

True West Co., LLC

FINAL DRAINAGE LETTER

Hotchkiss Commercial Offices, 2290 Old Ranch Road, Colorado Springs, Colorado
Lot 8, Block E, Amended Filing of Springs Crest Subdivision
El Paso County, Colorado

Prepared for:

John Hotchkiss
9161 Estebury Circle
Colorado Springs, Co 80920-7560

Revise title to Final Drainage Report. Per Drainage criteria manual section 4.5 a letter type report may be provided only when a complete drainage report was previously approved.

Prepared by:

True West Co, LLC
16352 E. Bates Drive
Aurora, CO 80013
truewest1@usa.net
303-523-3664
Attn: Connie Ellefson, P.E.

August 5, 2019

Add PCD File No. PPR203

Please delete the
crossed out text.

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 ~~City~~/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.

Connie L. Ellefson, P.E. Colorado P.E. 23317

Developer's Statement

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

Name, Title:

Date

Business Name

Address: _____

El Paso County Only

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 ~~Director of Public Works~~

Conditions:

Please delete the
crossed out text

Please clarify that the footprint is 2849 sq. ft. as the building is stated as 5700 sq.ft. in the letter of intent.

A. PURPOSE

The purpose of this letter is to demonstrate that the proposed drainage changes to Lot 8, Block E, Amended Filing of Springs Crest Subdivision will not adversely affect downstream properties, and conform to El Paso County drainage criteria.

This site was previously developed with a residence, storage shed, and garage, with a circular gravel driveway, landscape and utilities. With the proposed development, the existing house will be removed and replaced with a 2849-square foot office building. The existing garage will be remodeled into a studio/office, and the gravel drive replaced with paved drive and parking for the office building and studio.

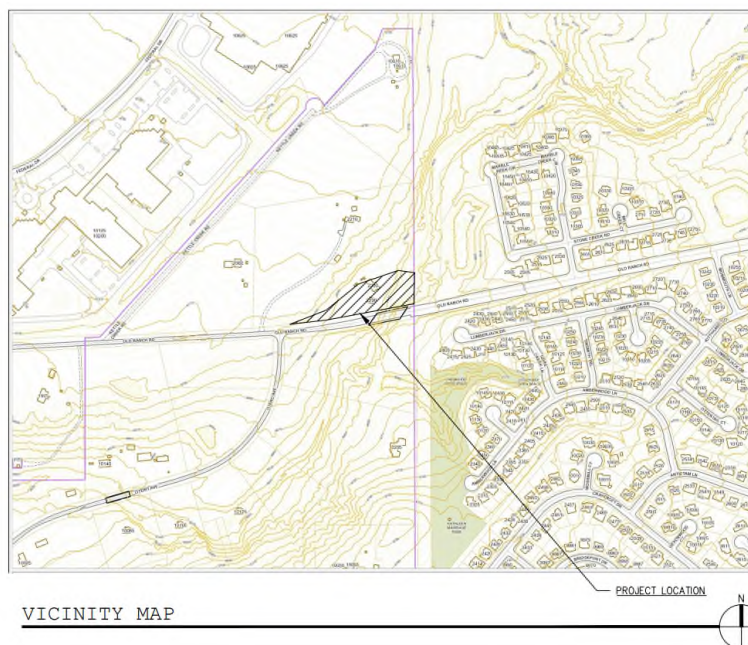
Parking areas will be asphalt with wheel stops only in order to maximize the opportunity for the impervious area to drain to open space and improve water quality, and in keeping with the more rural nature of the area this site is in. A small amount of concrete curb will be needed around the remodeled garage- to-studio to redirect new runoff away from the existing building.

Please also indicate what drainage basin the site is in (i.e. Kettle Creek drainage basin FOMO300).

B. GENERAL LOCATION AND DESCRIPTION

The site is a roughly triangular area north of Old Ranch Road, approximately 0.6 miles west of Voyager Parkway and one mile east of N. Powers Boulevard. Kettle Creek forms the southeast side of the site.

The lot contains 2.19 acres, of which approximately 0.5 acres along Kettle Creek is in the Zone AE floodplain (floodplain base flood elevation at 6671 adjacent to buildings, at least 10 below the finished floor elevations.)



Please elaborate on the existing drainage providing basin descriptions and design points. Also provide an existing drainage plan showing the appropriate basins and design points of existing/historic drainage flow patterns.

The existing entrance will be repaved with the redevelopment and the drive extended to parking spaces with asphalt paving.

Runoff will flow off the pavement as sheet flow, and via a shallow concrete pan, over riprap erosion protection to help return it to sheet flow, and flow into Kettle Creek.

Per the existing contours it appears that the flow is going to the east. Revise accordingly.

C. EXISTING DRAINAGE CHARACTERISTICS

The existing site is sloped from the northwest to the southwest, with steep slopes, between 8 and 20% along the northwest side. The area in the middle of the lot, where the existing buildings and circular drive are located is much flatter, averaging 1.5% slope. The lot drops off steeply to the southwest beyond that, to Kettle Creek, within the floodplain area.

The slope along the northwest side is heavily wooded with evergreen trees, the floodplain contains several large deciduous trees, and other trees of both types are scattered more sparsely throughout the lot, with native grass, and a small amount of sod and landscaping around the existing residence.

Offsite runoff enters the site from the northwest (2.83 acres) part of an existing large-acreage residence (one residence on 11.9 acres) of primarily grassland, with the heavily wooded area adjacent to the northwest corner of the site as sheet flow.

The only drainage provisions are an existing 18" CMP culvert under the entrance drive, connecting the roadside swale that flows along the north side of Old Ranch Road to Kettle Creek. On the east side of the drive the roadside swale angles more northeasterly towards the Creek, crossing a small area of Lot 8.

Please describe the condition of the drainageway. Is there excessive erosion? Is this drainageway stable? Are any improvements needed?

D. PROPOSED DRAINAGE CHARACTERISTICS

The developed area of the site has been divided into four small basins, and the flows from the total of these four areas was compared to the same area of the existing site, since existing and proposed development areas are roughly in the same part of the lot.

The wedge of land extending west along the right-of-way from the proposed parking lot, as well as the area of the floodplain for Kettle Creek, were both omitted from calculations. This is due to the fact that the land in both areas will remain unchanged, and any flows from offsite areas draining to those two areas will not be changed or redirected.

The existing culvert under the entrance drive will be cleaned of sediment, or replaced if damaged. The existing entrance drive will be repaved to the existing grade to the R.O.W. line, then regraded as needed on site to make the new drainage pattern work.

Onsite Basin A1 (0.14 acres) consists of the greenbelt area north of the parking lot. It will receive runoff from offsite Basin O1 (Design Point 1), and a swale will be graded in that basin to direct the offsite runoff east (Design Point 2) around the new development, rather than letting it flow onto the proposed parking areas.

Basin A2 (0.25 acres) contains open space and the north half of the proposed new office building at the east side of the new development. A swale has been graded to continue directing offsite flow around the building and into Kettle Creek.

Basin B1 (0.43 acres of parking lot and parts of the roofs of both buildings) will drain to a small concrete crossspan south of the studio office, and across riprap erosion protection designed to help spread the flow. The runoff will continue across an approximate 60' buffer of open space before reaching the Kettle Creek top of bank.

Basin B2 (0.17 acres of roof, concrete walk, and open space) drains southeast towards Kettle Creek in a wide, shallow swale designed to help return flow to sheet for.

The flows are as follows:

RUNOFF SUMMARY

DES. PT.	BASIN	AREA (AC.)	5-YR FLOW (cfs)	100-YR FLOW (cfs)
1	O1	2.83	1.89	4.18
	A1	0.14	0.09	0.22
2	O1 + A1	2.97	1.89	4.18
	A2	0.25	0.32	0.66
3	O1 + A1 + A2	3.22	1.98	4.34
4	B1	0.43	1.44	2.69
5	B2	0.17	0.30	0.60
	H	1.00	1.34	2.74
	O1 + H	3.83	2.90	6.22
	A1 - B2	1.00	1.83	3.54
	O1 + A1 - B2	3.83	3.10	6.45

The flow for design point 5 appears low as this design point would include flow from design point 4. Revise accordingly.

Provide an explanation as to what this basin is or where this basin is located as it is not shown on the drainage plan.

E. WATER QUALITY

No permanent water quality BMPs as all the impervious areas drain to wide grass buffers before draining into Kettle Creek.

Per ECM Appendix I the proposed development is considered an applicable development and must provide a permanent stormwater quality control measure. The permanent control measure shall meet one of the base design standards indicated in ECM section I.7.1.C. Please update the narrative and your design accordingly. See comment on EDARP from Public Works stormwater engineer.

See "Four-Step Process" below for further information.

F. HYDROLOGY CALCULATIONS AND DRAINAGE FACILITY DESIGN

Drainage criteria was taken from the El Paso County Drainage Design Criteria Manual Volume 1 (DCM). This manual refers to the Urban Drainage and Flood Control District's Criteria Manual, Volumes 1-3 (UD) for certain calculation methods, specifically in determining detention volume and Minimize Directly Connected Impervious Area.

The design rainfall for the minor storm (5-year) is a one-hour precipitation rate of 1.50 inches, and for the major storm (100-year), a one-hour rate of 2.60 inches. Runoff from all Basins was calculated using the rational method, as outlined in the DCM. Time of concentration was calculated using c-values from the El Paso County DCM Volume 1, Chapter 6. Design storm recurrence intervals used in this hydrologic analysis were the 5-year and the 100-year storms.

Flow rate calculations are shown in the Appendix for the Rational Method. The standard values used for the calculations, such as the rainfall intensity curves also appear in the Appendix.

Four Step Process for receiving water protection. The El Paso County requires discussion of how the "Four Step Process" as outlined in the **Urban Drainage Criteria Manual** for "reducing runoff volumes, treating water quality capture volume (EURV), stabilizing drainageways, and implementing long-term source controls."

The steps have been considered and incorporated in the drainage plan for this project as follows:

Step 1: Reduce runoff by disconnecting impervious area, eliminating "unnecessary" impervious area and encouraging infiltration into soils that are suitable.

The site is designed to provide only the required parking and circulation impervious areas, even though more parking might be possible. The amount of open space/landscape area on the site is more than 82%.

All of the existing and proposed impervious area will release into open space landscape buffers ranging from 40-70' wide before reaching the Kettle Creek channel.

The Impervious Reduction Factor BMP spreadsheet has been filled out and appears in the Appendix. As the Receiving Pervious area is nearly as large as

...as outlined in Appendix I.7.2. Please revise and update the steps to match what is listed in Appendix I.7.2.

Step 3 is provide Water Quality Capture Volume (WQCV)

Also provide discussion of water quality and how it is being addressed.

the impervious area, and the interface between the two is wide, the BMP spreadsheet shows no Water Quality Capture Volume is needed.

2. Step 2: Treat and slowly release the EURV.

Detention is not required for this site. For both the storms calculated, the 5-year and the 100-year, the downstream flow for the proposed developed area as well as its offsite to the north is only slightly higher than the existing flowrates for the same areas. (2.90 cfs for the 5-year, existing, vs. 3.10 cfs, proposed, and 6.22 cfs, existing vs. 6.45 cfs, proposed, for the 100-year storm – total acreage approx. 4 acres)

3. Step 3: Stabilize stream channels.

Step 2 is Stabilize Drainageways

The swales will be grass-lined, and designed with low velocities. Riprap will protect the one location of concentrated flow (outfall of small crossspan south of studio) to help return it to sheet flow.

4. Step 4: Implement source controls.

Step 4 is Consider Need for Industrial and Commercial BMP's

Source pollutants are not expected to be a large problem with the proposed site use. No automotive servicing activities are anticipated other than parking. All parking areas will be routed through wide grass buffers.

G. FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA), as depicted on Flood Insurance Rate Map ((FIRM) No. 08041C0506G, Dec. 7, 2018, the southeastern 0.5 acres of the site is in Zone AE, the deep, defined channel for Kettle Creek. The floodplain won't be disturbed with this redevelopment, and the floodplain base flood elevation is at 6671 adjacent to buildings, at least 10 below the finished floor elevations.

H. EROSION CONTROL

As indicated in the BESQP submitted, there is more than 1 acre of disturbance proposed. A grading and erosion control plan is required. Please revise the narrative and provide appropriate control measures. Fill out and submit the GEC checklist.

Erosion control plans were not required for this small site, with its substantial grass buffers all around the developed areas.

I. DRAINAGE/BRIDGE FEES

Drainage/bridge fee for Lot 8 will be determined with County input.

Although Kettle Creek Drainage basin is a fee basin, no fees are due with site development plan applications. Please revise the narrative.

J. CONSTRUCTION COST OPINION

Storm Sewer Cost Estimate (All are non-reimbursable)

8/4/2019

DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	COST
PRIVATE				
18" CMP - if needed	28	LF	\$ 30	\$ 840.00
Private Storm Improvements Cost				\$ 840.00
Subtotal Cost	\$		840.00	
Contingency			84.00	
Total	\$		924.00	

CONCLUSION

The redevelopment and proposed drainage patterns for Lot 8, Block E, Amended Filing of Springs Crest Subdivision, Hotchkiss Commercial Offices, will not negatively impact downstream properties.

The existing stream, Kettle Creek is protected by grass buffers at least 40-70' wide from any proposed or existing impervious area, and the

No negative downstream impact is expected, as nearly all the impervious area will be treated for water quality, and the 100-year outflow reduced from 4.1 cfs to the allowed outflow of 1.6 cfs. Runoff from the small (primarily landscape) areas which are not detained will release much earlier than the pond outflow.

Sincerely,
Connie Ellefson, P.E.



Astra Engineering
303-523-3664

missing text?

Previously it was indicated that the total flow increased. Also there is no proposed pond on the drainage plan or indicated in the narrative. Please revise this paragraph accordingly.

National Flood Hazard Layer FIRMMette



Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/20/2019 at 12:03:47 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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



38°59'5.14"N

104°47'25.94"W

USGS The National Map: Orthoimagery. Data refreshed April, 2019.

104°46'48.48"W

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

38°58'37.17"N

**True West Co., LLC
Hotchkiss Commercial Offices
2290 Old Ranch Road**

The narrative indicated that your analysis was done for the 5 year and 100yr storms. Revise accordingly. Also, in 2015 the County adopted Ch6 of the City of Colorado Springs DCM Vol. 1. Please use runoff coefficients listed in Table 6-6 for all calculations.

8/3/2019

Hydrologic Soil Type B

Existing Site

2.19 acres 95600

Existing Composite Coefficients of Runoff

Cover type	Area (sf)	C10	C100	Imperviousness
Landscape	87,770	0.15	0.20	2%
Gravel Rd	3,725	0.80	0.85	80%
Roof	2,990	0.90	0.95	90%
Walks/Drives	1,115	0.90	0.95	100%

95,600

Proposed Imperviousness

I= 8.9%

C5 = 0.21

C100 = 0.26

The table show C10 yet the imperviousness below indicates C5. Please also revise the other tables/text below.

Proposed Site

2.19 acres 95600

Proposed Composite Coefficients of Runoff

Cover type	Area (sf)	C5	C100	Imperviousness
Landscape	79,220	0.15	0.20	2%
Gravel Rd	0	0.80	0.85	80%
Roof	3,583	0.90	0.95	90%
Walks/Drives	12,797	0.90	0.95	100%

95,600

Proposed Imperviousness

I= 18.4%

C10 = 0.28

C100 = 0.33

Please include the concrete porch around the new structure that this indicated on the site development plan.

Basin O1

2.83 acres 123350 Soil Type A

Existing Composite Coefficients of Runoff

Cover type	Area (sf)	C10	C100	Imperviousness
Landscape	118,490	0.15	0.20	2%
Gravel Rd	3,860	0.80	0.85	80%
Roof	1,000	0.90	0.95	90%
Walks/Drives	0	0.90	0.95	100%

123,350

Proposed Imperviousness

I= 5.2%

C10 = 0.18

C100 = 0.23

Basin H 1.00 acres 43427 Soil Type B
(corresponding to developed area calculated)

Existing Composite Coefficients of Runoff

Cover type	Area (sf)	C10	C100	Imperviousness
Landscape	35,597	0.15	0.20	2%
Gravel Rd	3,725	0.80	0.85	80%
Roof	2,990	0.90	0.95	90%
Walks/Drives	1,115	0.90	0.95	100%
43,427				

Proposed Imperviousness

I= 17.3%

C10 = 0.28

C100 = 0.33

O1 and H weighted imperviousness and runoff coefficients

Imperviousness

O1	2.83	5.2	14.7
H	0.99	17.3	17.1
	3.82		31.8

Ave = $31.8/3.82 = 8.3$ %

C5

O1	2.83	0.18	0.51
H	0.99	0.28	0.28
	3.82		0.79

Ave = $0.79/3.82 = 0.21$

C100

O1	2.83	0.23	0.65
H	0.99	0.33	0.33
	3.82		0.98

Ave = $0.98/3.82 = 0.26$

A1 0.14 acres 5982

Proposed Composite Coefficients of Runoff

Cover type	Area (sf)	C5	C100	Imperviousness
Landscape	5,982	0.15	0.20	2%
Gravel Rd	0	0.80	0.85	80%
Roof	0	0.90	0.95	90%
Walks/Drives	0	0.90	0.95	100%
5,982				

Proposed Imperviousness

I= 2.0%

C10 = 0.15

C100 = 0.20

O1 and A1 weighted imperviousness and runoff coefficients

Imperviousness

O1 2.83 5.2 14.7
A1 0.14 2.0 0.3

2.97 15.0

$$\text{Ave} = 15.0/2.97 = 5.0 \quad \%$$

C5

O1 2.83 0.18 0.51
A1 0.14 0.15 0.02

2.97 0.53

$$\text{Ave} = 0.53/2.97 = 0.18$$

C100

O1 2.83 0.23 0.65
A1 0.14 0.20 0.03

2.97 0.68

$$\text{Ave} = 0.68/2.97 = 0.23$$

A2 0.25 acres 10990

Proposed Composite Coefficients of Runoff

Cover type	Area (sf)	C5	C100	Imperviousness
Landscape	9,590	0.15	0.20	2%
Gravel Rd	0	0.80	0.85	80%
Roof	1,400	0.90	0.95	90%
Walks/Drives	0	0.90	0.95	100%

10,990

Proposed Imperviousness

$$I = 13.2\%$$

$$C_{10} = 0.25$$

$$C_{100} = 0.30$$

O1 + A1 + A2 weighted imperviousness and runoff coefficients

Imperviousness

O1+A1	2.97	5.0	14.9
+A2	0.25	13.2	3.3
	3.22		18.2

$$\text{Ave} = 18.2/3.22 = 5.6 \quad \%$$

C5

O1 + A1	2.97	0.18	0.53
+A2	0.25	0.25	0.06
	3.22		0.60

$$\text{Ave} = 0.60/3.22 = 0.19$$

C100

O1 + A1	2.97	0.23	0.68
+A2	0.25	0.30	0.08
	3.22		0.76

$$\text{Ave} = 0.76/3.22 = 0.24$$

B1 0.43 acres 18875

Proposed Composite Coefficients of Runoff

Cover type	Area (sf)	C5	C100	Imperviousness
Landscape	5,956	0.15	0.20	2%
Gravel Rd	0	0.80	0.85	80%
Roof	657	0.90	0.95	90%
Walks/Drives	12,262	0.90	0.95	100%
	18,875			

Proposed Imperviousness

$$I = 68.7\%$$

$$\text{C10} = 0.66$$

$$\text{C100} = 0.71$$

B2 0.17 acres 7580

Proposed Composite Coefficients of Runoff

Cover type	Area (sf)	C5	C100	Imperviousness
Landscape	5,519	0.15	0.20	2%
Gravel Rd	0	0.80	0.85	80%
Roof	1,526	0.90	0.95	90%
Walks/Drives	535	0.90	0.95	100%
	7,580			

Proposed Imperviousness

$$I = 26.6\%$$

$$\text{C10} = 0.35$$

$$\text{C100} = 0.40$$

A1-B2

Imperviousness of redeveloped area - corresponding to H

Dev. Area-A1-B2 1.00 acres 43427**Proposed Composite Coefficients of Runoff**

Cover type	Area (sf)	C5	C100	Imperviousness
Landscape	27,047	0.15	0.20	2%
Gravel Rd	0	0.80	0.85	80%
Roof	3,583	0.90	0.95	90%
Walks/Drives	12,797	0.90	0.95	100%

43,427

Proposed Imperviousness

I= 38.1%

C10 = 0.43

C100 = 0.48

O1 + A1-B2 weighted imperviousness and runoff coefficients

Imperviousness

O1 2.83 5.2 14.7

A1-B2 1.00 38.1 38.1

3.83 52.8

Ave = $52.8/3.83 = 13.8$ %**C5**

O1 2.83 0.18 0.51

A1-B2 1.00 0.43 0.43

3.83 0.94

Ave = $0.94/3.83 = 0.25$ **C100**

O1 2.83 0.23 0.65

A1-B2 1.00 0.48 0.48

3.83 1.13

Ave = $1.13/3.83 = 0.30$

Calculation of Peak Runoff using Rational Method

Designer:	
Company:	
Date:	8/5/2019
Project:	Hotchkiss Office Buildings
Location:	

Version 2.00 released May 2017

Cells of this color are for required user-input

Cells of this color are for optional override values

Cells of this color are for calculated results based on overrides

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

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{\text{minimum}} = 5$ (urban)
 $t_{\text{minimum}} = 10$ (non-urban)

$$\text{Selected } t_c = \max\{t_{\text{minimum}}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website ([click this link](#)).

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.19	1.50	1.80	2.00	2.25	2.60	3.35

	a	b	c	$I(\text{in/hr}) = \frac{a \cdot P_1}{(b + t_c)^c}$
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786	

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time						Time of Concentration			Rainfall Intensity, I (in/hr)								Peak Flow, Q (cfs)							
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L _i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S _i (ft/ft)	Overland Flow Time t _i (min)	Channelized Flow Length L _i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S _i (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V _i (ft/sec)	Channelized Flow Time t _i (min)	Computed t _c (min)	Regional t _c (min)	Selected t _c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	
				0.05	0.06	0.13	0.30	0.38	0.47	0.57	50.00			0.080	6.67 5.72	160.00			0.019	20	2.76	0.97	7.64 6.69	26.38	10.00 6.69	3.22 3.71	4.06 4.68	4.87 5.61	5.41 6.24	6.09 7.02	7.03 8.11	9.06 10.45	0.35 0.40	0.55 2.15	1.37 1.58	3.61 4.16	5.03 5.80	7.20 4.62	11.29 13.01	
Site Historic	2.19	B	8.9																																					
Site Developed	2.19	B	18.4	0.12	0.14	0.21	0.36	0.43	0.51	0.60	30.00		0.140	3.99 3.39	170.00		0.028	20	3.35	0.85	4.84 4.24	24.33	10.00 5.00	3.22 4.04	4.06 5.09	4.87 6.11	5.41 6.78	6.09 7.63	7.03 8.82	9.06 11.36	0.81 1.02	1.21 3.12	2.19 2.75	4.32 5.42	5.74 7.20	7.88 6.37	11.98 15.01			
				0.28					0.33	9.12 7.77				370.00									0.035	7	1.31	4.71	13.83 12.48	28.50	13.83 12.48	2.81 3.70	3.54 4.44	4.24 4.94	4.71 5.55	5.30 6.42	6.13 8.27	7.90 9.14	9.06 1.18	10.45 0.20	11.36 0.27	13.27 0.43
O1	2.83	A	5.2	0.02	0.02	0.02	0.03	0.07	0.15	0.29	50.00		0.035	9.12 7.77	370.00		0.035	7	1.31	4.71	13.83 12.48	28.50	13.83 12.48	2.81 3.70	3.54 4.44	4.24 4.94	4.71 5.55	5.30 6.42	6.13 8.27	7.90 9.14	9.06 1.18	10.45 0.20	11.36 0.27	13.27 0.43	15.01 1.04	17.88 2.61	20.78 6.43			
H	1.00	B	17.3	0.11	0.13	0.20	0.36	0.42	0.51	0.60	50.00		0.080	6.25 5.27	130.00		0.015	20	2.45	0.88	7.14 6.16	24.61	10.00 6.16	3.22 3.81	4.06 4.80	4.87 5.76	5.41 6.40	6.09 7.20	7.03 8.32	9.06 10.72	0.35 0.41	0.52 1.34	0.96 1.13	1.94 2.29	2.58 3.06	3.56 2.74	5.43 6.42			
O1 + H	3.83		8.3		0.21				0.26						175.00			0.034	20	3.69	0.79		26.15	13.27	2.86	3.60	4.32	4.80	5.40	6.24	8.05		2.90			6.22				
A1	0.14	B	2.0	0.01	0.01	0.07	0.26	0.34	0.44	0.54	45.00		0.150	5.39 4.71	170.00		0.021	7	1.01	2.79	8.18 7.50	27.77	10.00 7.50	3.22 3.58	4.06 4.51	4.87 5.41	5.41 6.01	6.09 6.76	7.03 7.81	9.06 10.07	0.00 0.00	0.01 0.09	0.05 0.06	0.20 0.22	0.29 0.32	0.43 0.22	0.69 0.77			
O1 + A1	2.97		5.0		0.18				0.23						170.00		0.021	7	1.01	2.79		27.17	15.27	2.68	3.38	4.05	4.50	5.07	5.85	7.54		1.81			4.00					
A2	0.25	B	13.2	0.08	0.09	0.16	0.33	0.40	0.49	0.58	30.00		0.083	4.95 4.18	175.00		0.012	20	2.19	1.33	6.28 5.51	26.21	10.00 5.00	3.22 4.04	4.06 5.09	4.87 6.11	5.41 6.78	6.09 7.63	7.03 8.82	9.06 11.36	0.06 0.08	0.10 0.32	0.20 0.25	0.45 0.56	0.61 0.77	0.86 0.66	1.32 1.66			
O1 + A1 + A2	3.22		5.6		0.19				0.24						180.00		0.012	20	2.19	1.37		27.85	16.64	2.57	3.24	3.89	4.32	4.86	5.61	7.23		1.98			4.34					
B1																																								
B1	0.43	B	68.7	0.54	0.57	0.61	0.68	0.71	0.75	0.79	30.00		0.140	2.20 1.82	170.00		0.028	20	3.35	0.85	3.04 2.67	15.23	5.00	4.04	5.09	6.11	6.78	7.63	8.82	11.36	0.93	1.25 1.44	1.61	1.98	2.33	2.83 2.69	3.85			
B2	0.17	B	26.6	0.18	0.20	0.27	0.42	0.48	0.55	0.63																														
					0.35				0.40																															
A1-B2	1.00		38.1		0.43				0.48						175.00		0.012	20	2.19	1.33		21.38	8.83	3.38	4.26	5.11	5.67	6.38	7.38	9.50		1.83			3.54					
O1 + A1-B2	3.83		13.8		0.25				0.30																										6.45					

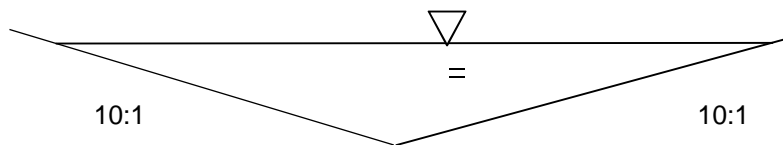
True West Co., LLC
Hotchkiss Commercial Offices
2290 Old Ranch Road

8/4/2019

Swale A1 - for Basins O1 + A1 flow - Grass-lined

Q100 = 4.18 cfs
S = 2.1 %
n = 0.035

$$Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$

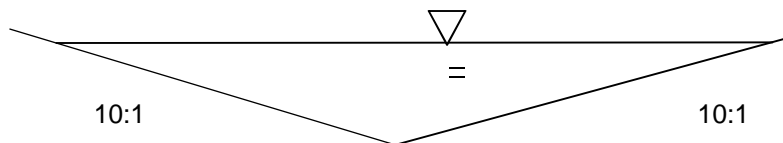


D =	N =	0.035	Q =	4.37 cfs	
0.44	A =	1.94 sf.	V =	2.3	fps
10	WP =	8.84 ft.			
10	S =	0.021 %			

Swale A2-for Basins O1 + A1 + A2 flow - Grass-lined

Q100 = 4.34 cfs
S = 1.2 %
n = 0.035

$$Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$



D =	N =	0.035	Q =	4.40 cfs	
0.49	A =	2.40 sf.	V =	1.8	fps
10	WP =	9.85 ft.			
10	S =	0.012 %			

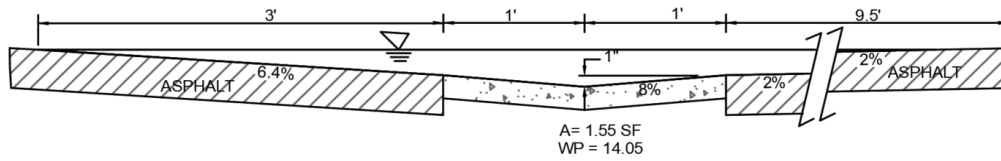
Swale B1 for Basin B1 - Concrete and Asphalt

$$Q_{100} = 2.69 \text{ cfs}$$

$$S = 0.7 \%$$

$$n = 0.017$$

$$Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$

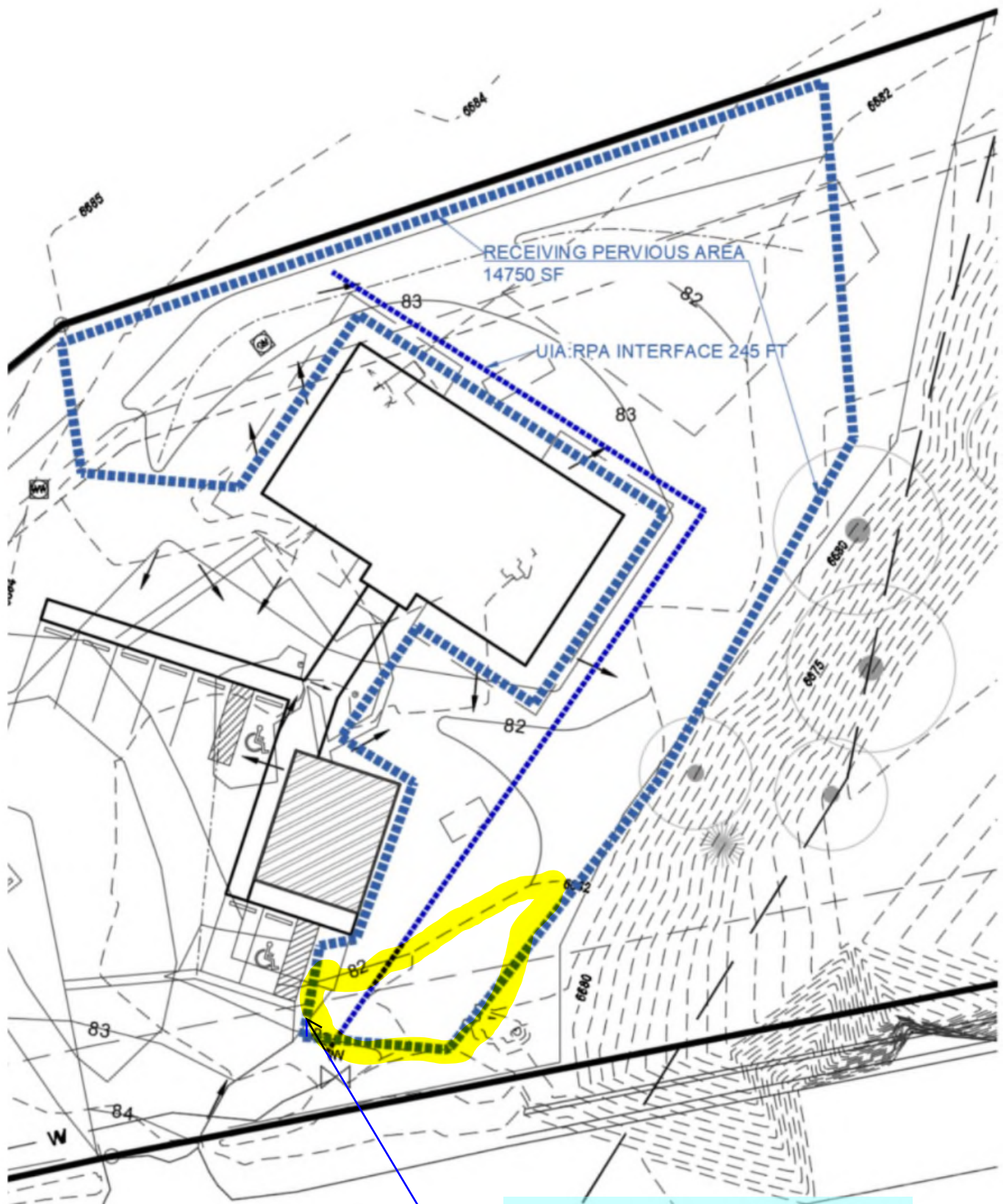


$D =$	$N =$	0.017	$Q =$	2.65 cfs
$0.27'$	$A =$	1.55 sf.	$V =$	1.7 fps
	$WP =$	14.05 ft.		
	$S =$	0.007%		

Riprap B1 Swale

With outlet velocity at only 1.7 fps for the 100-year storm,
only minimal riprap erosion protection is proposed.

Use 5' W x 5' long x 1.5' deep buried Type L riprap



The majority of your impervious area is from the paved parking area which will flow through a small concrete channel and outfall to a small receiving pervious area not the entire area that is shown in this drawing.

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Total Area (ft ²)	31,105
Total Impervious Area (ft ²)	16,355
WQCV (ft ³)	681
WQCV Reduction (ft ³)	681
WQCV Reduction (%)	100%
Untreated WQCV (ft ³)	0

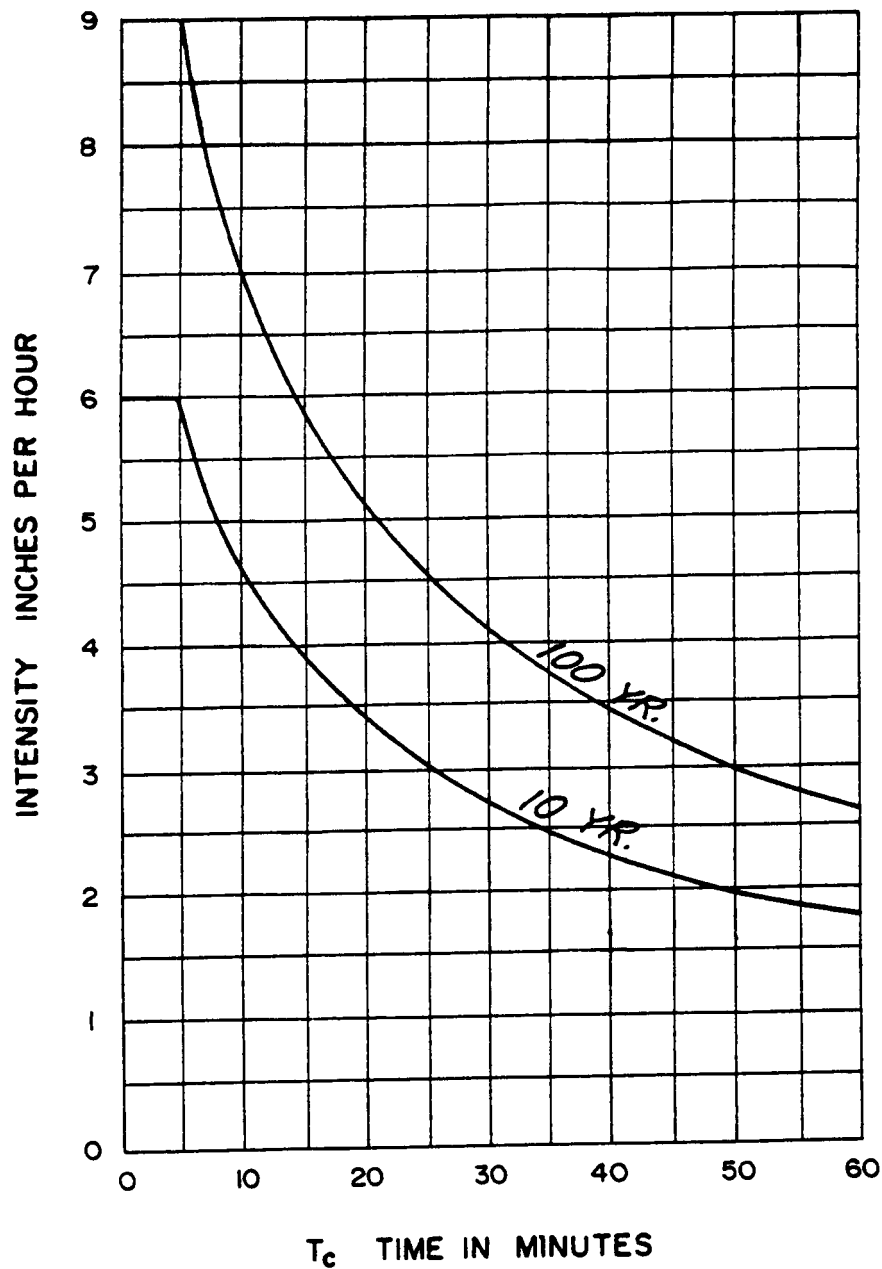
TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY			
		10		100	
		A&B*	C&D*	A&B*	C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45

* Hydrologic Soil Group

9/30/90



RE: Based upon Pikes Peak area council of governments/
areawide urban runoff control manual.



HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

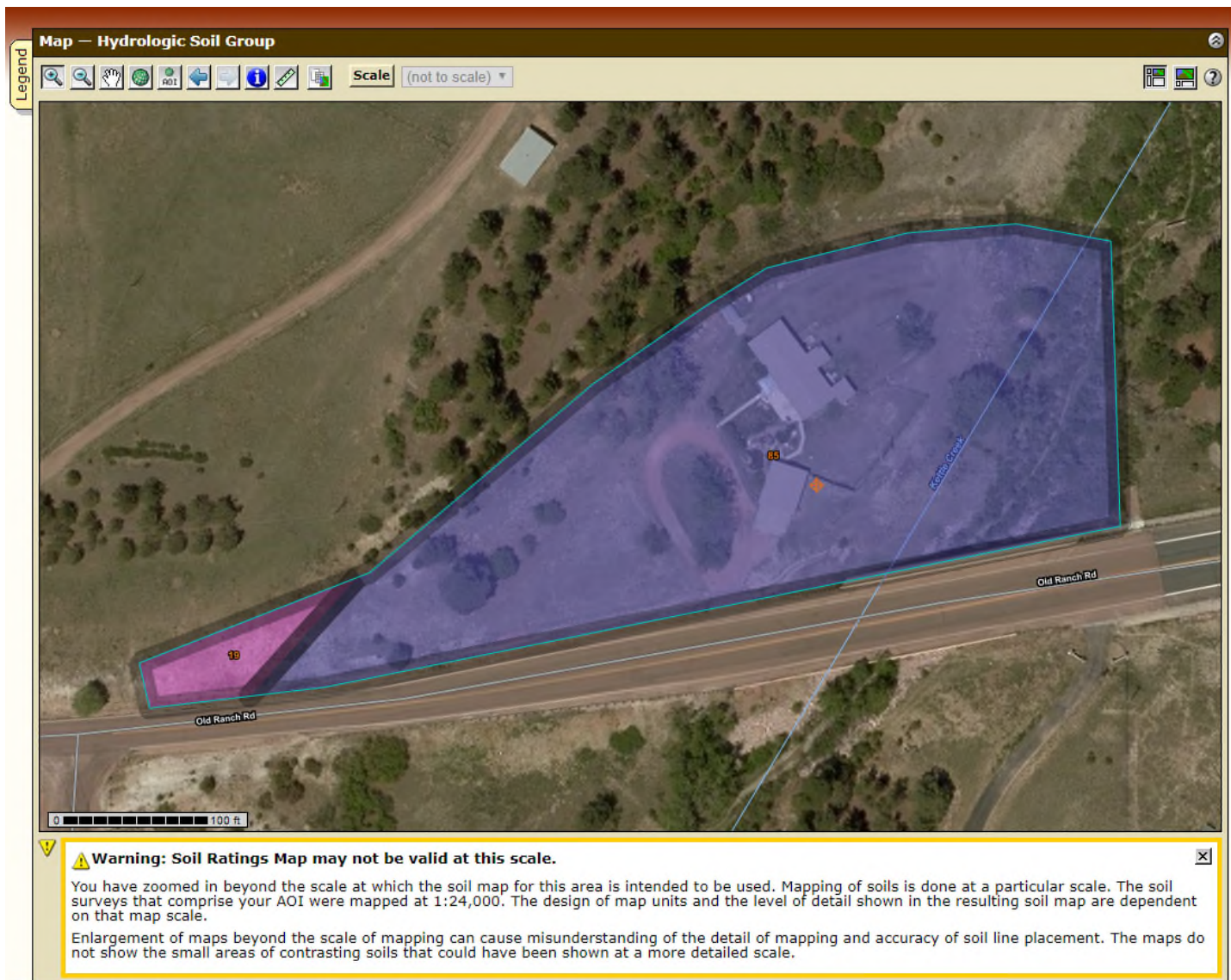
Storm Rainfall
Time Intensity-Frequency Curves

Date

OCT. 1987

Figure

5 - 1



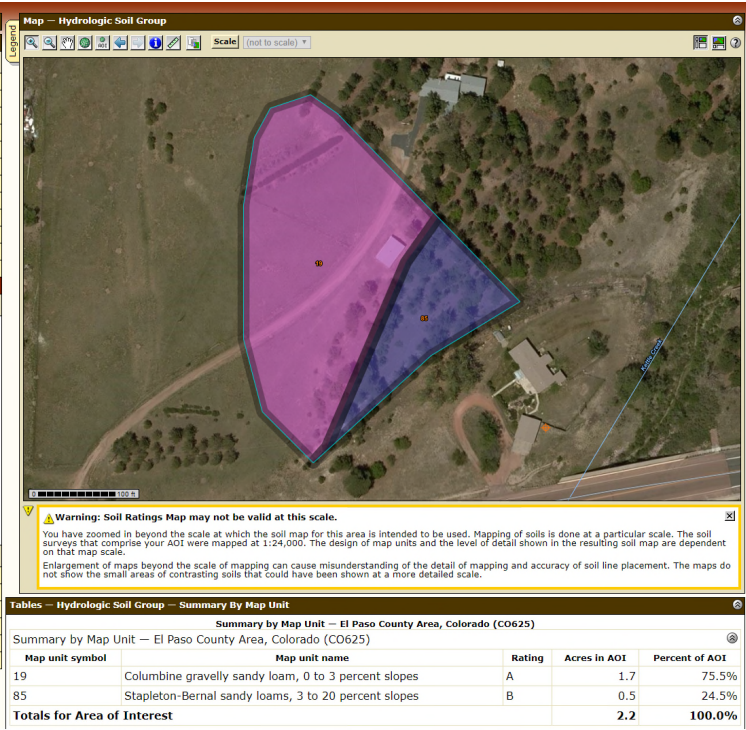
Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — El Paso County Area, Colorado (CO625)

Summary by Map Unit — El Paso County Area, Colorado (CO625)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	0.1	4.8%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	B	2.3	95.2%
Totals for Area of Interest			2.4	100.0%

Description — Hydrologic Soil Group





United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

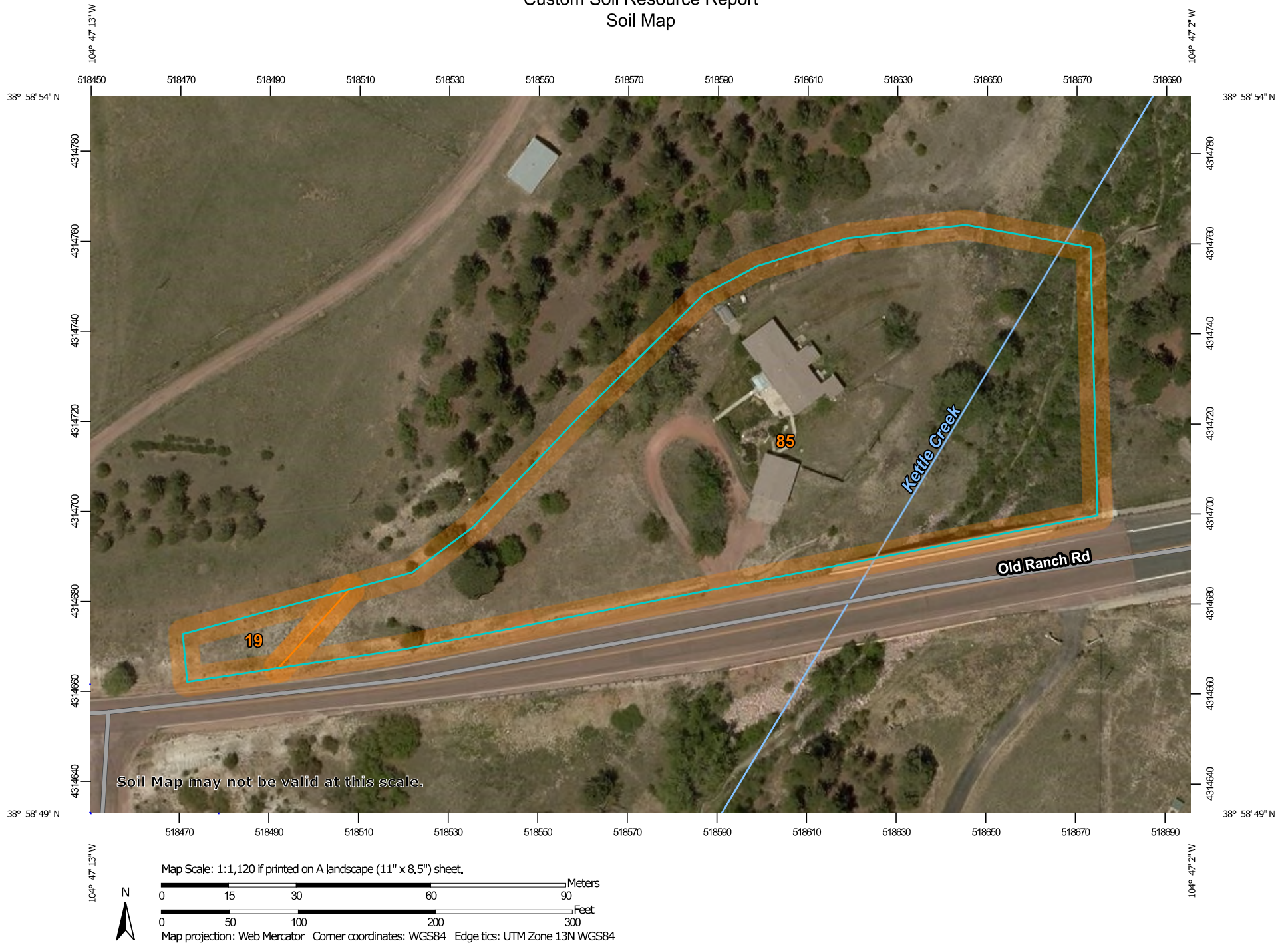
A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **El Paso County Area, Colorado**



July 20, 2019

Custom Soil Resource Report Soil Map



Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	0.1	3.9%
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	2.2	96.1%
Totals for Area of Interest		2.3	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,

El Paso County Area, Colorado

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Columbine

Setting

Landform: Flood plains, fan terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
→ *Hydrologic Soil Group:* A
Ecological site: Gravelly Foothill (R049BY214CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquolls

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

Pleasant

Percent of map unit:

Landform: Depressions

Hydric soil rating: Yes

Other soils

Percent of map unit:

Hydric soil rating: No

85—Stapleton-Bernal sandy loams, 3 to 20 percent slopes

Map Unit Setting

National map unit symbol: 36b1

Elevation: 6,500 to 6,800 feet

Mean annual precipitation: 14 to 16 inches

Mean annual air temperature: 46 to 48 degrees F

Frost-free period: 125 to 145 days

Farmland classification: Not prime farmland

Map Unit Composition

Stapleton and similar soils: 40 percent

Bernal and similar soils: 30 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stapleton

Setting

Landform: Hills

Landform position (three-dimensional): Crest, side slope

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 11 inches: sandy loam

Bw - 11 to 17 inches: gravelly sandy loam

C - 17 to 60 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 15 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 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

→ *Hydrologic Soil Group: B*
Ecological site: Gravelly Foothill (R049BY214CO)
Hydric soil rating: No

Description of Bernal

Setting

Landform: Hills
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone

Typical profile

A - 0 to 4 inches: sandy loam
Bt - 4 to 11 inches: sandy clay loam
C - 11 to 13 inches: sandy loam
R - 13 to 17 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 20 percent
Depth to restrictive feature: 8 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 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 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e

→ *Hydrologic Soil Group: D*
Ecological site: Shallow Foothill (R049BY204CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

LOTS 8, BLOCK E, AMENDED FILING OF SPRINGS CREST SUBDIVISION
NW 1/4, SEC. 28, T.12 S., R. 66 W OF THE 6TH P.M.
COUNTY OF EL PASO, STATE OF COLORADO

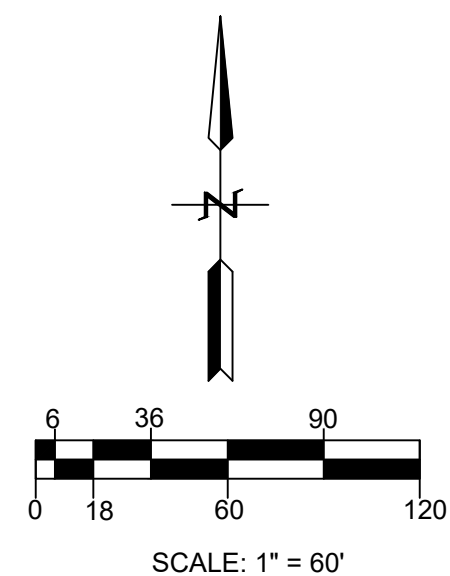
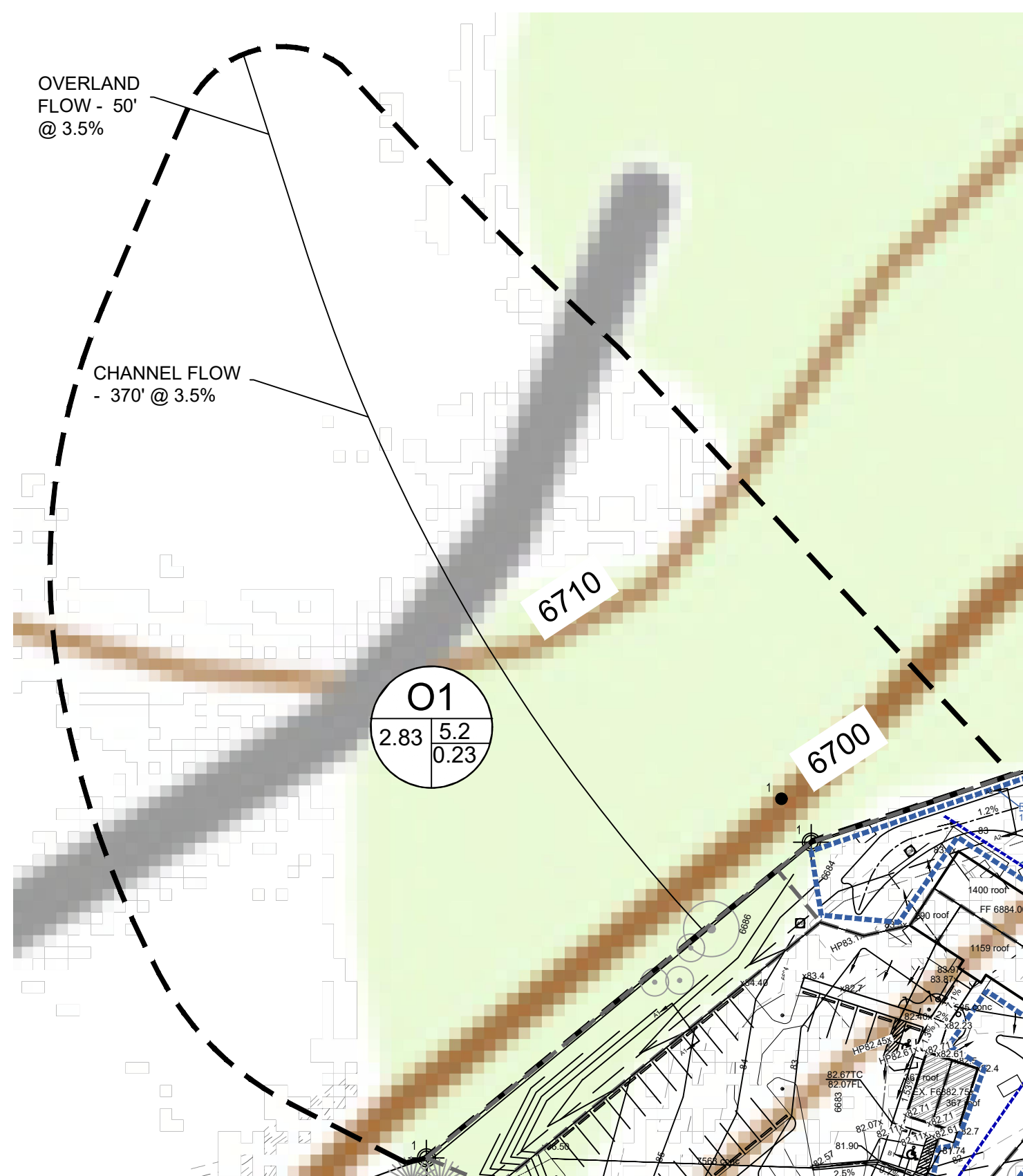
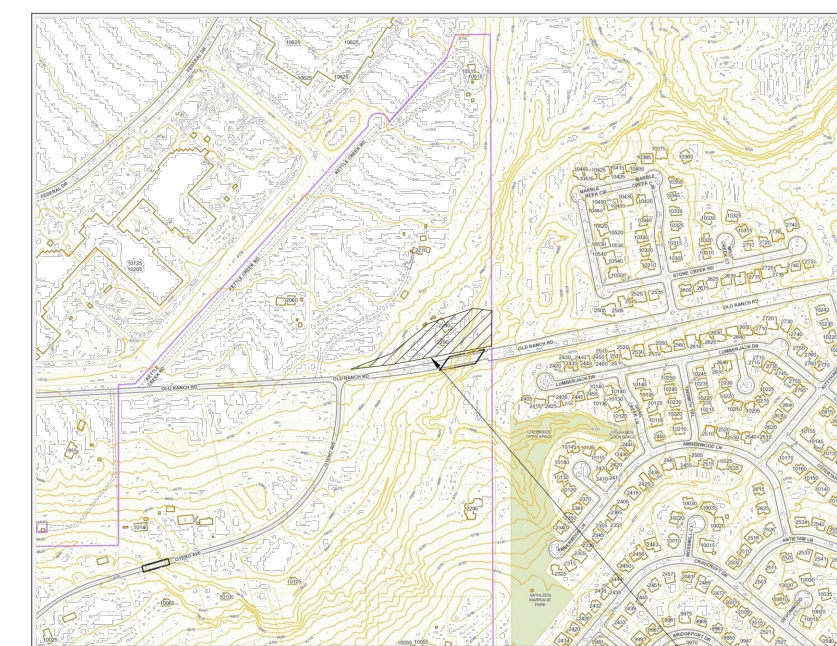


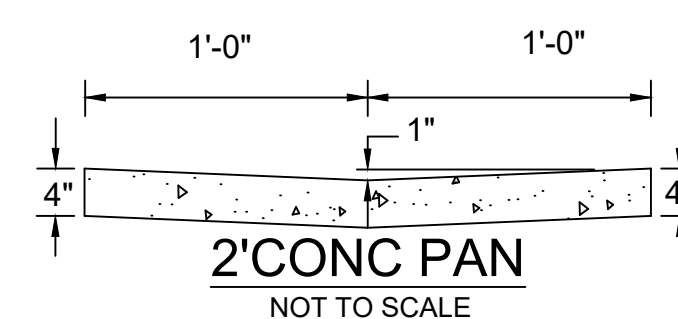
Diagram illustrating the parameters for a basin (A1) and its associated flow characteristics:

- Basin Designation:** A1
- Area in Acres:** 0.14
- Imperviousness:** 2.0
- 100-Year Runoff Coefficient:** 0.20
- Directional Flow Arrow:** Indicated by a thick black arrow pointing left.
- Proposed Contour:** 83
- Proposed Spot Elevation:** x85.3
- Zone AE Floodplain Limits:** Kettle Creek - F.I.R.M. No. 08041C0506G, Dec. 7, 2018



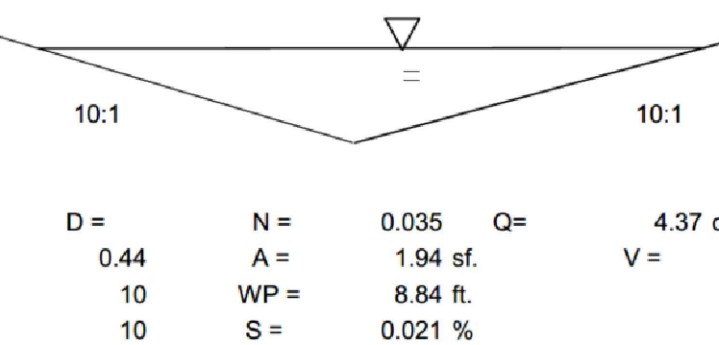
RUNOFF SUMMARY

DES. PT.	BASIN	AREA (AC.)	5-YR FLOW (cfs)	100-YR FLOW (cfs)
1	O1	2.83	1.89	4.18
	A1	0.14	0.09	0.22
2	O1 + A1	2.97	1.89	4.18
	A2	0.25	0.32	0.66
3	O1 + A1 + A2	3.22	1.98	4.34
4	B1	0.43	1.44	2.69
5	B2	0.17	0.30	0.60
	H	1.00	1.34	2.74
	O1 + H	3.83	2.90	6.22
	A1 - B2	1.00	1.83	3.54
	O1 + A1 - B2	3.83	3.10	6.45



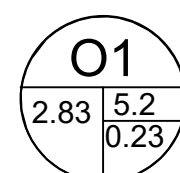
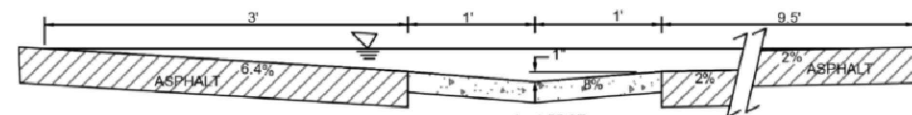
Swale A1 - for Basins O1 + A1 flow - Grass-lined

$$Q_{100} = 4.18 \text{ cfs}$$
$$S = 2.1 \%$$
$$n = 0.035$$
$$Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$



Swale B1 for Basin B1 - Concrete and Asphalt

$$Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$

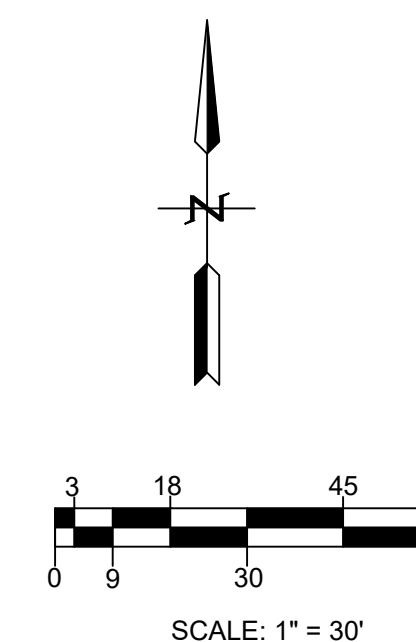
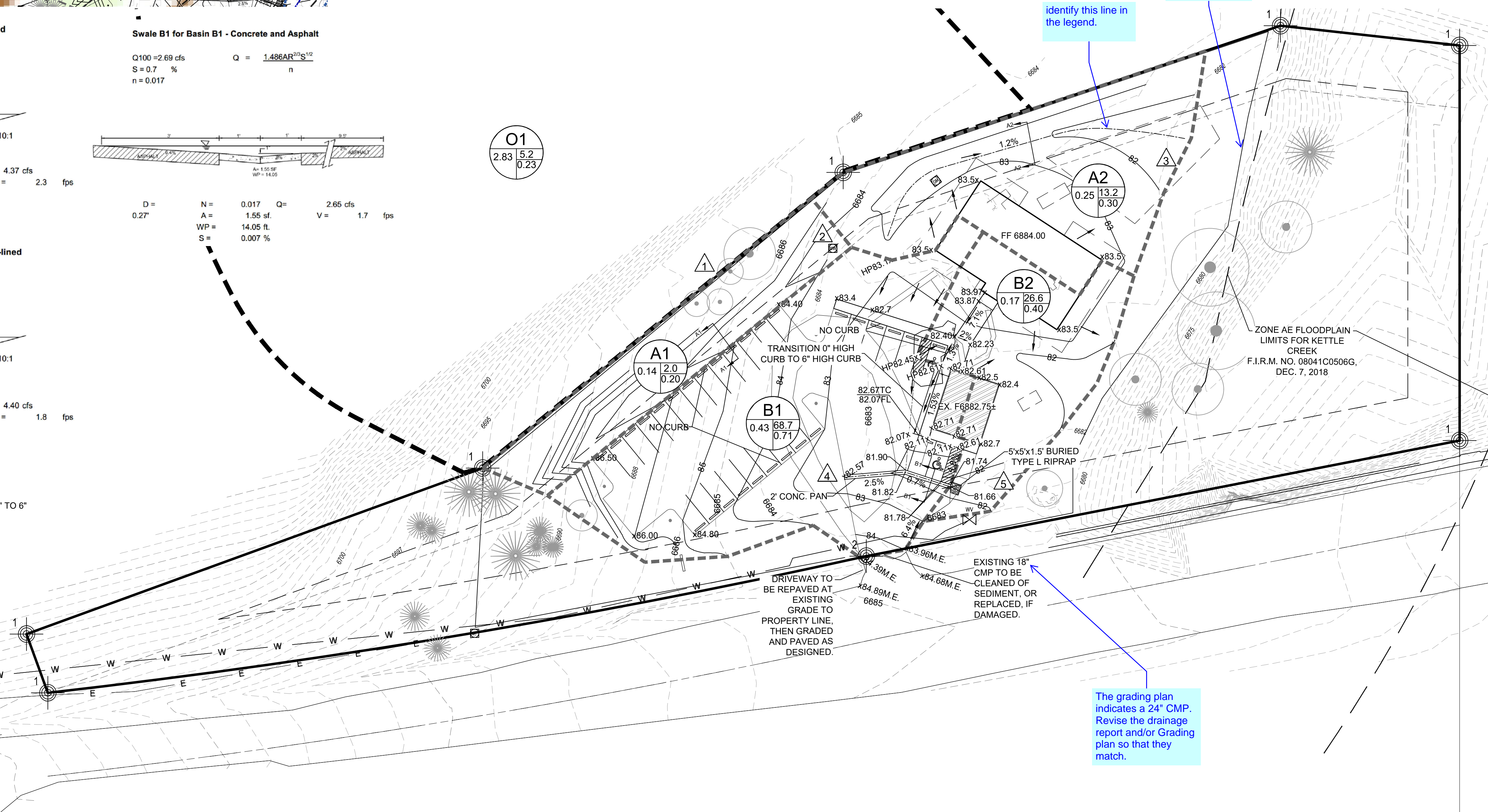
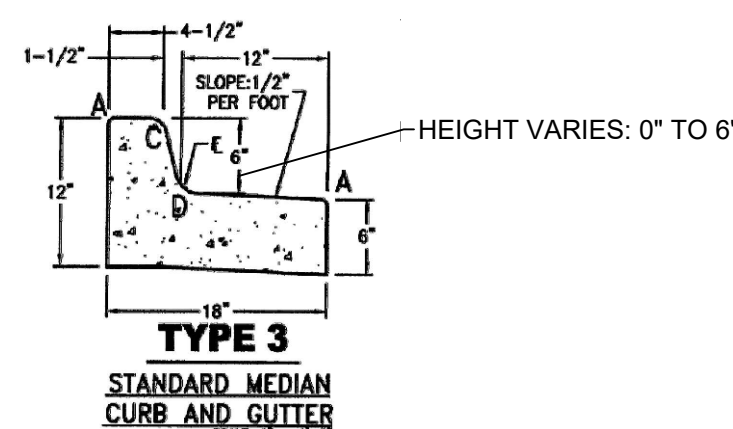
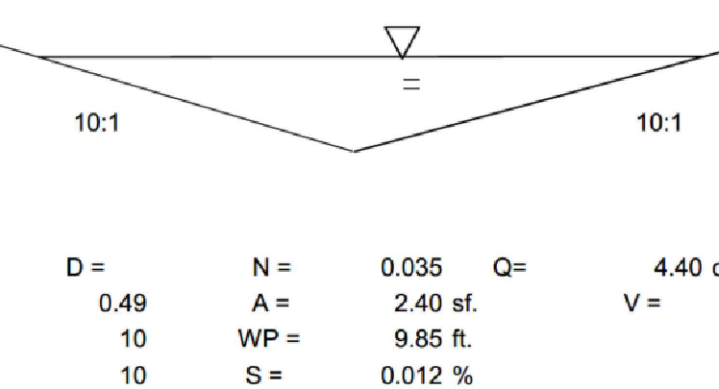


Swale A2-for Basins O1 + A1 + A2 flow - Grass-lined

$$Q_{100} = 4.34 \text{ cfs} \quad Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$

$$S = 1.2 \quad \%$$

$$n = 0.035$$



BEFORE YOU DIG
CALL UTILITY NOTIFICATION
CENTER OF COLORADO
811

REVISIONS

1

PREPARED BY:

FINAL DRAINAGE PLAN
HOTCHKISS COMMERCIAL OFFICES
2290 OLD RANCH ROAD

NOTES:

ENGINEERS SEAL

DESIGNED BY: CLF

DRAWN BY: CL

CHECKED BY: CL

DRAWER NUMBER

DATE: 8/5/2

SCALE: AS NO

SHEET NUMBER:
1