surface elevation will be 7119.08 feet. The WQCV is 0.080 acre-feet or 3,484 cubic feet and the WQCV water surface elevation will be 7117.18 feet.

Discharge will be controlled by a standard outlet structure with an flow control plate designed to release the WQCV over 40 hours and release 97% of the 5-year storm in less than 72 hours. The 100-year discharge will be limited to 2.35 cfs (0.85 cfs/acre for Type B soils) and will be controlled by a circular orifice plate located at the discharge side of the outlet structure prior to the flow entering an 18” RCP flowing to the proposed drainage swale adjacent to Monument Hill Road. This swale flows to the south and will be constructed as part of the Monument Hill Road Safety Improvements. In the event the outlet structure should become clogged with debris, and emergency overflow weir and swale will be constructed along the west side of the pond. The emergency overflow swale will be 10’ wide by 1’ deep with 4:1 side slopes. Overflow will go to the proposed drainage swale along Monument Hill Road flowing to the south.

All storm sewers and the Extended Detention Basin facility will be private and will be maintained by the property owner.

V. CONCLUSIONS

The drainage plan for the Monument Hill Business Center site is in conformance to acceptable engineering standards and practices and criteria established by the El Paso County. No variances to any of the regulations and requirements are being requested. No adverse impacts to downstream facilities and/or adjacent properties are expected as a result of the development of the site.

VI. REFERENCES

1. El Paso County's *Engineering Criteria Manual*, Revised 07/29/2015 Revision 5.
2. City of Colorado Springs *Drainage Criteria Manual Volumes 1 and 2*, dated May 2014.
3. *Storm Drainage Criteria Manual. Volumes 1 - 3*, Urban Drainage and Flood Control District, latest versions.
4. FEMA Flood Insurance Rate Map Number08041CO295F dated March 17, 1997.
5. National Resources Conservation Services *Custom Soil Resource Report of El Paso County Area, Colorado* dated February 13, 2017.
6. *Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study* prepared by Kiowa Engineering dated September, 1993.
7. *Final Drainage Report, Monument Hill Self Storage* prepared by Vermillion Peak Engineering dated December 15, 2014.

VII. APPENDICES

1. Hydrologic Computations
   a. Land use assumptions, composite "C" and % Impervious calculations
   b. Initial and major storm runoff computations for developed runoff conditions

2. Hydraulic Computations
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3. Referenced Information
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APPENDIX 1

HYDROLOGIC COMPUTATIONS

COMPOSITE 'C' FACTORS (DEVELOPED)

LOCATION: Sievers Business Center El Paso County, CO Soil Type: B Final Drainage Report BY: GSK DATE: 9/20/2017

SUB-BASIN	Acreage				PAVEMENT				ROOFS				LAWNS				COMPOSITE C FACTOR				PERCENT IMPERVIOUS
DESIGNATION	PAVED	ROOFS	LAWNS	TOTAL	2YR	5 YR	10 YR	100 YR	2YR	5 YR	10 YR	100 YR	2YR	5 YR	10 YR	100 YR	2YR	5 YR	10 YR	100 YR	
				Imperviousness (%) =	100				90				0								
A	1.20	0.16	0.03	1.39	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.85	0.86	0.88	0.93	96.2%
B	0.58	0.22	0.15	0.95	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.71	0.73	0.76	0.83	81.5%
C	0.14	0.05	0.02	0.21	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.76	0.78	0.81	0.87	87.6%
D	0.00	0.00	0.07	0.07	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.02	0.08	0.15	0.35	0.0%
E	0.00	0.00	0.22	0.22	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.02	0.08	0.15	0.35	0.0%
F	0.00	0.00	0.15	0.15	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.02	0.08	0.15	0.35	0.0%
EDB CONTRIBUTION	1.92	0.43	0.42	2.77	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.73	0.75	0.78	0.84	**82.9%**
OFF-SITE																					
OS2	0.05	0.00	0.12	0.17	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.28	0.32	0.38	0.53	29.3%
EXISTING SITE																					
E1	0.00	0.00	0.51	0.51	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.02	0.08	0.15	0.35	0.0%
E2	0.00	0.00	0.68	0.68	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.02	0.08	0.15	0.35	0.0%
E3	0.00	0.00	2.08	2.08	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.02	0.08	0.15	0.35	0.0%
E4	0.19	0.00	0.31	0.50	0.89	0.90	0.92	0.96	0.71	0.73	0.75	0.81	0.02	0.08	0.15	0.35	0.35	0.39	0.44	0.58	37.8%

TIME OF CONCENTRATION (STANDARD FORM SF-2)

LOCATION: Sievers Business Center — **Final Drainage Report** — **BY: GSK** — **DATE: 9/20/2017**

SUB-BASIN DATA			INIT./OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					TOTAL	Tc Check (Urbanized Basins)		FINAL Tc	REMARKS
DESIGNATION	C_5	AREA (AC)	LENGTH (FT)	SLOPE %	Ti (Min.)*	GRASS/ PAVED	LENGTH (FT)	SLOPE %	VEL (FPS)**	Tt (Min.)	Ti+Tt (Min.)	LGTH. (FT)	Tc = (L/180) + 10	(minutes)	FORMULAS: * Ti = 0.395 (1.1-C5)L^0.5/S/100^1/3 ** V=Cv*(S/100)^0.5
A	0.86	1.39	40	2.00	2.18	PAVED	455	1.32	2.30	3.30	5.5	495	12.8	5.5	Design Point 1 - Inlet
B	0.73	0.95	50	6.00	2.63	PAVED	335	1.34	2.32	2.41	5.0	385	12.1	5.0	Design Point 2 - Inlet
C	0.78	0.21	50	10.00	1.92	PAVED	166	1.33	2.31	1.20	3.1	216	11.2	5.0	Design Point 3 - Inlet
D	0.08	0.07	142	3.50	14.68	GRASS	0	1.00	0.70	0.00	14.7	142	10.8	10.8	
E	0.08	0.22	60	5.00	8.47	PAVED	90	2.22	2.98	0.50	9.0	150	10.8	9.0	
F	0.08	0.15	25	12.00	4.08	GRASS	0	1.00	0.70	0.00	4.1	25	10.1	5.0	
OS2	0.32	0.17	10	2.00	3.58	GRASS	280	1.77	0.93	5.01	8.6	290	11.6	8.6	
E1	0.08	0.51	227	3.96	17.81	GRASS	0	1.00	0.70	0.00	17.8	227	11.3	11.3	
E2	0.08	0.68	200	3.50	17.42	GRASS	0	1.00	0.70	0.00	17.4	200	11.1	11.1	
E3	0.08	2.08	300	3.00	22.46	GRASS	200	3.00	1.21	2.75	25.2	500	12.8	12.8	
E4	0.39	0.50	10	2.00	3.26	GRASS	658	1.00	0.70	15.67	18.9	668	13.7	13.7	

Standard Form SF - 3
Storm Drainage System Design
(Rational Method Procedure)

Subdivision: Sievers Business Center
Designer: GSK
Date: 9/20/2017
Design Storm: 5 -YR DEVELOPED

$I = \frac{28.5 \cdot P_1}{(10+T_C)^{0.786}}$ 0

Where: P_1 = 1.50

Design Point	Direct Runoff							Total Runoff				Comment
	Subbasin Designation	Area	Runoff Coeffecient	t_c	C x A	I	Q	t_c	C x A	I	Q	
		ac.		min.	ac.	in/hr	cfs	min.	ac.	in/hr	cfs	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
1	A	1.39	0.86	5.5	1.20	4.96	5.95				5.95	Flow at Inlet & Pipe to pond
2	B	0.95	0.73	5.0	0.69	5.08	3.53				3.53	Flow at Inlet
3	C	0.21	0.78	5.0	0.16	5.09	0.83	5.0	0.86	5.08	4.36	Flow in Pipe to Pond
4	E	0.22	0.08	9.0	0.02	4.23	0.07	9.0	2.08	4.23	8.78	Total Flow to Pond
5	OS2	0.17	0.32	8.6	0.05	4.30	0.23				0.23	Flow at 18" culvert
	D	0.07	0.08	10.8	0.01	3.94	0.02				0.02	
	F	0.15	0.08	5.0	0.01	5.09	0.06				0.06	
	E1	0.51	0.08	11.3	0.04	3.87	0.16				0.16	
	E2	0.68	0.08	11.1	0.05	3.89	0.21				0.21	
	E3	2.08	0.08	12.8	0.17	3.66	0.61				0.61	
E4	E4	0.50	0.39	13.7	0.20	3.55	0.70				0.70	

Standard Form SF - 3
Storm Drainage System Design
(Rational Method Procedure)

Subdivision	Sievers Business Center	
Designer	GSK	$I = \frac{28.5 \cdot P_1}{(10+T_C)^{0.786}}$
Date	9/20/2017	
Design Storm	100-YR DEVELOPED	Where: P_1 = 2.52

Design Point	Direct Runoff							Total Runoff				Comment
	Subbasin Designation	Area	Runoff Coeffecient	t_c	C x A	I	Q	t_c	C x A	I	Q	
		ac.		min.	ac.	in/hr	cfs	min.	ac.	in/hr	cfs	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
1	A	1.39	0.93	5.5	1.29	8.34	10.77				10.77	Flow at Inlet & Pipe to pond
2	B	0.95	0.83	5.0	0.79	8.53	6.72				6.72	Flow at Inlet
3	C	0.21	0.87	5.0	0.18	8.55	1.55	5.0	0.97	8.53	8.27	Flow in Pipe to Pond
4	E	0.22	0.35	9.0	0.08	7.11	0.55	9.0	2.34	7.11	16.62	Total Flow to Pond
5	OS2	0.17	0.53	8.6	0.09	7.22	0.65				0.65	Flow at 18" culvert
	D	0.07	0.35	10.8	0.02	6.61	0.16	10.8	0.11	6.61	0.76	
	F	0.15	0.35	5.0	0.05	8.55	0.45				0.45	
	E1	0.51	0.35	11.3	0.18	6.50	1.16				1.16	
	E2	0.68	0.35	11.1	0.24	6.53	1.56				1.56	
	E3	2.08	0.35	12.8	0.73	6.16	4.48				4.48	
E4	E4	0.50	0.58	13.7	0.29	5.96	1.73				1.73	

DEVELOPED SUB-BASIN RUNOFF SUMMARY TABLE								
Sub-basin Designation	**Design Point**	**Sub-basin Area (ac)**	**Percent Impervious**	**C_5**	**C_{100}**	**T_c (min)**	**Q_5 (cfs)**	**Q_{100} (cfs)**
A	1	1.39	96%	0.86	0.93	5.5	5.95	10.77
B	2	0.95	81%	0.73	0.83	5.0	3.53	6.72
C	3	0.21	88%	0.78	0.87	5.0	0.83	1.55
D		0.07	0%	0.08	0.35	10.8	0.02	0.16
E		0.22	0%	0.08	0.35	9.0	0.07	0.55
F		0.15	0%	0.08	0.35	5.0	0.06	0.45
OS2	6	0.17	29%	0.32	0.53	8.6	0.23	0.65

EXISTING SUB-BASIN RUNOFF SUMMARY TABLE								
Sub-basin Designation	**Design Point**	**Sub-basin Area (ac)**	**Percent Impervious**	**C_5**	**C_{100}**	**T_c (min)**	**Q_5 (cfs)**	**Q_{100} (cfs)**
E1		0.51	0.0%	0.08	0.35	11.3	0.16	1.16
E2		0.68	0.0%	0.08	0.35	11.1	0.21	1.56
E3		2.08	0.0%	0.08	0.35	12.8	0.61	4.48
E4	E4	0.50	37.8%	0.39	0.58	13.7	0.70	1.73

DESIGN POINT RUNOFF SUMMARY TABLE					
Design Point	**Contributing Sub-basins**	**Contributing Area (acres)**	**T_c (min)**	**Q_5 (cfs)**	**Q_{100} (cfs)**
1	A	1.39	5.5	5.95	10.77
2	B	0.95	5.0	3.53	6.72
3	C	0.95	5.0	0.83	1.55
4	B, C	1.16	5.0	4.36	8.27
5	A, B, C, E	2.77	9.0	8.78	16.62
6	OS2	0.17	8.6	0.23	0.65
E4	E4	0.50	13.7	0.70	1.73

APPENDIX 2

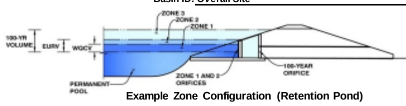
HYDRAULIC COMPUTATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Siever Business Center

Basin ID: Overall Site



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	2.77	acres		
Watershed Length =	530	ft		
Watershed Slope =	0.028	ft/ft		
Watershed Imperviousness =	82.9%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.080	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.255	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.216	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.283	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.349	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.421	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.477	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.551	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.203	acre-feet		
Approximate 5-yr Detention Volume =	0.266	acre-feet		
Approximate 10-yr Detention Volume =	0.329	acre-feet		
Approximate 25-yr Detention Volume =	0.353	acre-feet		
Approximate 50-yr Detention Volume =	0.366	acre-feet		
Approximate 100-yr Detention Volume =	0.384	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.080	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.175	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.129	acre-feet
Total Detention Basin Volume =	0.384	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	--	--	--	0	0.000		
7114	--	0.20	--	--	--	123	0.003	11	0.000
7115	--	1.20	--	--	--	448	0.010	293	0.007
7116	--	2.20	--	--	--	1,252	0.029	1,148	0.026
7117	--	3.20	--	--	--	2,497	0.057	3,022	0.069
7118	--	4.20	--	--	--	3,863	0.089	6,202	0.142
7119	--	5.20	--	--	--	5,157	0.118	10,712	0.246
7120	--	6.20	--	--	--	6,602	0.152	16,592	0.381
7121	--	7.20	--	--	--	7,949	0.182	23,867	0.548
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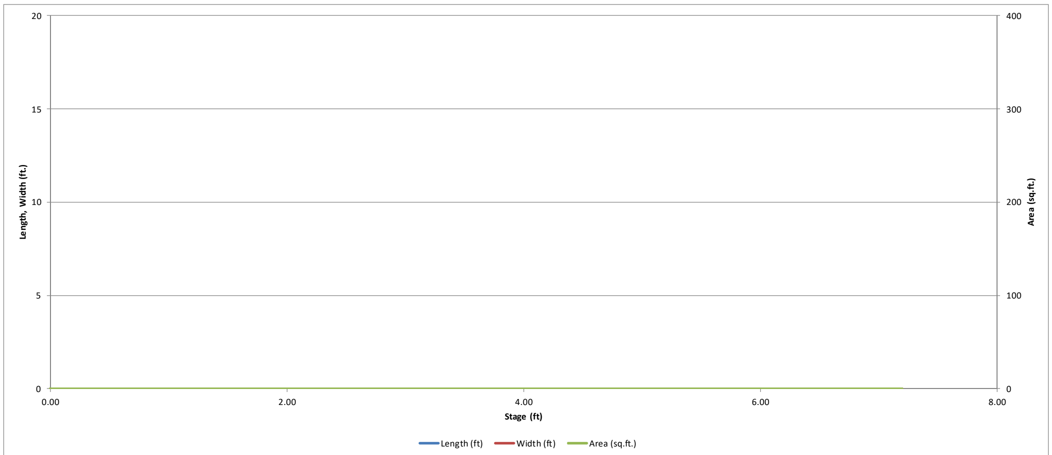
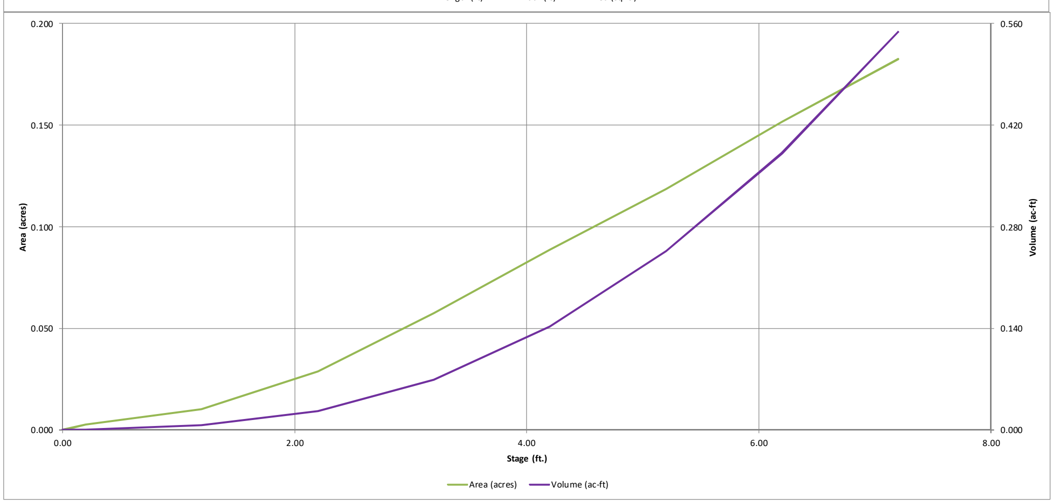
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



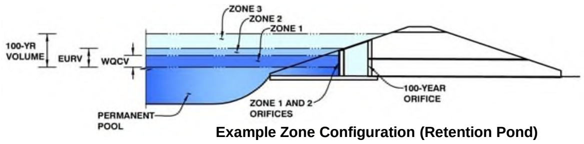


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Sievers Business Center

Basin ID: Overall Site



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.38	0.080	Orifice Plate
Zone 2 (EURV)	5.28	0.175	Orifice Plate
Zone 3 (100-year)	6.23	0.129	Weir&Pipe (Circular)
		0.384	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.28	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	21.10	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.76	3.52					
Orifice Area (sq. inches)	0.36	0.36	0.99					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.28	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Open Area % =	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 =	6.03	N/A	feet
Over Flow Weir Slope Length =	3.09	N/A	feet
Grate Open Area / 100-yr Orifice Area =	29.07	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	6.49	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.25	N/A	ft^2

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

	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	6.40	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected	
Outlet Orifice Area =	0.22	N/A	ft^2
Outlet Orifice Centroid =	0.27	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.10	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	10.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

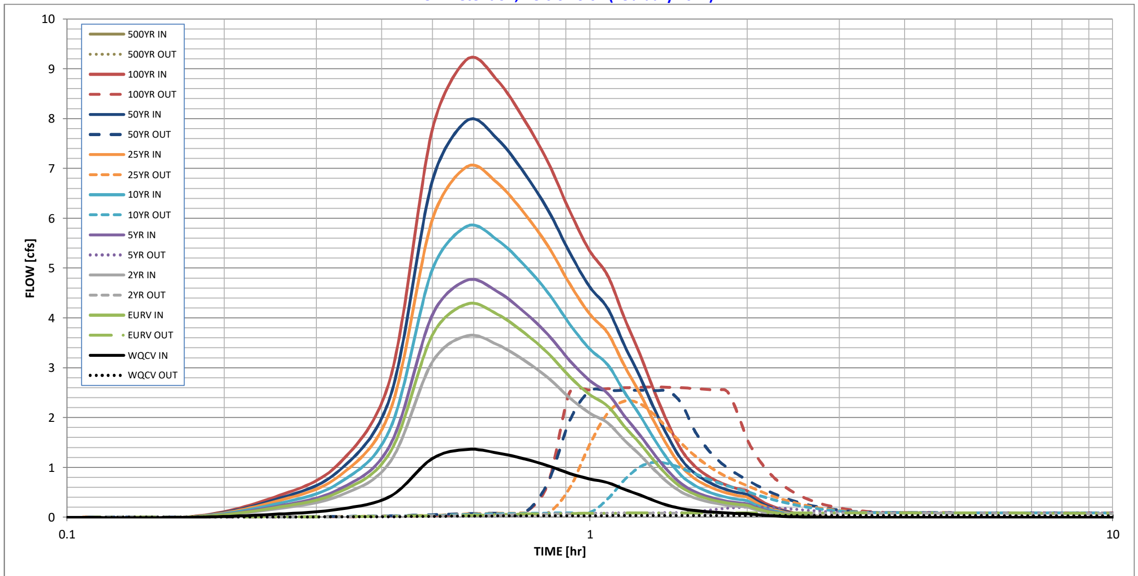
Spillway Design Flow Depth=	0.41	feet
Stage at Top of Freeboard =	8.51	feet
Basin Area at Top of Freeboard =	0.18	acres

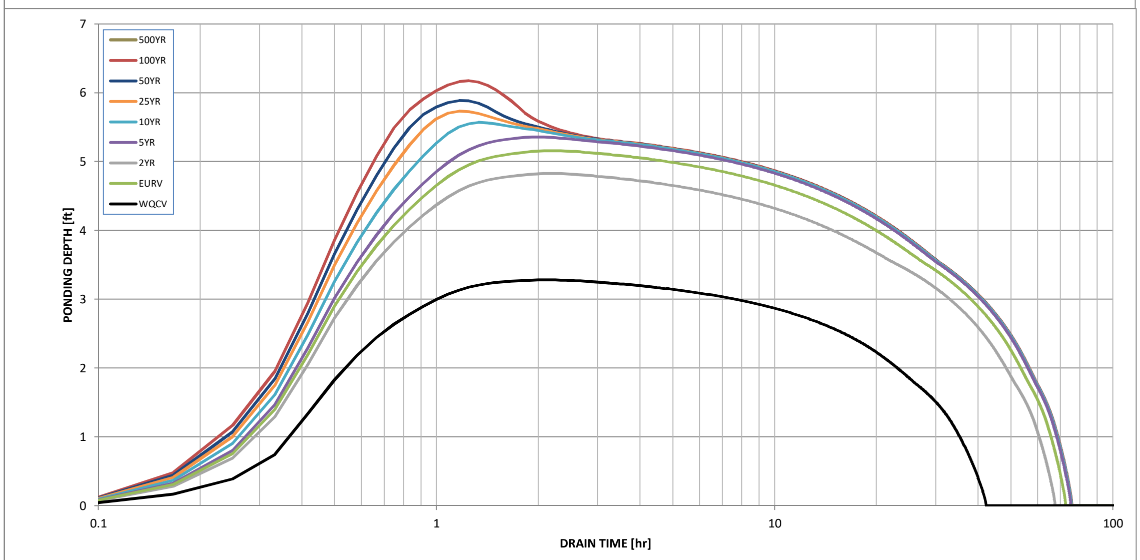
Routed Hydrograph Results

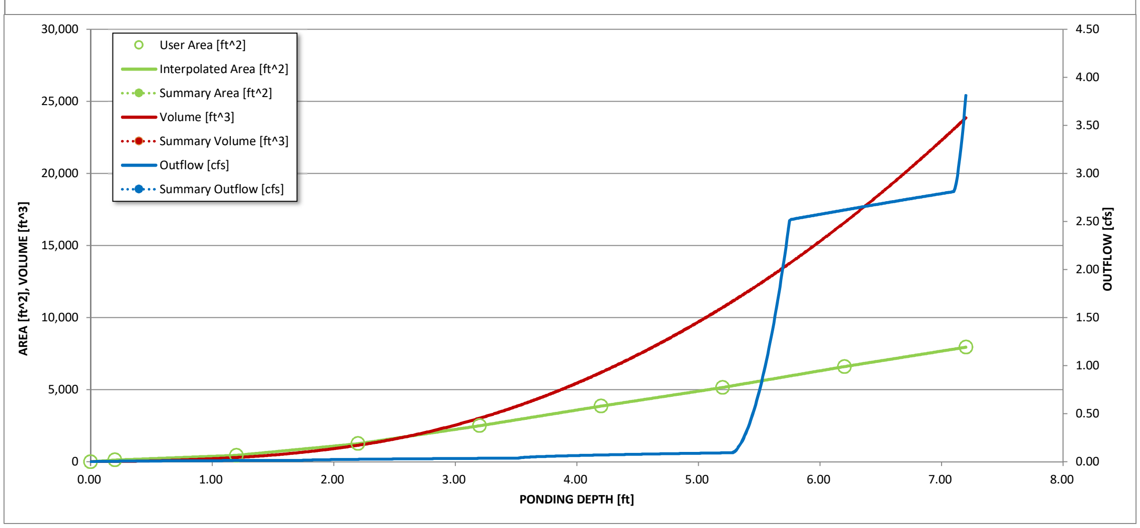
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.080	0.255	0.216	0.283	0.349	0.421	0.477	0.551	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.080	0.254	0.216	0.283	0.349	0.421	0.477	0.552	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.66	0.92	1.24	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.6	1.8	2.5	3.4	0.0
Peak Inflow Q (cfs) =	1.4	4.3	3.6	4.8	5.8	7.0	8.0	9.2	#N/A
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.2	1.1	2.3	2.6	2.6	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.7	2.0	1.3	1.0	0.8	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.2	0.3	0.4	0.4	#N/A
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	63	59	65	64	62	61	59	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	68	64	71	70	69	69	68	#N/A
Maximum Ponding Depth (ft) =	3.28	5.16	4.83	5.36	5.57	5.73	5.89	6.18	#N/A
Area at Maximum Ponding Depth (acres) =	0.06	0.12	0.11	0.12	0.13	0.14	0.14	0.15	#N/A
Maximum Volume Stored (acre-ft) =	0.074	0.240	0.203	0.264	0.291	0.313	0.334	0.376	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

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

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

Time Interval	
4.99 min	
Hydrograph Constant	1.003

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:04:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:09:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
0:14:58	0.06	0.19	0.17	0.21	0.26	0.32	0.36	0.41	#N/A
0:19:58	0.17	0.52	0.44	0.57	0.70	0.84	0.95	1.10	#N/A
0:24:57	0.43	1.33	1.13	1.47	1.80	2.17	2.45	2.82	#N/A
0:29:56	1.18	3.65	3.11	4.05	4.96	5.96	6.74	7.76	#N/A
0:34:56	1.36	4.28	3.64	4.76	5.84	7.04	7.96	9.19	#N/A
0:39:55	1.29	4.07	3.47	4.53	5.57	6.71	7.59	8.77	#N/A
0:44:55	1.17	3.71	3.15	4.12	5.07	6.11	6.91	7.98	#N/A
0:49:54	1.04	3.29	2.80	3.67	4.51	5.44	6.16	7.12	#N/A
0:54:53	0.88	2.83	2.40	3.15	3.88	4.69	5.31	6.14	#N/A
0:59:53	0.77	2.47	2.10	2.75	3.38	4.09	4.63	5.36	#N/A
1:04:52	0.70	2.23	1.90	2.49	3.06	3.70	4.19	4.85	#N/A
1:09:52	0.56	1.83	1.55	2.04	2.51	3.04	3.45	4.00	#N/A
1:14:51	0.45	1.48	1.25	1.65	2.04	2.47	2.81	3.26	#N/A
1:19:50	0.33	1.12	0.94	1.25	1.56	1.89	2.15	2.50	#N/A
1:24:50	0.24	0.82	0.69	0.92	1.15	1.40	1.60	1.86	#N/A
1:29:49	0.18	0.60	0.51	0.67	0.84	1.02	1.16	1.35	#N/A
1:34:49	0.14	0.47	0.40	0.53	0.65	0.79	0.90	1.05	#N/A
1:39:48	0.12	0.39	0.33	0.43	0.54	0.65	0.74	0.86	#N/A
1:44:47	0.10	0.33	0.28	0.37	0.46	0.55	0.63	0.73	#N/A
1:49:47	0.09	0.29	0.25	0.32	0.40	0.49	0.55	0.64	#N/A
1:54:46	0.08	0.26	0.22	0.29	0.36	0.44	0.50	0.58	#N/A
1:59:46	0.07	0.24	0.21	0.27	0.34	0.41	0.46	0.54	#N/A
2:04:45	0.05	0.18	0.15	0.20	0.25	0.30	0.34	0.39	#N/A
2:09:44	0.04	0.13	0.11	0.15	0.18	0.22	0.25	0.29	#N/A
2:14:44	0.03	0.10	0.08	0.11	0.13	0.16	0.18	0.21	#N/A
2:19:43	0.02	0.07	0.06	0.08	0.10	0.12	0.13	0.15	#N/A
2:24:43	0.01	0.05	0.04	0.06	0.07	0.08	0.10	0.11	#N/A
2:29:42	0.01	0.03	0.03	0.04	0.05	0.06	0.07	0.08	#N/A
2:34:41	0.01	0.02	0.02	0.03	0.03	0.04	0.05	0.06	#N/A
2:39:41	0.00	0.02	0.01	0.02	0.02	0.03	0.03	0.04	#N/A
2:44:40	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	#N/A
2:49:40	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	#N/A
2:54:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
2:59:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:04:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:09:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:14:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:19:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:24:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:29:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:34:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:39:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:44:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:49:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:54:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
3:59:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:04:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:09:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:14:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:19:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:24:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:29:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:34:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:39:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:44:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:49:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:54:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
4:59:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:04:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:09:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:14:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:19:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:24:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:29:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:34:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:39:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:44:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:49:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:54:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
5:59:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Sievers Business Center Extended Detention Basin**

Facility Location & Jurisdiction: **1945 Deer Creek Road, El Paso County**

User Input: Watershed Characteristics

Watershed Slope =	0.028	ft/ft
Watershed Length =	530	ft
Watershed Area =	2.77	acres
Watershed Imperviousness =	82.9%	percent
Percentage Hydrologic Soil Group A =		percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =		percent

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

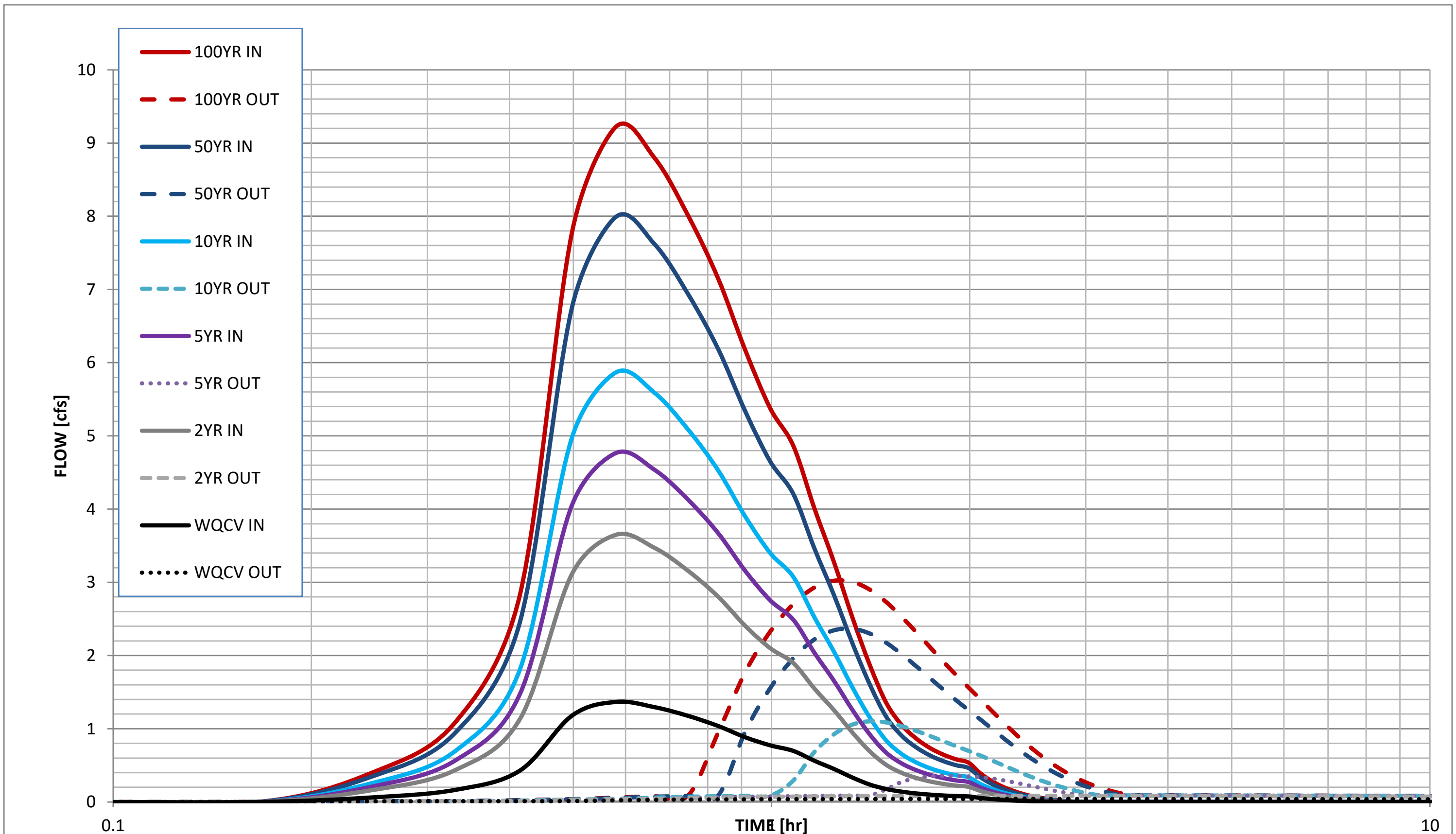
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	0	0.00	0.00
0.20	123	0.20	0.01
1.20	448	1.20	0.01
2.20	1,252	2.20	0.03
3.20	2,497	3.20	0.04
4.20	3,863	4.20	0.07
5.20	5,157	5.20	0.09
6.20	6,602	6.20	3.12
7.20	7,949	7.20	4.28

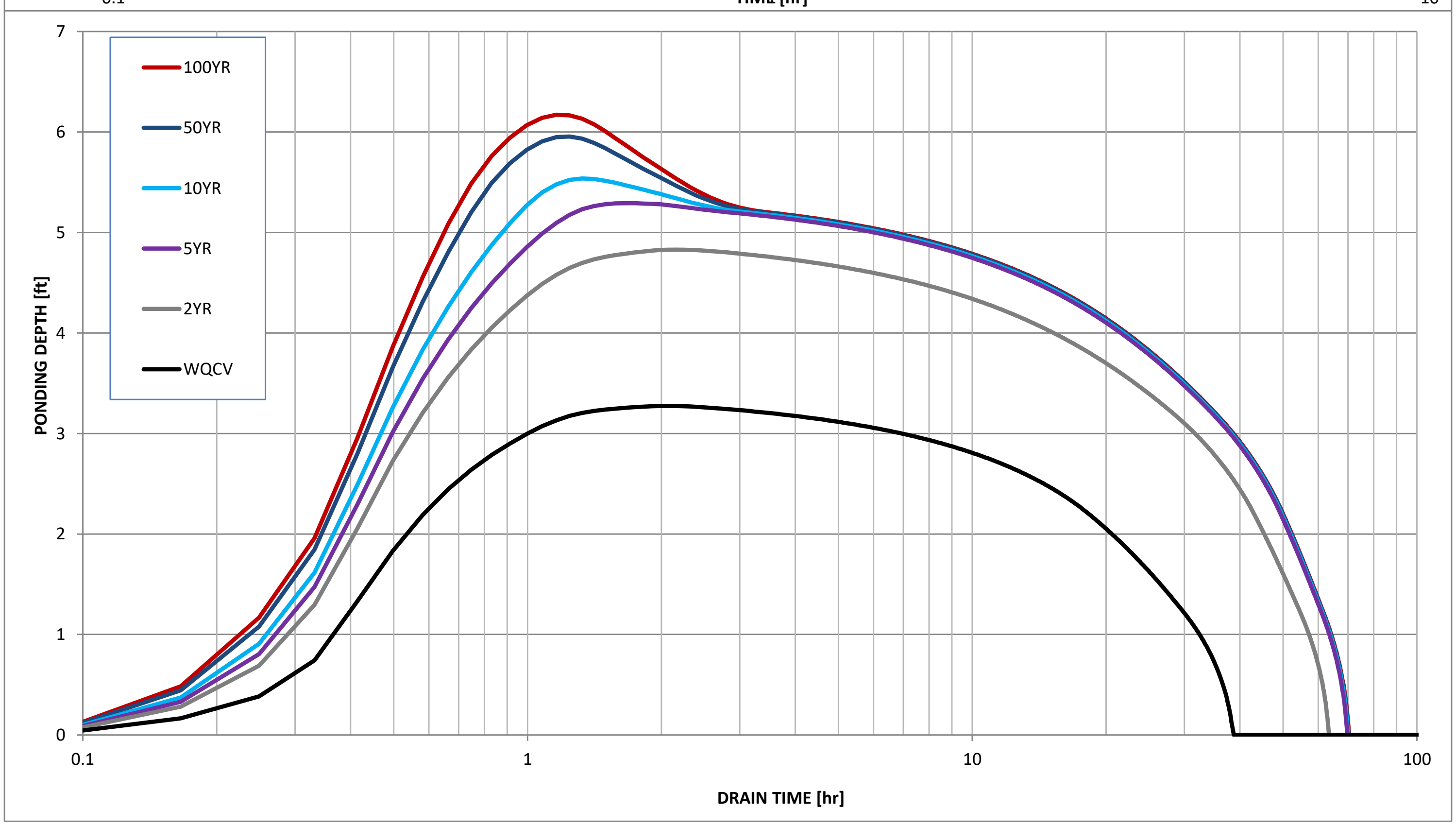
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.080	0.217	0.284	0.350	0.478	0.552	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.080	0.216	0.283	0.349	0.478	0.552	acre-ft
Time to Drain 97% of Inflow Volume =	35.5	55.3	**59.5**	58.1	55.8	54.5	hours
Time to Drain 99% of Inflow Volume =	37.5	60.6	66.1	65.5	64.3	**63.5**	hours
Maximum Ponding Depth =	3.27	4.83	5.29	5.54	5.96	6.17	ft
Maximum Ponded Area =	0.06	0.11	0.12	0.13	0.14	**0.15**	acres
Maximum Volume Stored =	0.073	0.204	0.256	0.287	0.344	0.376	acre-ft

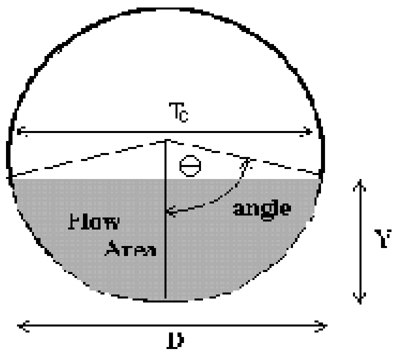
Stormwater Detention and Infiltration Design Data Sheet





CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

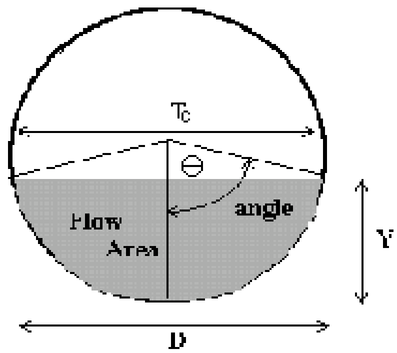
Project: **Seibers Business Center**
Pipe ID: **DP 1 to EDB**



Design Information (Input)			
Pipe Invert Slope	So =	0.0263	ft/ft
Pipe Manning's n-value	n =	0.0120	
Pipe Diameter	D =	18.00	inches
Design discharge	**Q =**	**10.77**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	18.50	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.67	radians
Flow area	An =	0.99	sq ft
Top width	Tn =	1.49	ft
Wetted perimeter	Pn =	2.50	ft
Flow depth	Yn =	0.82	ft
Flow velocity	Vn =	10.87	fps
Discharge	Qn =	10.77	cfs
Percent Full Flow	Flow =	58.2%	of full flow
Normal Depth Froude Number	Fr_n =	2.35	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.32	radians
Critical flow area	Ac =	1.58	sq ft
Critical top width	Tc =	1.10	ft
Critical flow depth	Yc =	1.26	ft
Critical flow velocity	Vc =	6.80	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

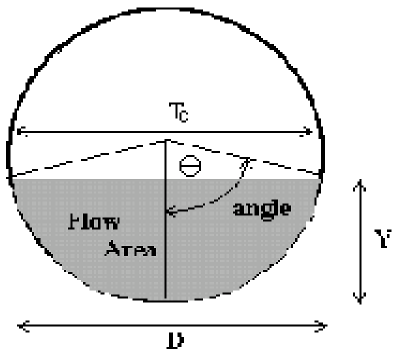
Project: **Sievers Business Center**
Pipe ID: **DP 2 to DP 3**



Design Information (Input)			
Pipe Invert Slope	So =	0.0095	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	**Q =**	**6.72**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	10.27	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.75	radians
Flow area	An =	1.08	sq ft
Top width	Tn =	1.48	ft
Wetted perimeter	Pn =	2.63	ft
Flow depth	Yn =	0.88	ft
Flow velocity	Vn =	6.19	fps
Discharge	Qn =	6.72	cfs
Percent Full Flow	Flow =	65.4%	of full flow
Normal Depth Froude Number	Fr_n =	1.27	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.92	radians
Critical flow area	Ac =	1.26	sq ft
Critical top width	Tc =	1.41	ft
Critical flow depth	Yc =	1.00	ft
Critical flow velocity	Vc =	5.35	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

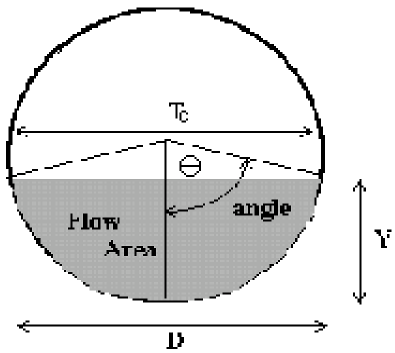
Project: **Sievers Business Center**
Pipe ID: **DP 3 to DP 4**



Design Information (Input)			
Pipe Invert Slope	So =	0.0093	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	**Q =**	**8.27**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	10.16	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.95	radians
Flow area	An =	1.29	sq ft
Top width	Tn =	1.39	ft
Wetted perimeter	Pn =	2.93	ft
Flow depth	Yn =	1.03	ft
Flow velocity	Vn =	6.41	fps
Discharge	Qn =	8.27	cfs
Percent Full Flow	Flow =	81.4%	of full flow
Normal Depth Froude Number	Fr_n =	1.17	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	2.08	radians
Critical flow area	Ac =	1.41	sq ft
Critical top width	Tc =	1.31	ft
Critical flow depth	Yc =	1.11	ft
Critical flow velocity	Vc =	5.88	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

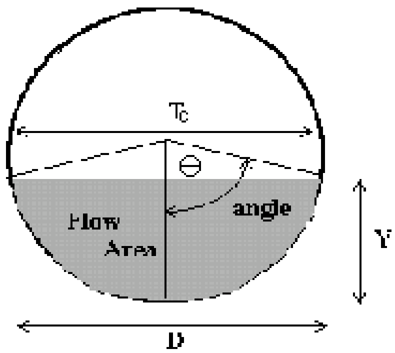
Project: Sievers Business Center
Pipe ID: DP 7 Pipe from Outlet Structure



Design Information (Input)			
Pipe Invert Slope	So =	0.0303	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	**Q =**	**2.35**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	18.33	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.03	radians
Flow area	An =	0.33	sq ft
Top width	Tn =	1.28	ft
Wetted perimeter	Pn =	1.54	ft
Flow depth	Yn =	0.36	ft
Flow velocity	Vn =	7.13	fps
Discharge	Qn =	2.35	cfs
Percent Full Flow	Flow =	12.8%	of full flow
Normal Depth Froude Number	Fr_n =	2.48	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.34	radians
Critical flow area	Ac =	0.63	sq ft
Critical top width	Tc =	1.46	ft
Critical flow depth	Yc =	0.58	ft
Critical flow velocity	Vc =	3.73	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

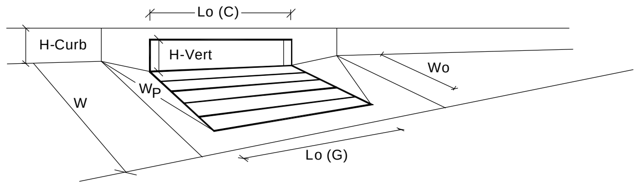
Project: Seivers Business Center
Pipe ID: Culvert at DP 6



Design Information (Input)			
Pipe Invert Slope	So =	0.0055	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	18.00	inches
Design discharge	**Q =**	**0.65**	**cfs**
Full-flow Capacity (Calculated)			
Full-flow area	Af =	1.77	sq ft
Full-flow wetted perimeter	Pf =	4.71	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	7.81	cfs
Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	0.91	radians
Flow area	An =	0.24	sq ft
Top width	Tn =	1.19	ft
Wetted perimeter	Pn =	1.37	ft
Flow depth	Yn =	0.29	ft
Flow velocity	Vn =	2.68	fps
Discharge	Qn =	0.65	cfs
Percent Full Flow	Flow =	8.3%	of full flow
Normal Depth Froude Number	Fr_n =	1.04	supercritical
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	0.93	radians
Critical flow area	Ac =	0.25	sq ft
Critical top width	Tc =	1.20	ft
Critical flow depth	Yc =	0.30	ft
Critical flow velocity	Vc =	2.59	fps
Critical Depth Froude Number	Fr_c =	1.00	

INLET IN A SUMP OR SAG LOCATION

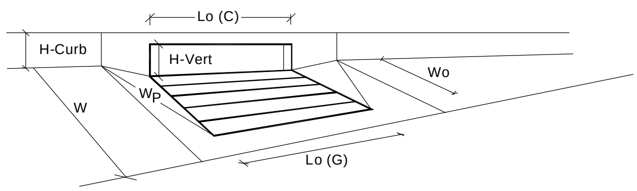
Project = **Sievers Business center**
Inlet ID = **Design Point 1**



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6	6	inches
				☑ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	11.17	11.66	cfs
Interception with Clogging	Q_{wa} =	10.47	10.93	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	19.51	19.66	cfs
Interception with Clogging	Q_{oa} =	18.29	18.43	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.73	14.08	cfs
Interception with Clogging	Q_{ma} =	12.87	13.20	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**10.47**	**10.93**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	18.7	19.1	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.5**	**10.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	Q PEAK REQUIRED =	6.0	10.8	cfs

INLET IN A SUMP OR SAG LOCATION

Project = Sievers Business Center
Inlet ID = Design Point 2

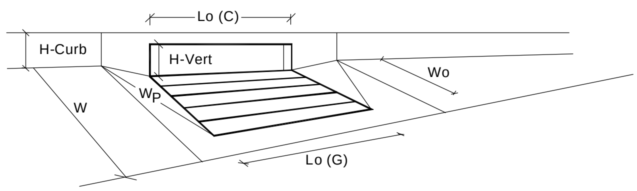


		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6	6	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	11.17	11.17	cfs
Interception with Clogging	Q_{wa} =	10.47	10.47	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	19.51	19.51	cfs
Interception with Clogging	Q_{oa} =	18.29	18.29	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	13.73	13.73	cfs
Interception with Clogging	Q_{ma} =	12.87	12.87	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**10.47**	**10.47**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	18.7	18.7	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.5**	**10.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.5	6.7	cfs

INLET IN A SUMP OR SAG LOCATION

Project = **Sievers Business Center**

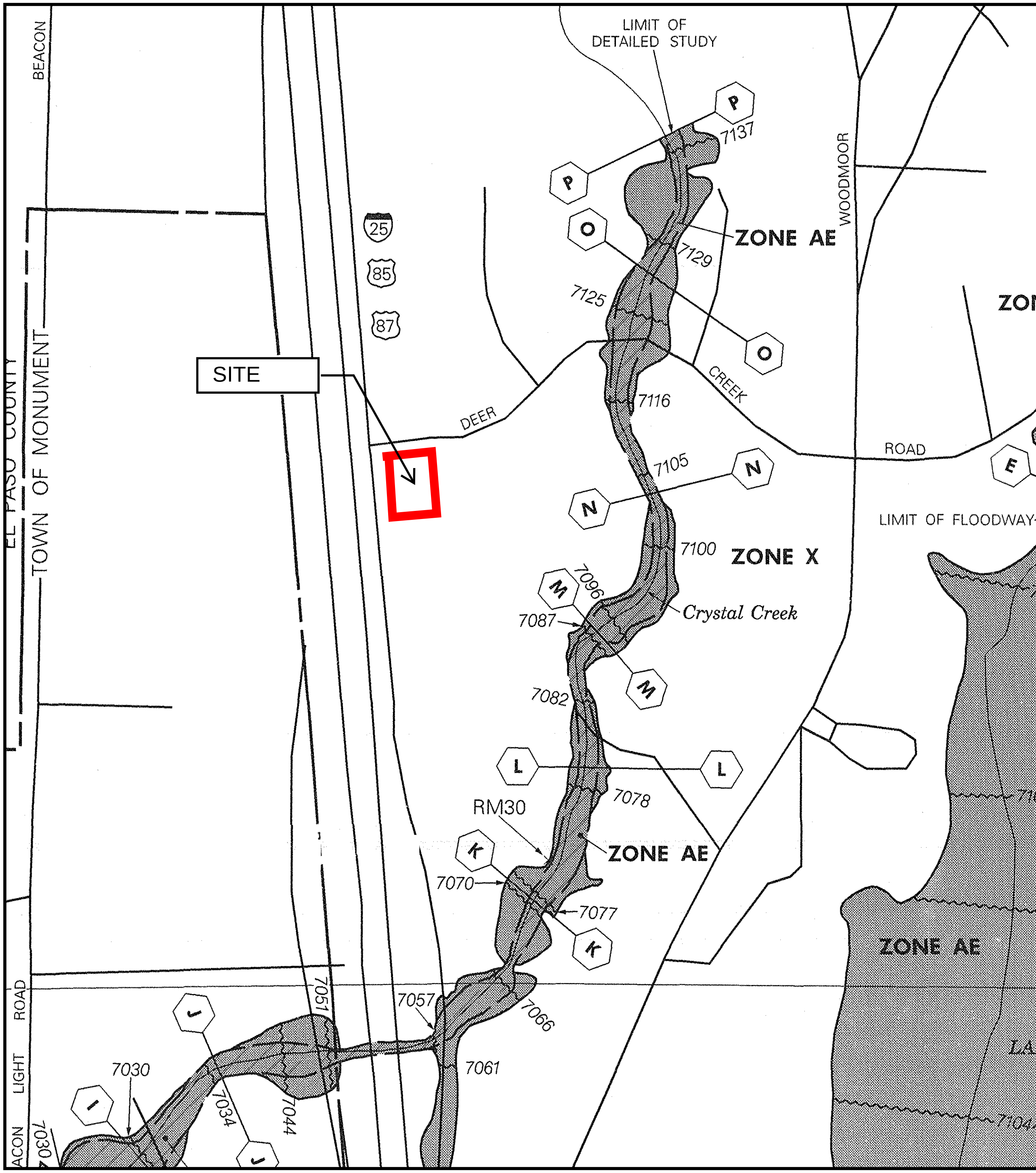
Inlet ID = **Design Point 3**



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Inlet Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
				☐ Override Depths
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	5.98	5.98	cfs
Interception with Clogging	Q_{wa} =	5.38	5.38	cfs
Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	9.75	9.75	cfs
Interception with Clogging	Q_{oa} =	8.78	8.78	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.10	7.10	cfs
Interception with Clogging	Q_{ma} =	6.39	6.39	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**5.38**	**5.38**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet *Q-Allow* geometry)	T =	18.7	18.7	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.8	1.6	cfs

APPENDIX 3

REFERENCED INFORMATION



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 276 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0276	F
MONUMENT, TOWN OF	080064	0276	F
PALMER LAKE, TOWN OF	080065	0276	F

MAP NUMBER 08041C0276 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado

February 13, 2017

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


104° 51' 51'' W
104° 51' 45'' W
39° 6' 19'' N
39° 6' 13'' N
511750
511770
511790
511810
511830
511850
511870
4328490
4328470
4328450
4328430
4328410
4328390
4328370
4328350
4328330
4328310
Deer Creek Rd
Monument Hill Rd
92
71
Soil Map may not be valid at this scale.
N
Map Scale: 1:936 if printed on A portrait (8.5" x 11") sheet.
Meters
0
10
20
40
60
Feet
0
45
90
180
270
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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 14, Sep 23, 2016

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—Sep 22, 2011

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

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
71	Pring coarse sandy loam, 3 to 8 percent slopes	0.0	0.4%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	3.2	99.6%
Totals for Area of Interest		**3.3**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy Park (R048AY222CO)
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

92—Tomah-Crowfoot loamy sands, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b9
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Alluvial fans, hills

Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

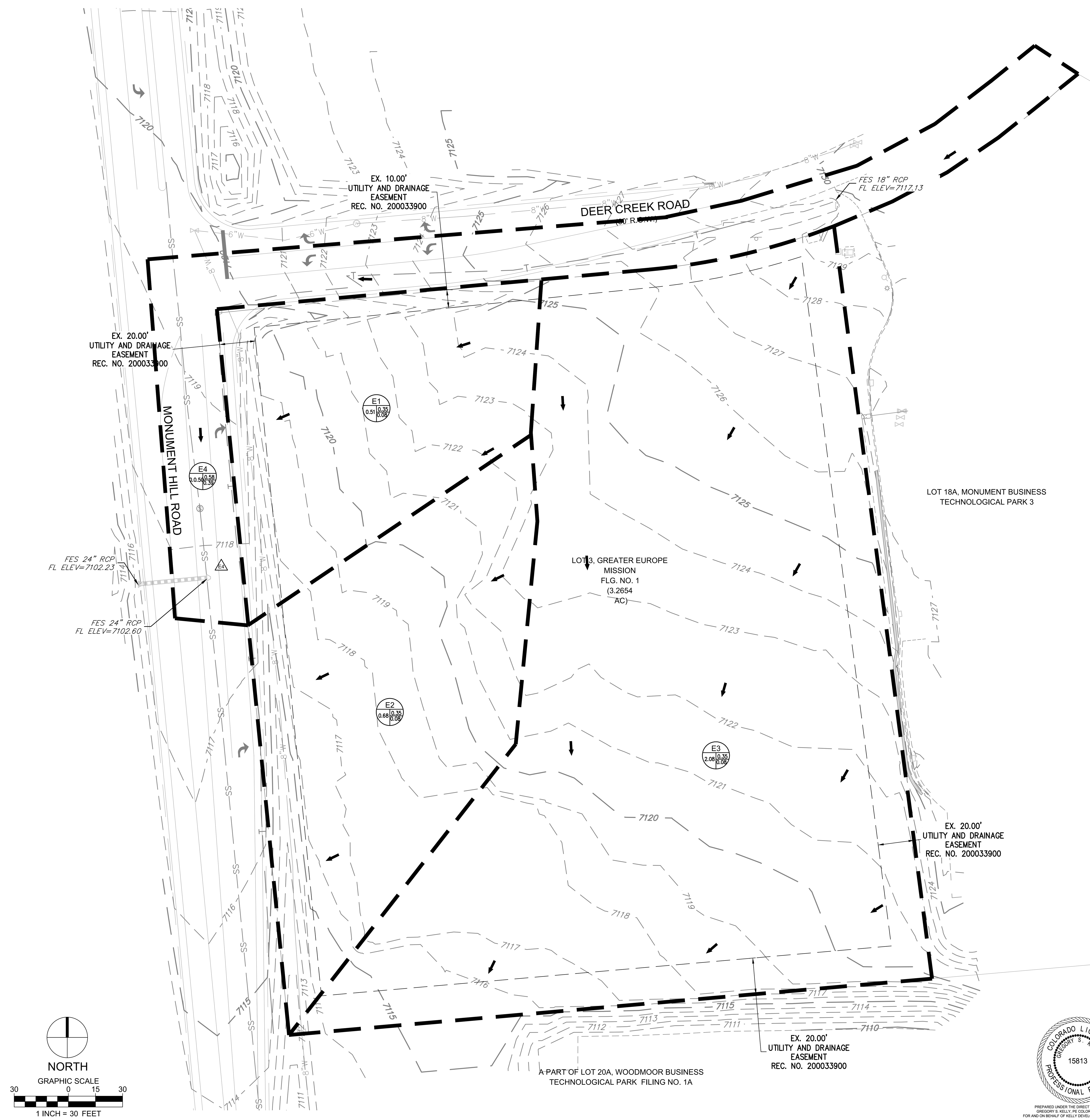
Minor Components

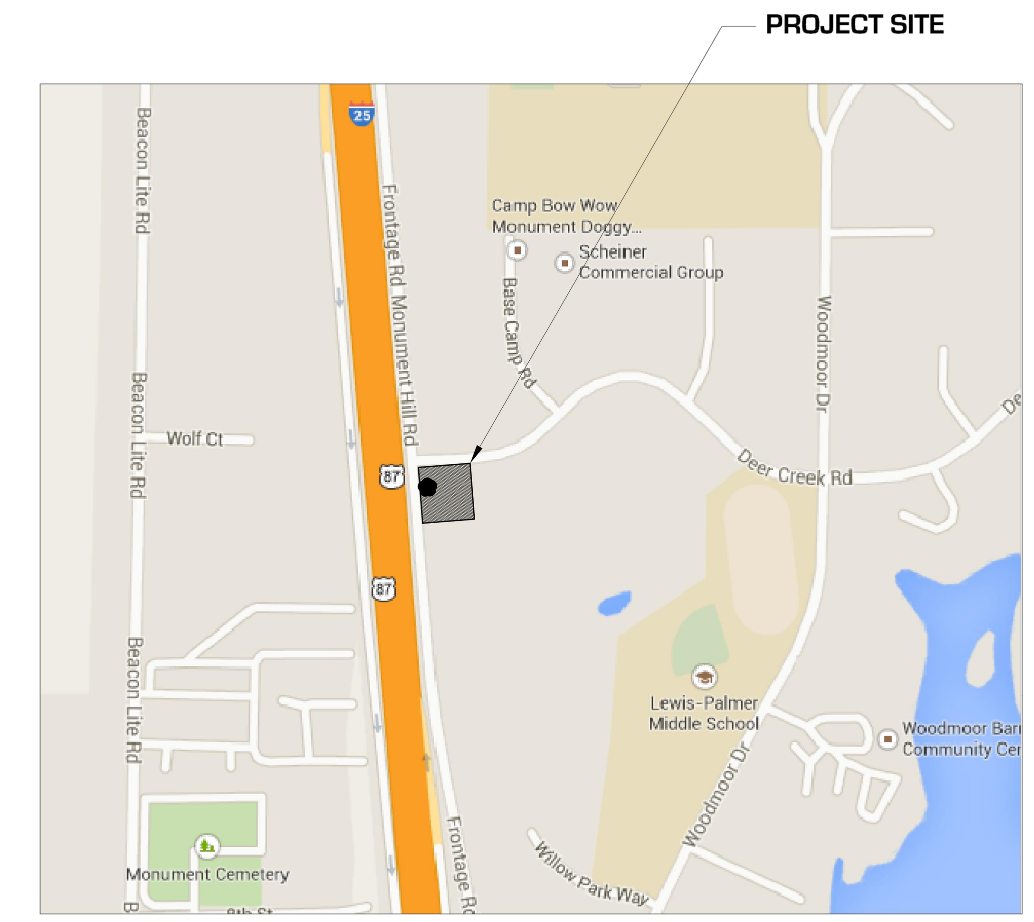
Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes





VICINITY MAP

SUB-BASIN ID
100 YR. 'C'
5 YR. 'C'
AREA (AC)
DESIGN PT
SUB-BASIN BOUNDARY
FLOW ARROW
EMERGENCY OVERFLOW
MAJOR CONTOUR
MINOR CONTOUR

EXISTING SUB-BASIN RUNOFF SUMMARY TABLE								
Sub-basin Designation	Design Point	Sub-basin Area (ac)	Percent Impervious	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
E1		0.51	0.0%	0.08	0.35	11.3	0.16	1.16
E2		0.68	0.0%	0.08	0.35	11.1	0.21	1.56
E3		2.08	0.0%	0.08	0.35	12.8	0.61	4.48
E4	E4	0.50	38.0%	0.39	0.58	13.7	0.70	1.73

COLORADO LICENSED GREGORY S. KELLY 15813 PROFESSIONAL ENGINEER
11/30/2017

"THIS REPORT AND PLAN FOR THE FINAL DRAINAGE DESIGN OF THE SIEVERS BUSINESS CENTER WAS PREPARED BY ME (OR UNDER MY DIRECT SUPERVISION) IN ACCORDANCE WITH THE PROVISIONS OF EL PASO COUNTY'S DRAINAGE DESIGN AND TECHNICAL CRITERIA FOR THE OWNERS THEREOF. I UNDERSTAND THAT EL PASO COUNTY DOES NOT ASSUME LIABILITY FOR DRAINAGE FACILITIES DESIGNED BY OTHERS."

SIGNATURE: Greg Kelly

REGISTERED PROFESSIONAL ENGINEER STATE OF COLORADO NO. 15813

COLORADO 811 KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

CAUTION NOTICE TO CONTRACTORS

THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES AND, WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUCH CALL 811 AT LEAST 72 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATIONS OF THE UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATED ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THESE PLANS.

PREPARED FOR:

HOVER ARCHITECTURE
TROY KIRSCHMAN
8089 S. LINCOLN ST., SUITE 201
LITTLETON, CO 80122
PH: 720-773-2801
FAX:

#	DATE	REVISION DESCRIPTION	BY
△			
△			
△			
△			

project no.	1508.01	drawn by	
date		designed by	
dwg.		approved by	

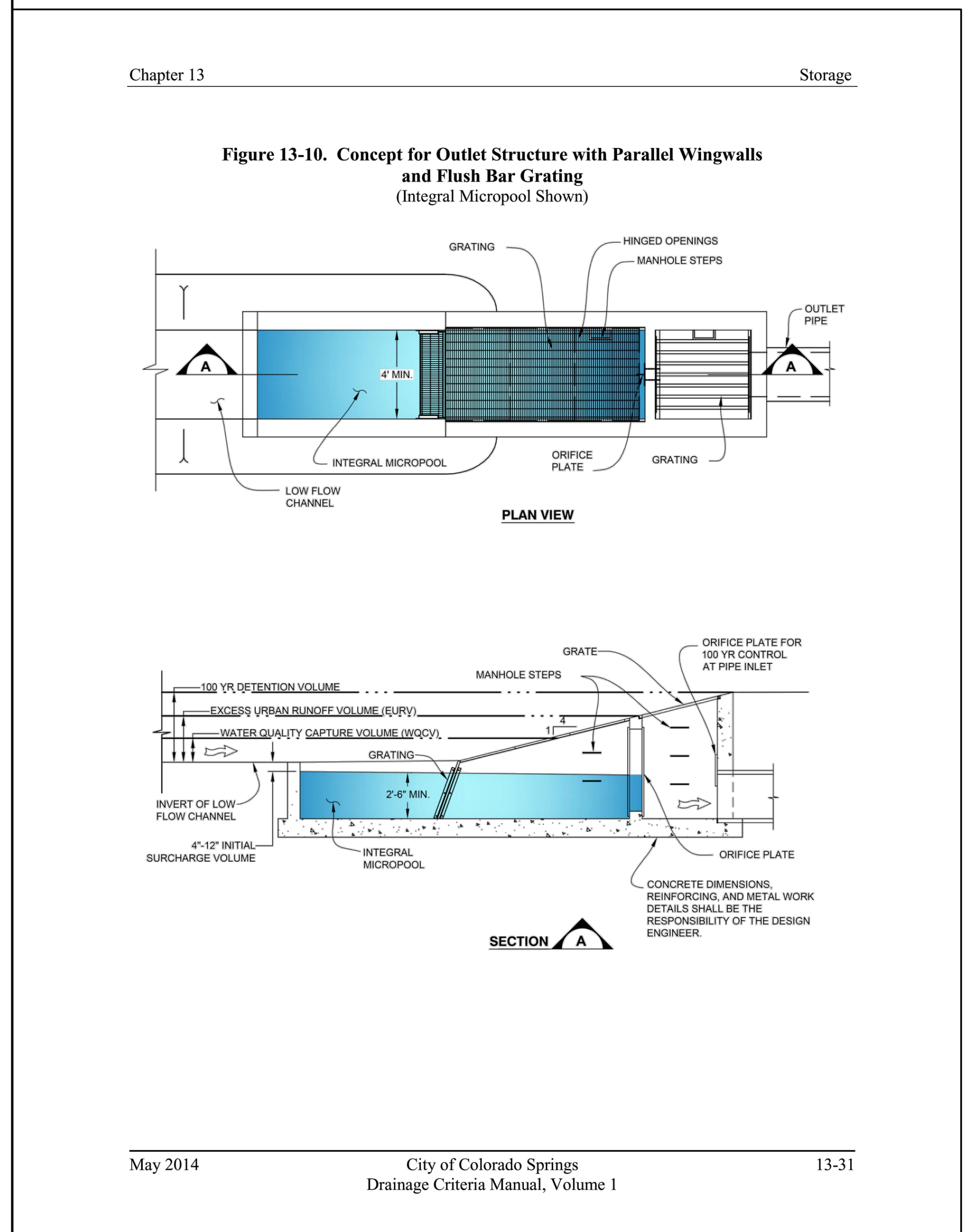
MONUMENT HILL BUSINESS CENTER

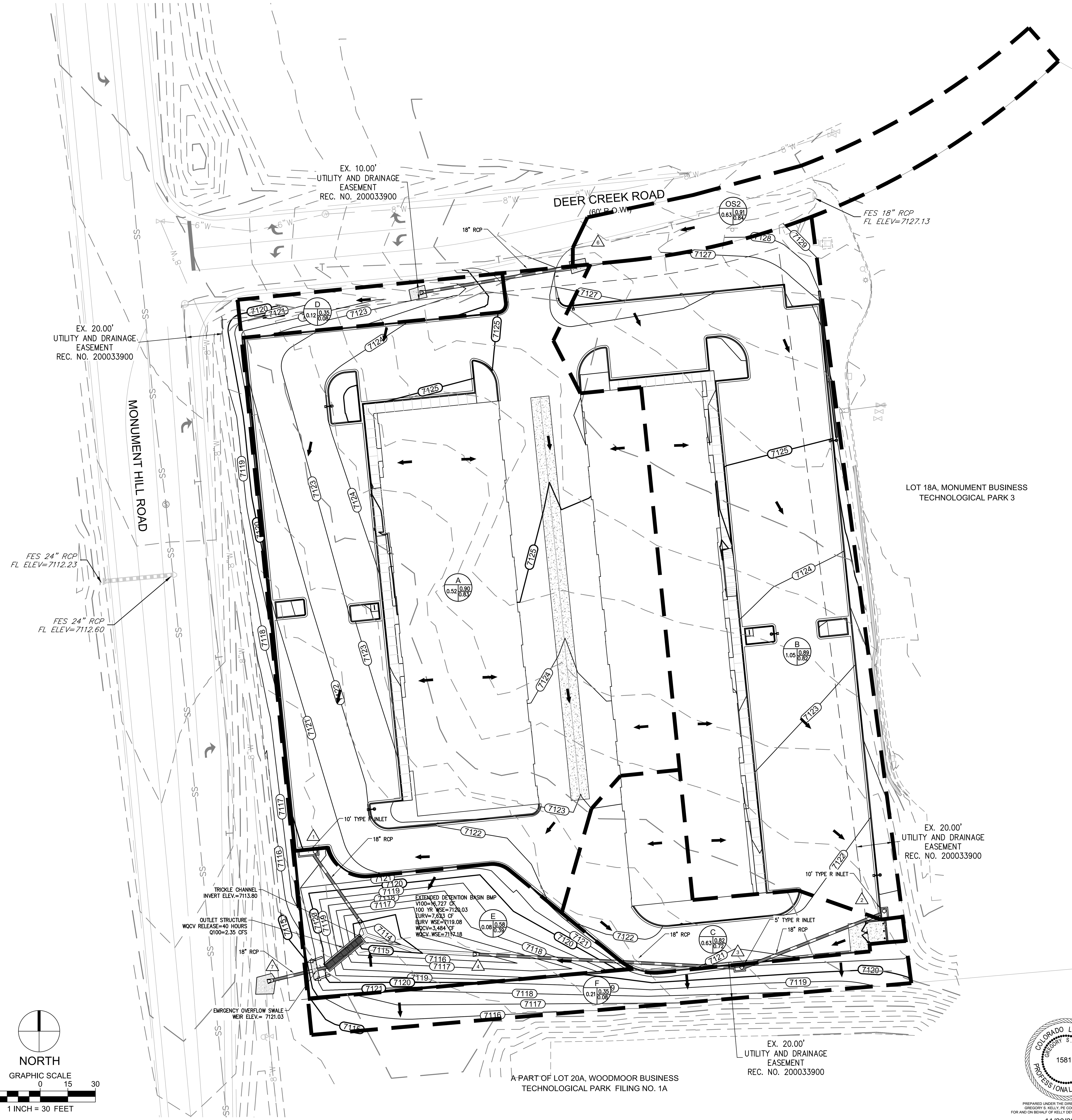
LOT 3, GREATER EUROPE MISSION FILING NO. 1
EL PASO COUNTY, CO

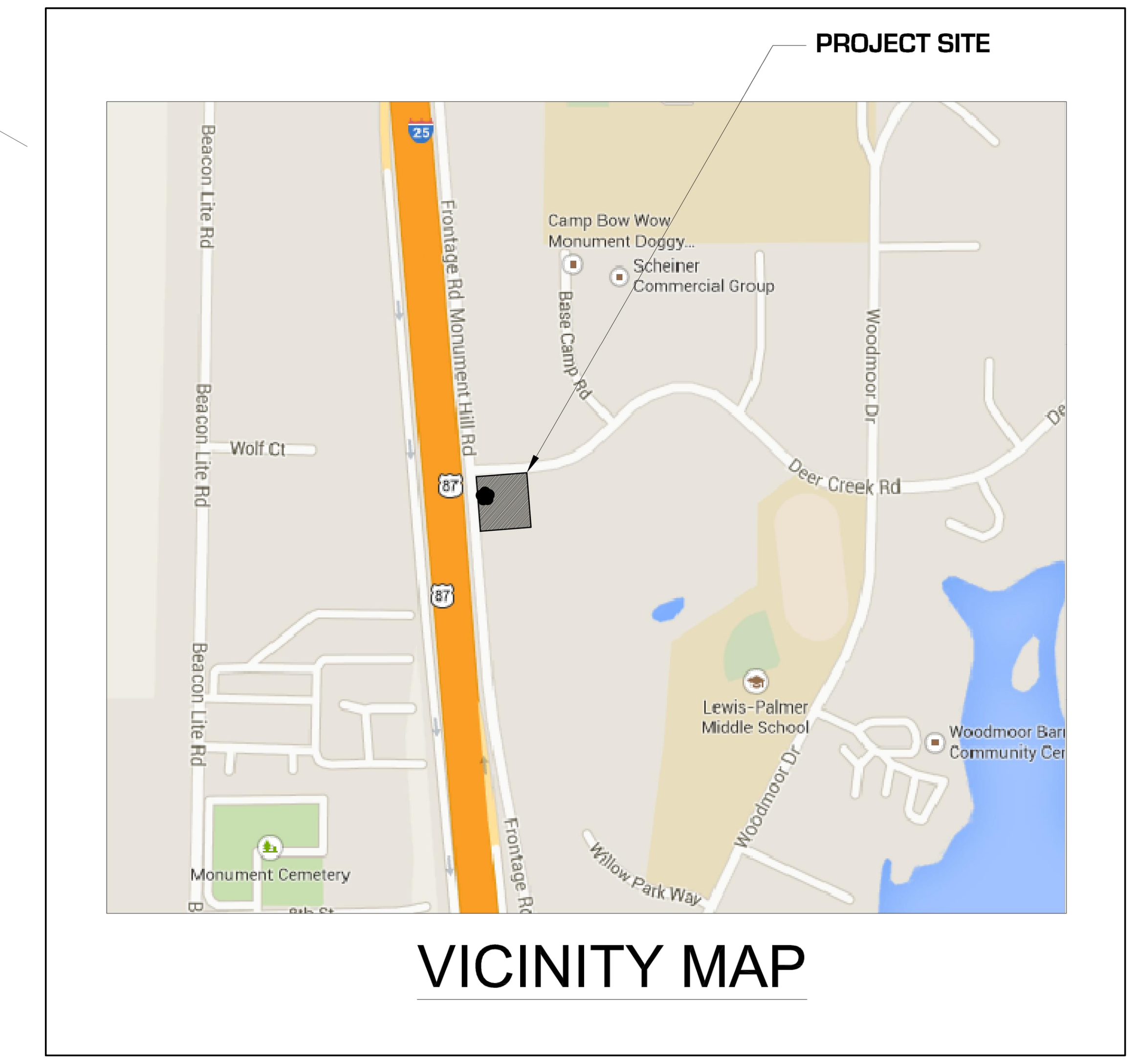
EXISTING DRAINAGE PLAN

KELLY DEVELOPMENT SERVICES, LLC
9301 SCRUB OAK DR
LONE TREE, CO 80124
303-888-6338
greg@kellydev.com

SHEET NUMBER
EDP
SHEET 1 OF 2
PROJECT NUMBER
1704.01







SUB-BASIN ID
100 YR. 'C'
5 YR. 'C'
AREA (AC)
DESIGN PT
SUB-BASIN BOUNDARY
FLOW ARROW
EMERGENCY OVERFLOW
MAJOR CONTOUR
MINOR CONTOUR

NORTH
GRAPHIC SCALE
30 0 15 30
1 INCH = 30 FEET

DEVELOPED SUB-BASIN RUNOFF SUMMARY TABLE								
Sub-basin Designation	Design Point	Sub-basin Area (ac)	Percent Impervious	C_5	C_{100}	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	1	1.39	96%	0.86	0.93	5.5	5.95	10.77
B	2	0.95	81%	0.73	0.83	5.0	3.53	6.72
C	3	0.21	88%	0.78	0.87	5.0	0.83	1.55
D		0.07	0%	0.08	0.35	10.8	0.02	0.16
E		0.22	0%	0.08	0.35	9.0	0.07	0.55
F		0.15	0%	0.08	0.35	5.0	0.06	0.45
OS2	6	0.17	29%	0.32	0.53	8.6	0.23	0.65

DESIGN POINT RUNOFF SUMMARY TABLE					
Design Point	Contributing Sub-basins	Contributing Area (acres)	T_c (min)	Q_5 (cfs)	Q_{100} (cfs)
1	A	1.39	5.5	5.95	10.77
2	B	0.95	5.0	3.53	6.72
3	C	0.95	5.0	0.83	1.55
4	B, C	1.16	5.0	4.36	8.27
5	A, B, C, E	2.77	9.0	8.78	16.62
6	OS2	0.17	8.6	0.23	0.65
E4	E4	0.50	13.7	0.70	1.73

"THIS REPORT AND PLAN FOR THE FINAL DRAINAGE DESIGN OF THE SIEVERS BUSINESS CENTER WAS PREPARED BY ME (OR UNDER MY DIRECT SUPERVISION) IN ACCORDANCE WITH THE PROVISIONS OF EL PASO COUNTY'S DRAINAGE DESIGN AND TECHNICAL CRITERIA FOR THE OWNERS THEREOF. I UNDERSTAND THAT EL PASO COUNTY DOES NOT ASSUME LIABILITY FOR DRAINAGE FACILITIES DESIGNED BY OTHERS."

SIGNATURE: Greg Kelly

REGISTERED PROFESSIONAL ENGINEER STATE OF COLORADO NO. 15813

COLORADO LICENSED GREGORY S. KELLY 15813 PROFESSIONAL ENGINEER
11/30/2017

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MONUMENT HILL BUSINESS CENTER

LOT 3, GREATER EUROPE MISSION FILING NO. 1
EL PASO COUNTY, CO

FINAL DRAINAGE PLAN

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SHEET NUMBER
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SHEET 1
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PCD PROJECT NO. PPR-17-007