

Architectural  
Structural  
Geotechnical



Materials Testing  
Forensic  
Civil/Planning

## FINAL DRAINAGE REPORT

Gunners Ridge Minor Subdivision  
12172 Goodson Rd  
El Paso County, Colorado

### PREPARED FOR:

Drew Makings  
9630 Arroya Lane  
Colorado Springs, CO 80908

JOB NO. 192027

PCD File No. MS-23-003

June 7, 2023  
June 28, 2023

SIGNATURE PAGE

ENGINEER'S STATEMENT

This report and plan for the drainage design of Gunners Ridge Minor Subdivision was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the El Paso County Drainage Criteria Manuals Volumes 1 and 2 and is in conformity with the master plan of the drainage basin. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in the preparing this report.

Respectfully Submitted,

RMG – Rocky Mountain Group



David Walker, P.E.  
Sr. Civil Project Manager

**DEVELOPER'S STATEMENT**

Drew Makings hereby certifies that the drainage facilities for Gunners Ridge Minor Subdivision shall be constructed according to the design presented in this report. I understand that El Paso County does not and will not assume liability for drainage facilities designed and/or certified by my engineer and that are submitted to El Paso County; and cannot, on behalf of Gunners Ridge Minor Subdivision, guarantee that final drainage design review will absolve Drew Makings and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Drew Makings  
Name of Developer

*Drew Makings* 6/28/23  
Authorized Signature Date

Drew Makings  
Printed Name

Owner 719-482-6050  
Title Phone

9630 Arroya, Lane, Colorado Springs, CO 80908  
Address

**EL PASO COUNTY STATEMENT**

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

\_\_\_\_\_  
Joshua Palmer, P.E. Date  
County Engineer / ECM Administrator

Conditions:

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## I. PURPOSE

This report is a Final Drainage Report for Gunners Ridge Minor Subdivision for the development of single-family residences.

The purpose of this report is to identify on-site and off-site drainage patterns, assess stormwater conditions per delineated basin and sub-basins, demonstrate adequate design standards for storm water flow and release into the existing storm water system or right-of-way, and provide a narrative for any other drainage considerations related to the development of this parcel.

## II. GENERAL LOCATION AND DESCRIPTION

### A. LOCATION

The proposed development of Gunners Ridge Minor Subdivision is located at the address of 12172 Goodson Rd in El Paso County, Colorado. The parcel schedule number is 5214000014 and the legal description is currently a portion of special warranty deed recorded at reception no. 219050325 of the El Paso County Clerk and Recorder Office. The parcel is located in a portion of the Northeast Quarter of Section 14, Township 12 South, Range 65 West of the 6th Principal Meridian, County of El Paso, State of Colorado. The names and descriptions of surrounding platted developments can be seen on plan sets and appendix documents:

### B. DESCRIPTION OF PROPERTY – EXISTING CONDITIONS

The project site is approximately 1,691,363 square feet (38.83 acres) and consists of undeveloped natural vegetation.

The existing percent imperviousness is approximately 0 percent on Gunners Ridge Minor Subdivision. The vegetation is grassy with shrub brush and a mix of evergreen trees

The existing topography consists of grades between 2.0 and 10.0 percent. Drainage patterns show the southern portion of the site slopes toward Goodson Road and the northern portion of the site slopes to the northeast. The roadside drainage flows toward the north along Goodson Road.

This site is not located within a streamside zone.

### C. EXISTING SOILS

The soils indicative to the site are classified as Kettle gravelly loamy sand by the USDA Soil Conservation Service and are listed as NRCS (National Resources Conservation Service) Hydrologic Soil Group B. Group B soils have a moderate infiltration rate when thoroughly wet. These consist chiefly of deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission. The USDA Soil Map is provided in the Appendix.

#### D. EXISTING DRAINAGE

According to the “Final Drainage Report for Seclusion”, by Classic Consulting Engineers & Surveyors LLC dated June 2007.

“Off/on-site “P” discharges from the site in an existing 36” diameter galvanized corrugated metal culvert under Goodson Road. On-site “N” discharges from the site in an existing 18” diameter galvanized corrugated metal culver under Goodson Road. On-site “M” discharges from the site in an existing 30” diameter galvanized corrugated metal culvert under Goodson Road at the northeast corner of Basin M, near the access road for the electric substation.“

The parcel is located in the El Paso County Upper Black Squirrel (CHBS 2000) drainage basin.

There are no known off-site flows that discharges on to the property. The runoff ultimately outfalls downstream into the Black Squirrel Creek. Site runoff will not adversely affect the downstream and surrounding developments.

The project site does not lie within a designated flood plain according to information published in the Federal Emergency Management Agency Floodplain Map No. 08041C0320G, dated December 7, 2018. The FEMA Floodplain map is provided in the Appendix showing it lies within Zone X, a minimal flood hazard area.

There are no known non-stormwater discharges that contribute to the storm water systems on site and downstream, both private and public.

#### E. DESCRIPTION OF PROPERTY – PROPOSED CONDITIONS

The proposed development consists of four lots with single-family residences.

There is one existing vehicle entry access point to the property. Lot #1 will have a driveway off Goodson Road from the existing access point. Lots #2, #3 and #4 will share a common driveway off Goodson Road from a new access point. There will be no public improvements.

The proposed development will require an approximate limits of disturbance of approximately 29,086 square feet or 0.67 acres which is 1.72 percent of the property. The limits of disturbance do not disturb the existing hillsides. The grading limits are kept within the setbacks wherever possible and the developed conditions remain consistent with the historical drainage pattern of the subdivision. A sub-basin delineation sheet for the proposed conditions is provided in the Appendix.

Water quality is not needed for this site per ECM I.7.1.B.5., since there is no roadway being proposed and the only disturbance on the site will be for the driveways.

### III. DRAINAGE BASINS AND SUB-BASINS

#### A. EXISTING MAJOR DRAINAGE BASIN AND SUB-BASINS

The parcel is delineated into sub-basins according to the existing and proposed grading for existing and developed conditions. A drainage plan of the delineated basins for existing conditions can be found in the Appendix.

Basin E is the entirety of the parcel to be redeveloped representing existing conditions in four on-site basins. The Final Drainage Report for Seclusion, by Classic Consulting Engineers & Surveyors LLC dated June 2007 shows this property as portions of sub-basins P, N, and M.

Sub-basin E-1 (14.33 ac.; Q10 = 6.13 cfs, Q100 = 20.58 cfs) is the southerly portion of the property that consists of all natural vegetation. The basin flows east across the property to an existing 36" diameter galvanized corrugated metal culvert under Goodson Road, also known as Existing Point 1 (EP1). The flow travels north in the ROW ditch along Goodson Road. The Final Drainage Report for Seclusion, by Classic Consulting Engineers & Surveyors LLC dated June 2007 shows this as part of sub-basin P.

Sub-basin E-2 (7.47 ac.; Q10 = 3.20 cfs, Q100 = 10.73 cfs) is the easterly portion of the property that consists of natural vegetation. The basin flows east across the property to an existing 18" diameter galvanized corrugated metal culvert under Goodson Road, also known as Existing Point 2 (EP2). The flow travels north in the ROW ditch along Goodson Road. The Final Drainage Report for Seclusion, by Classic Consulting Engineers & Surveyors LLC dated June 2007 shows this as part of sub-basin N.

Sub-basin E-3 (15.31 ac.; Q10 = 6.55 cfs, Q100 = 22.00 cfs) is the northerly portion of the property that consists of natural vegetation. The basin flows east across the property and outlets into the Goodson Road ROW, also known as Existing Point 3 (EP3). The flow travels north in the ROW ditch along Goodson Road and ultimately goes to an existing 30" diameter galvanized corrugated metal culvert under the access road for the electric substation and then to an existing 30" diameter galvanized corrugated metal culvert under Goodson Road. The Final Drainage Report for Seclusion, by Classic Consulting Engineers & Surveyors LLC dated June 2007 shows this as part of sub-basin M.

Sub-basin E-4 (1.72 ac.; Q10 = 0.73 cfs, Q100 = 2.47 cfs) is the northwest corner of the property that consists of natural vegetation. The basin flows north across the property to exit the site, also known as Existing Point 4 (EP4). The flow travels northeast to the ROW ditch and ultimately goes to an existing 30" diameter galvanized corrugated metal culvert under the access road for the electric substation and then to an existing 30" diameter galvanized corrugated metal culvert under Goodson Road. The Final Drainage Report for Seclusion, by Classic Consulting Engineers & Surveyors LLC dated June 2007 shows this as part of sub-basin M.

Existing Point 1 (EP1) is the existing design point representing the existing 36" diameter galvanized corrugated metal culvert under Goodson Road. The Final Drainage Report for Seclusion, by Classic Consulting Engineers & Surveyors LLC dated June 2007 shows this as design point E-16.

Existing Point 2 (EP2) is the existing design point representing the existing 18" diameter galvanized corrugated metal culvert under Goodson Road. The Final Drainage Report for Seclusion, by Classic Consulting Engineers & Surveyors LLC dated June 2007 shows this as design point E-15.

Existing Point 3 (EP3) is the existing design point representing the location that flows exit the site into the Goodson Road ROW ditch.

Existing Point 4 (EP4) is the existing design point representing the location that flows exit the site at the northwest corner.

#### A. DEVELOPED MAJOR DRAINAGE BASIN AND SUB-BASINS

Basin D is the entirety of the platted parcel representing developed conditions and consists of several sub-basins. A Drainage Plan for developed conditions can be found in the Appendix.

Sub-basin D-1 (14.33 ac.;  $Q_{10} = 6.13$  cfs,  $Q_{100} = 20.58$  cfs) is the southerly portion of the property that consists of a single-family residence on lot #1 with a private driveway. The basin flows east across the property to an existing 36" diameter galvanized corrugated metal culvert under Goodson Road, also known as Design Point 1 (DP1).

Sub-basin D-2 (4.97 ac.;  $Q_{10} = 2.72$  cfs,  $Q_{100} = 8.23$  cfs) is the easterly portion of the property that includes lot #1 and consists of natural vegetation and half of the initial portion of the shared driveway to lots #2, #3, and #4. The basin flows east across the property to a proposed 18" diameter galvanized corrugated metal culvert at the driveway entrance, also known as Design Point 2 (DP2), to allow flow to keep its natural path flowing north in the ROW ditch.

Sub-basin D-3 (15.31 ac.;  $Q_{10} = 6.82$  cfs,  $Q_{100} = 21.57$  cfs) is the northerly portion of the property that consists of three single-family residences on lots #2, #3, and #4 with part of the shared driveway. The basin flows east across the property and outlets into the Goodson Road ROW, also known as Design Point 3 (DP3). The flow travels north in the ROW ditch along Goodson Road and ultimately goes to an existing 30" diameter galvanized corrugated metal culvert under the access road for the electric substation and then to an existing 30" diameter galvanized corrugated metal culvert under Goodson Road.

Sub-basin D-4 (1.72 ac.;  $Q_{10} = 0.85$  cfs,  $Q_{100} = 2.85$  cfs) is the northwest corner of the property that consists of natural vegetation. The basin flows north across the property to exit the site, also known as Design Point 4 (DP4). The flow travels northeast to the ROW ditch and ultimately goes to an existing 30" diameter galvanized corrugated metal culvert under the access road for the electric substation and then to an existing 30" diameter galvanized corrugated metal culvert under Goodson Road.

Sub-basin D-5 (2.50 ac.;  $Q_{10} = 1.71$  cfs,  $Q_{100} = 4.74$  cfs) is the easterly portion of the property that includes lot #2 and consists of natural vegetation and half of the initial portion of the shared driveway to lots #2, #3, and #4. The basin flows east across the property to an existing 18" diameter



galvanized corrugated metal culvert under Goodson Road, also known as Design Point 5 (DP5). The flow travels north in the ROW ditch along Goodson Road.

Design Point 1 (DP1) is the existing design point representing the existing 36” diameter galvanized corrugated metal culvert under Goodson Road.

Design Point 2 (DP2) is the existing design point representing the proposed 18” diameter galvanized corrugated metal culvert under the proposed driveway entrance.

Design Point 3 (DP3) is the existing design point representing the location that flows exit the site into the Goodson Road ROW ditch.

Design Point 4 (DP4) is the existing design point representing the location that flows exit the site at the northwest corner.

Design Point 5 (DP5) is the existing design point representing the existing 18” diameter galvanized corrugated metal culvert under Goodson Road.

## IV. DRAINAGE DESIGN CRITERIA

### A. REGULATIONS

The hydrologic and hydraulic calculations and design of the site conform to the El Paso County Drainage Criteria Manuals I and II (October 2018), City of Colorado Springs Drainage Criteria Manuals I and II (May 2014), as well as the Mile High Flood District Drainage Criteria Manual (August 2018).

### B. DEVELOPMENT CRITERIA REFERENCE AND CONSTRAINTS

The parcel falls within the Upper Black Squirrel (CHBS 2000) drainage basin. The runoff from this parcel will have no adverse effects on downstream infrastructure or facilities, streets, utilities, transit, or further development of adjacent lots. Relevant criteria for the calculations shown further include equations and design criteria for the rational method, volumes and runoff of various storms.

### C. HYDROLOGICAL CRITERIA

The rational method was used to calculate the peak runoff of the delineated basin and sub-basins using the manuals referenced prior with the C, I and PI values from the Drainage Criteria Manual Volume I, Chapter 6 as well as the Colorado Springs designated IDF curve values. Specific calculations and tables are provided further with inputs including design rainfall, sub-basin acreage and percent imperviousness, runoff coefficients, one-hour rainfall depths, rainfall intensities, time of concentration, and peak discharge of various storm events. Weighted runoff coefficients were calculated for each basin and sub-basin due to the mix of impervious surfaces.

#### D. FOUR-STEP PROCESS

The selection of appropriate control measures is based on the characteristics of the site and potential pollutants. The Four-Step Process provides a method of going through the selection process. The proposed development has an approximate limit of disturbance of 29,086 square feet (0.67 acres), which is less than 1 acre, therefore the Four-Step Process is not required.

### V. DRAINAGE INFRASTRUCTURE COSTS AND FEES

#### A. DRAINAGE AND BRIDGE FEES

The development falls within the Upper Black Squirrel (CHBS 2000) drainage basin which has a drainage basin fee of \$0/acre and a bridge fee of \$0/acre according to the El Paso County Drainage Basin 2023 fee schedule.

Any outstanding fees must be paid prior to new plat recordation.

### VI. CONCLUSIONS

#### A. COMPLIANCE WITH STANDARDS

This Final Drainage Report is in conformance with the El Paso County Drainage Criteria Manual, Volumes 1 & 2, Colorado Springs Drainage Criteria Manual, Volumes 1 & 2, as well as the Mile High Flood District Drainage Criteria Manual. Grading practices for optimal drainage comply with the geotechnical investigative report and County standards. The development of Gunners Ridge Minor Subdivision is within compliance and standards and meets the requirements for the drainage design.

The overall change from the existing conditions to the developed conditions was an increase in the 10-year runoff by 1.62 cfs and an increase in the 100-year runoff by 2.19 cfs, which is negligible. There will be no improvements needed to the existing ROW ditch.

The proposed grading and drainage is within substantial conformance for the master drainage plan for the Subdivision and Drainage Basin. There is no impact on major drainage way planning studies within the larger drainage basin. Site runoff and storm drain appurtenances will not adversely affect the downstream and surrounding developments.

## VII. REFERENCES

Colorado Springs Drainage Manual Volumes I & II (May 2014, Rev. January 2021)

El Paso County Drainage Criteria Manual Volumes I & II (October 2018)

Colorado Urban Drainage and Flood Control District Drainage Criteria Manual, Volume I  
(January 2016)

Colorado Urban Drainage and Flood Control District Drainage Criteria Manual, Volume III  
(April 2018)

Urban Storm Drainage Criteria Manual, Volume III (November, 2015)

FEMA Flood Map Service Center

United States Department of Agriculture National Resources Conservation Service

Final Drainage Report for Seclusion, dated June 2007, prepared by Classic Consulting Engineers  
& Surveyors LLC

## VIII. APPENDICES

## **Appendix A – Vicinity Map**

## Vicinity Map



## **Appendix B – Hydrologic and Hydraulic Computations**

Project Number: 192027 - Gunners Ridge Subdivision - Existing Conditions  
 Engineer: TPE  
 Date: 5/10/2023  
 Address: 12172 Goodson Rd

Sub-Basin % Duration:	1-1 10.71	[DF Curve Equations from Figure B-3 of the DCM Volume 1]				
	$t_2$	$t_3$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$
	1.958193	2.445428	2.853167	3.269905	3.666643	4.103880

Hydrologic Soil Type: B

Coefficient (Table G-6)																				
Land Use or Surface Characteristic	SQUARE FEET	ACREAGE	Coefficient <sub>1</sub>	Coefficient <sub>2</sub>	Coefficient <sub>3</sub>	Coefficient <sub>4</sub>	Coefficient <sub>5</sub>	Coefficient <sub>6</sub>	2 Yr. C <sub>1</sub> -A	5 Yr. C <sub>1</sub> -A	10 Yr. C <sub>1</sub> -A	25 Yr. C <sub>1</sub> -A	50 Yr. C <sub>1</sub> -A	100 Yr. C <sub>1</sub> -A	2 Yr. C <sub>2</sub>	5 Yr. C <sub>2</sub>	10 Yr. C <sub>2</sub>	25 Yr. C <sub>2</sub>	50 Yr. C <sub>2</sub>	100 Yr. C <sub>2</sub>
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.080	0.150	0.250	0.300	0.350
Pavement	0	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.250	0.300	0.350
Lawn	624133	14.33	0.02	0.08	0.15	0.25	0.30	0.35	0.287	1.146	2.149	3.582	4.298	5.615						
<b>A<sub>1</sub>:</b>	<b>624133</b>	<b>14.33</b>																		

Q Peak Flow (cfs)						
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q	
0.56	2.80	4.23	11.68	15.77	211.58	

Sub-Basin % Duration:	1-2 11.92	[DF Curve Equations from Figure B-3 of the DCM Volume 1]				
	$t_2$	$t_3$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$
	2.073301	2.589261	3.020971	3.452682	3.984392	4.345519

Hydrologic Soil Type: B

Coefficient (Table G-6)																				
Land Use or Surface Characteristic	SQUARE FEET	ACREAGE	Coefficient <sub>1</sub>	Coefficient <sub>2</sub>	Coefficient <sub>3</sub>	Coefficient <sub>4</sub>	Coefficient <sub>5</sub>	Coefficient <sub>6</sub>	2 Yr. C <sub>1</sub> -A	5 Yr. C <sub>1</sub> -A	10 Yr. C <sub>1</sub> -A	25 Yr. C <sub>1</sub> -A	50 Yr. C <sub>1</sub> -A	100 Yr. C <sub>1</sub> -A	2 Yr. C <sub>2</sub>	5 Yr. C <sub>2</sub>	10 Yr. C <sub>2</sub>	25 Yr. C <sub>2</sub>	50 Yr. C <sub>2</sub>	100 Yr. C <sub>2</sub>
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.080	0.150	0.250	0.300	0.350
Pavement	0	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.250	0.300	0.350
Lawn	325344	7.47	0.02	0.08	0.15	0.25	0.30	0.35	0.149	0.598	1.120	1.867	2.241	2.614						
<b>A<sub>1</sub>:</b>	<b>325344</b>	<b>7.47</b>																		

Q Peak Flow (cfs)						
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q	
0.29	3.46	5.20	8.09	8.32	111.73	

Sub-Basin % Duration:	1-3 13.87	[DF Curve Equations from Figure B-3 of the DCM Volume 1]				
	$t_2$	$t_3$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$
	1.849679	2.307378	2.692127	3.076837	3.461567	3.871955

Hydrologic Soil Type: B

Coefficient (Table G-6)																				
Land Use or Surface Characteristic	SQUARE FEET	ACREAGE	Coefficient <sub>1</sub>	Coefficient <sub>2</sub>	Coefficient <sub>3</sub>	Coefficient <sub>4</sub>	Coefficient <sub>5</sub>	Coefficient <sub>6</sub>	2 Yr. C <sub>1</sub> -A	5 Yr. C <sub>1</sub> -A	10 Yr. C <sub>1</sub> -A	25 Yr. C <sub>1</sub> -A	50 Yr. C <sub>1</sub> -A	100 Yr. C <sub>1</sub> -A	2 Yr. C <sub>2</sub>	5 Yr. C <sub>2</sub>	10 Yr. C <sub>2</sub>	25 Yr. C <sub>2</sub>	50 Yr. C <sub>2</sub>	100 Yr. C <sub>2</sub>
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.080	0.150	0.250	0.300	0.350
Pavement	0	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.250	0.300	0.350
Lawn	667120	15.31	0.02	0.08	0.15	0.25	0.30	0.35	0.306	1.225	2.297	3.829	4.594	5.360						
<b>A<sub>1</sub>:</b>	<b>667120</b>	<b>15.31</b>																		

Q Peak Flow (cfs)						
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q	
0.60	3.00	4.53	12.49	16.86	73.88	

Sub-Basin % Duration:	1-4 15.78	[DF Curve Equations from Figure B-3 of the DCM Volume 1]				
	$t_2$	$t_3$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$
	2.263805	2.829399	3.301125	3.772857	4.244589	4.748940

Hydrologic Soil Type: B

Coefficient (Table G-6)																				
Land Use or Surface Characteristic	SQUARE FEET	ACREAGE	Coefficient <sub>1</sub>	Coefficient <sub>2</sub>	Coefficient <sub>3</sub>	Coefficient <sub>4</sub>	Coefficient <sub>5</sub>	Coefficient <sub>6</sub>	2 Yr. C <sub>1</sub> -A	5 Yr. C <sub>1</sub> -A	10 Yr. C <sub>1</sub> -A	25 Yr. C <sub>1</sub> -A	50 Yr. C <sub>1</sub> -A	100 Yr. C <sub>1</sub> -A	2 Yr. C <sub>2</sub>	5 Yr. C <sub>2</sub>	10 Yr. C <sub>2</sub>	25 Yr. C <sub>2</sub>	50 Yr. C <sub>2</sub>	100 Yr. C <sub>2</sub>
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.080	0.150	0.250	0.300	0.350
Pavement	0	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.250	0.300	0.350
Lawn	74765	1.72	0.02	0.08	0.15	0.25	0.30	0.35	0.084	0.137	0.257	0.429	0.515	0.601						
<b>A<sub>1</sub>:</b>	<b>74765</b>	<b>1.72</b>																		

Q Peak Flow (cfs)						
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q	
0.07	0.34	0.73	1.40	1.89	2.47	

Design Points		
Design Point	C <sub>1</sub>	C <sub>2</sub>
D-1	6.13	20.58
D-2	3.23	10.73
D-3	6.55	22.00
D-4	0.73	2.47
<b>Total flow</b>	<b>16.67</b>	<b>55.77</b>

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## Time of Concentration

$$t_c = t_1 + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_1 = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_1$  = overland (initial) flow time (min)
- $C_s$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	E-1
L (initial time):	300 ft
S (initial time):	0.034 ft/ft

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	0	0.00	0.90
Lawn	624133	14.33	0.08
Total:	624133	14.33	

#### Composite Runoff Coefficient Calculation:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \dots + C_nA_n) / A_t$$

$$C_c = \quad \quad \quad 0.08$$

$$t_1 = (0.395 * (1.1 - C_s) * \text{sqrt}(L)) / (S^{0.33})$$

$$t_1 = \quad \quad \quad 21.30 \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

Conveyance Coeff.:

Slope (travel time):  ft/ft

$$V = C_v S_w^{0.5} \quad \quad \quad 2.02 \text{ ft/s}$$

L (travel time):  ft

$$t_t = L/V = \quad \quad \quad 565.48 \text{ sec.}$$

$$t_t = \quad \quad \quad 9.42 \text{ min.}$$

$$t_c = t_1 + t_t = \quad \quad \quad 30.72 \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$ .

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

Final  $t_c$ :  min.

## Time of Concentration

$$t_c = t_1 + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_1 = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_1$  = overland (initial) flow time (min)
- $C_s$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	E-2
L (initial time):	300 ft
S (initial time):	0.042 ft/ft

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	0	0.00	0.90
Lawn	325344	7.47	0.08
Total :	325344	7.47	

#### Composite Runoff Coefficient Calculation:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \dots + C_nA_n) / A_t$$

$$C_c = \quad \boxed{0.08}$$

$$t_1 = (0.395 * (1.1 - C_s) * \text{sqrt}(L)) / (S^{0.33})$$

$$t_1 = \quad \boxed{19.86} \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

$$\text{Conveyance Coeff.:} \quad \boxed{10}$$

$$\text{Slope (travel time):} \quad \boxed{0.041} \text{ ft/ft}$$

$$V = C_v S_w^{0.5} \quad \boxed{2.02} \text{ ft/s}$$

$$L \text{ (travel time):} \quad \boxed{927} \text{ ft}$$

$$t_t = L/V = \quad \boxed{457.81} \text{ sec.}$$

$$t_t = \quad \boxed{7.63} \text{ min.}$$

$$t_c = t_1 + t_t = \quad \boxed{27.50} \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

$$\text{Final } t_c: \quad \boxed{27.50} \text{ min.}$$

## Time of Concentration

$$t_c = t_i + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_i$  = overland (initial) flow time (min)
- $C_s$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	E-3	
L (initial time):	300	ft
S (initial time):	0.03	ft/ft

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	0	0.00	0.90
Lawn	667120	15.31	0.08
Total :	667120	15.31	

Composite Runoff Coefficient Calculation:

$$C_c = (C_1 A_1 + C_2 A_2 + C_3 A_3 + \dots + C_i A_i) / A_t$$

$$C_c = \boxed{0.08}$$

$$t_i = (0.395 * (1.1 - C_s) * \text{sqrt}(L)) / (S^{0.33})$$

$$t_i = \boxed{22.20} \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

Conveyance Coeff.:  $\boxed{10}$

Slope (travel time):  $\boxed{0.034}$  ft/ft

$$V = C_v S_w^{0.5} = \boxed{1.84} \text{ ft/s}$$

L (travel time):  $\boxed{1271}$  ft

$$t_t = L/V = \boxed{689.30} \text{ sec.}$$

$$t_t = \boxed{11.49} \text{ min.}$$

$$t_c = t_i + t_t = \boxed{33.69} \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

For bermed riprap, select  $C_v$  value based on type of vegetative cover.

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

Final  $t_c$ :  $\boxed{33.69}$  min.

## Time of Concentration

$$t_c = t_1 + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_1 = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_1$  = overland (initial) flow time (min)
- $C_s$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	$t_1$	
L (initial time):	300	ft
S (initial time):	0.033	ft/ft

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	0	0.00	0.90
Lawn	74765	1.72	0.08
Total :	74765	1.72	

#### Composite Runoff Coefficient Calculation:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \dots + C_iA_i) / A_t$$

$$C_c = \quad \quad \quad 0.08$$

$$t_1 = (0.395 * (1.1 - C_s) * \text{sqrt}(L)) / (S^{0.33})$$

$$t_1 = \quad \quad \quad 21.51 \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

Conveyance Coeff.:

Slope (travel time):  ft/ft

$$V = C_v S_w^{0.5} \quad \quad \quad 2.00 \text{ ft/s}$$

L (travel time):  ft

$$t_t = L/V = \quad \quad \quad 136.50 \text{ sec.}$$

$$t_t = \quad \quad \quad 2.28 \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

$$t_c = t_1 + t_t = \quad \quad \quad 23.79 \text{ min.}$$

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

Final  $t_c$ :  min.

Project Number: 332017 - Guernsey Ridge Subdivision - Developed Conditions  
 Engineer: TTY  
 Date: 5/19/2023  
 Address: 31172 Goodson Rd

Sub-Basin: [Redacted] (DIF Curve Equations from Figure 6-5 of the DCM Volume 1)						
$t_b$	$t_s$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$	
1.959199316	2.44642855	2.8531566	3.2695047	3.6866428	4.10363	

Hydrologic Soil Type: B

Coefficient (Table 6-6)															
Land Use or Surface Characteristic	Square Feet	Acres	Coefficient $\phi$	Coefficient $\psi$	Coefficient $\omega$	Coefficient $\alpha$	Coefficient $\beta$	Coefficient $\gamma$	Coefficient $\delta$	2 Yr. $C_t$	5 Yr. $C_t$	10 Yr. $C_t$	25 Yr. $C_t$	50 Yr. $C_t$	100 Yr. $C_t$
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pavement	0	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lawn	644133	14.33	0.02	0.06	0.15	0.25	0.30	0.35	0.287	1.146	2.149	3.582	4.298	5.015	
<b>A<sub>c</sub>:</b>	<b>644133</b>	<b>14.33</b>													

Q Peak Flow (cfs)					
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.56	2.80	6.13	11.68	23.77	33.58

Sub-Basin: [Redacted] (DIF Curve Equations from Figure 6-5 of the DCM Volume 1)						
$t_b$	$t_s$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$	
2.126998753	2.65694802	3.0999304	3.5429307	3.985922	4.4292317	

Hydrologic Soil Type: B

Coefficient (Table 6-6)															
Land Use or Surface Characteristic	Square Feet	Acres	Coefficient $\phi$	Coefficient $\psi$	Coefficient $\omega$	Coefficient $\alpha$	Coefficient $\beta$	Coefficient $\gamma$	Coefficient $\delta$	2 Yr. $C_t$	5 Yr. $C_t$	10 Yr. $C_t$	25 Yr. $C_t$	50 Yr. $C_t$	100 Yr. $C_t$
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pavement	7545	0.17	0.89	0.90	0.92	0.94	0.95	0.96	0.154	0.156	0.159	0.162	0.165	0.166	
Lawn	208895	4.80	0.02	0.06	0.15	0.25	0.30	0.35	0.096	0.384	0.719	1.199	1.439	1.678	
<b>A<sub>c</sub>:</b>	<b>216440</b>	<b>4.97</b>													

Q Peak Flow (cfs)					
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.40	1.32	3.72	6.44	5.88	6.81

Sub-Basin: [Redacted] (DIF Curve Equations from Figure 6-5 of the DCM Volume 1)						
$t_b$	$t_s$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$	
3.86149226	2.32223472	2.70944	3.0566458	3.483515	3.8969137	

Hydrologic Soil Type: B

Coefficient (Table 6-6)															
Land Use or Surface Characteristic	Square Feet	Acres	Coefficient $\phi$	Coefficient $\psi$	Coefficient $\omega$	Coefficient $\alpha$	Coefficient $\beta$	Coefficient $\gamma$	Coefficient $\delta$	2 Yr. $C_t$	5 Yr. $C_t$	10 Yr. $C_t$	25 Yr. $C_t$	50 Yr. $C_t$	100 Yr. $C_t$
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pavement	12411	0.28	0.89	0.90	0.92	0.94	0.95	0.96	0.154	0.156	0.159	0.162	0.165	0.166	
Lawn	664708	15.03	0.02	0.06	0.15	0.25	0.30	0.35	0.301	1.207	2.255	3.758	4.509	5.261	
<b>A<sub>c</sub>:</b>	<b>667319</b>	<b>15.31</b>													

Q Peak Flow (cfs)					
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
1.09	3.57	6.81	13.13	17.53	23.17

Sub-Basin: [Redacted] (DIF Curve Equations from Figure 6-5 of the DCM Volume 1)						
$t_b$	$t_s$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$	
2.363004858	2.82932658	3.3011348	3.7728569	4.244589	4.7489397	

Hydrologic Soil Type: B

Coefficient (Table 6-6)															
Land Use or Surface Characteristic	Square Feet	Acres	Coefficient $\phi$	Coefficient $\psi$	Coefficient $\omega$	Coefficient $\alpha$	Coefficient $\beta$	Coefficient $\gamma$	Coefficient $\delta$	2 Yr. $C_t$	5 Yr. $C_t$	10 Yr. $C_t$	25 Yr. $C_t$	50 Yr. $C_t$	100 Yr. $C_t$
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pavement	0	0.00	0.89	0.90	0.92	0.94	0.95	0.96	0.009	0.000	0.009	0.000	0.000	0.000	0.000
Lawn	74860	1.72	0.02	0.06	0.15	0.25	0.30	0.35	0.034	0.137	0.257	0.499	0.515	0.603	
<b>A<sub>c</sub>:</b>	<b>74765</b>	<b>1.72</b>													

Q Peak Flow (cfs)					
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.87	0.34	0.83	1.40	1.89	2.89

Sub-Basin: [Redacted] (DIF Curve Equations from Figure 6-5 of the DCM Volume 1)						
$t_b$	$t_s$	$t_{10}$	$t_{25}$	$t_{50}$	$t_{100}$	
2.298283186	2.87385375	3.3518282	3.8408097	4.3097791	4.8119510	

Hydrologic Soil Type: B

Coefficient (Table 6-6)															
Land Use or Surface Characteristic	Square Feet	Acres	Coefficient $\phi$	Coefficient $\psi$	Coefficient $\omega$	Coefficient $\alpha$	Coefficient $\beta$	Coefficient $\gamma$	Coefficient $\delta$	2 Yr. $C_t$	5 Yr. $C_t$	10 Yr. $C_t$	25 Yr. $C_t$	50 Yr. $C_t$	100 Yr. $C_t$
Roof	0	0.00	0.71	0.73	0.75	0.78	0.80	0.81	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pavement	7689	0.18	0.89	0.90	0.92	0.94	0.95	0.96	0.157	0.159	0.162	0.166	0.168	0.169	
Lawn	101215	2.32	0.02	0.06	0.15	0.25	0.30	0.35	0.046	0.186	0.349	0.581	0.697	0.813	
<b>A<sub>c</sub>:</b>	<b>108904</b>	<b>2.50</b>													

Q Peak Flow (cfs)					
2 Year Q	5 Year Q	10 Year Q	25 Year Q	50 Year Q	100 Year Q
0.60	0.84	1.71	2.44	3.17	4.38

Design Points		
Design Point	$Q_{10}$	$Q_{100}$
D-1	6.13	20.58
D-2	2.72	8.23
D-3	6.82	21.57
D-4	0.85	2.85
D-5	1.71	4.74
<b>Total Site</b>	<b>18.24</b>	<b>57.86</b>

Values are difficult to read please resubmit copy

## Time of Concentration

$$t_c = t_i + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_i$  = overland (initial) flow time (min)
- $C_s$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	D-1	
L (initial time):	300	ft
S (initial time):	0.034	ft/ft

#### Composite Runoff Coefficient Calculation:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \dots + C_nA_n) / A_t$$

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	0	0.00	0.90
Lawn	624133	14.33	0.08
Total :	624133	14.33	

$$C_c = \boxed{0.08}$$

$$t_i = (0.395 * (1.1 - C_s) * \text{sqrt}(L)) / (S^{0.33})$$

$$t_i = \boxed{21.30} \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_o$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

Conveyance Coeff.:  $\boxed{10}$

Slope (travel time):  $\boxed{0.041}$  ft/ft

$$V = C_v S_w^{0.5} = \boxed{2.02} \text{ ft/s}$$

L (travel time):  $\boxed{1145}$  ft

$$t_t = L/V = \boxed{565.48} \text{ sec.}$$

$$t_t = \boxed{9.42} \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

$$t_c = t_i + t_t = \boxed{30.72} \text{ min.}$$

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

Final  $t_c$ :  $\boxed{30.72}$  min.

## Time of Concentration

$$t_c = t_1 + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_1 = \frac{0.395(1.1 - C_1)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_1$  = overland (initial) flow time (min)
- $C_1$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	D-2
L (initial time):	300 ft
S (initial time):	0.042 ft/ft

#### Composite Runoff Coefficient Calculation:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \dots + C_iA_i) / A_t$$

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	7545	0.17	0.90
Lawn	208895	4.80	0.08
Total:	216440	4.97	

$$C_c = \boxed{0.11}$$

$$t_1 = (0.395 * (1.1 - C_c) * \sqrt{L}) / (S^{0.33})$$

$$t_1 = \boxed{19.31} \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

Conveyance Coeff.:  $\boxed{10}$

Slope (travel time):  $\boxed{0.041}$  ft/ft

$$V = C_v S_w^{0.5} = \boxed{2.02} \text{ ft/s}$$

L (travel time):  $\boxed{896}$  ft

$$t_t = L/V = \boxed{442.50} \text{ sec.}$$

$$t_t = \boxed{7.38} \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$

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

\*For buried riprap, select  $C_v$  value based on type of vegetation cover.

$$t_c = t_1 + t_t = \boxed{26.68} \text{ min.}$$

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

Final  $t_c$ :  $\boxed{26.68}$  min.

## Time of Concentration

$$t_c = t_i + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_i$  = overland (initial) flow time (min)
- $C_s$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	D-3
L (initial time):	300 ft
S (initial time):	0.03 ft/ft

#### Composite Runoff Coefficient Calculation:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \dots + C_iA_i) / A_t$$

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	12411	0.28	0.90
Lawn	654708	15.03	0.08
Total :	667119	15.31	

$$C_c = \boxed{0.10}$$

$$t_i = (0.395 * (1.1 - C_s) * \text{sqrt}(L)) / (S^{0.33})$$

$$t_i = \boxed{21.87} \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

Conveyance Coeff.:  $\boxed{10}$

Slope (travel time):  $\boxed{0.034}$  ft/ft

$$V = C_v S_w^{0.5} = \boxed{1.84} \text{ ft/s}$$

L (travel time):  $\boxed{1271}$  ft

$$t_t = L/V = \boxed{689.30} \text{ sec.}$$

$$t_t = \boxed{11.49} \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

$$t_c = t_i + t_t = \boxed{33.35} \text{ min.}$$

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

$$\text{Final } t_c: \boxed{33.35} \text{ min.}$$



## Time of Concentration

$$t_c = t_i + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_i$  = overland (initial) flow time (min)
- $C_s$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	D-4	
L (initial time):	300	ft
S (initial time):	0.033	ft/ft

#### Composite Runoff Coefficient Calculation:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \dots + C_nA_n) / A_t$$

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	0	0.00	0.90
Lawn	74765	1.72	0.08
Total :	74765	1.72	

$$C_c = 0.08$$

$$t_i = (0.395 * (1.1 - C_s) * \sqrt{L}) / (S^{0.33})$$

$$t_i = 21.51 \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

$$\begin{aligned} \text{Conveyance Coeff.:} & 10 \\ \text{Slope (travel time):} & 0.04 \text{ ft/ft} \\ V = C_v S_w^{0.5} & 2.00 \text{ ft/s} \end{aligned}$$

$$L \text{ (travel time): } 273 \text{ ft}$$

$$t_t = L/V = 136.50 \text{ sec.}$$

$$t_t = 2.28 \text{ min.}$$

$$t_c = t_i + t_t = 23.79 \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

$$\text{Final } t_c: 23.79 \text{ min.}$$

## Time of Concentration

$$t_c = t_1 + t_t$$

### 3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad (\text{Eq. 6-8})$$

Where:

- $t_i$  = overland (initial) flow time (min)
- $C_s$  = runoff coefficient for 5-year frequency (see Table 6-6)
- $L$  = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
- $S$  = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

Sub-Basin:	D-5	
L (initial time):	300	ft
S (initial time):	0.033	ft/ft

#### Composite Runoff Coefficient Calculation:

$$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \dots + C_nA_n) / A_t$$

Land Use or Surface Characteristic	Square Feet	Acreage	$C_s$
Roof	0	0.00	0.73
Pavement	7689	0.18	0.90
Lawn	101215	2.32	0.08
Total :	108904	2.50	

$$C_c = \boxed{0.14}$$

$$t_i = (0.395 * (1.1 - C_s) * \sqrt{L}) / (S^{0.33})$$

$$t_i = \boxed{20.29} \text{ mins}$$

### 3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time,  $t_t$ , which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time,  $t_t$ , can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad (\text{Eq. 6-9})$$

Where:

- $V$  = velocity (ft/s)
- $C_v$  = conveyance coefficient (from Table 6-7)
- $S_w$  = watercourse slope (ft/ft)

$$\text{Conveyance Coeff.: } \boxed{10}$$

$$\text{Slope (travel time): } \boxed{0.04} \text{ ft/ft}$$

$$V = C_v S_w^{0.5} = \boxed{2.00} \text{ ft/s}$$

$$L \text{ (travel time): } \boxed{338} \text{ ft}$$

$$t_t = L/V = \boxed{169.00} \text{ sec.}$$

$$t_t = \boxed{2.82} \text{ min.}$$

$$t_c = t_1 + t_t = \boxed{23.11} \text{ min.}$$

Table 6-7. Conveyance Coefficient,  $C_v$

Type of Land Surface	$C_v$
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

### 3.2.4 Minimum Time of Concentration

If the calculations result in a  $t_c$  of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum  $t_c$  for urbanized areas is 5 minutes.

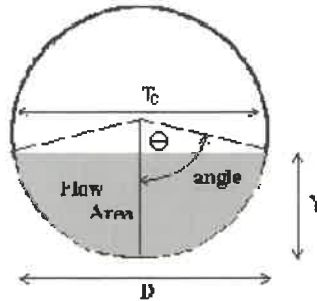
$$\text{Final } t_c: \boxed{23.11} \text{ min.}$$

# CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Gunners Ridge Subdivision**

Pipe ID: **Proposed 18" CMP Culvert (Developed Conditions)**



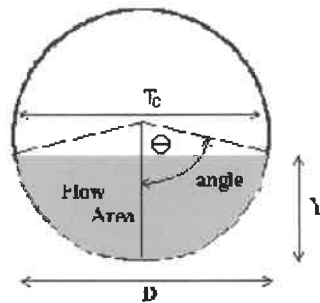
Design Information (Input)	
Pipe Invert Slope	So = 0.0150 ft/ft
Pipe Manning's n-value	n = 0.0120
Pipe Diameter	D = 18.00 inches
Design discharge	Q = 7.57 cfs
Full-Flow Capacity (Calculated)	
Full-flow area	Af = 1.77 sq ft
Full-flow wetted perimeter	Pf = 4.71 ft
Half Central Angle	Theta = 3.14 radians
Full-flow capacity	Qf = 13.97 cfs
Calculation of Normal Flow Condition	
Half Central Angle ( $0 < \text{Theta} < 3.14$ )	Theta = 1.62 radians
Flow area	An = 0.94 sq ft
Top width	Tn = 1.50 ft
Wetted perimeter	Pn = 2.43 ft
Flow depth	Yn = 0.79 ft
Flow velocity	Vn = 8.07 fps
Discharge	Qn = 7.57 cfs
Percent of Full Flow	Flow = 54.2% of full flow
Normal Depth Froude Number	Fr <sub>n</sub> = 1.80 supercritical
Calculation of Critical Flow Condition	
Half Central Angle ( $0 < \text{Theta-c} < 3.14$ )	Theta-c = 2.01 radians
Critical flow area	Ac = 1.34 sq ft
Critical top width	Tc = 1.36 ft
Critical flow depth	Yc = 1.07 ft
Critical flow velocity	Vc = 5.64 fps
Critical Depth Froude Number	Fr <sub>c</sub> = 1.00

# CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project: Gunners Ridge Subdivision**

**Pipe ID: Existing 18" CMP Culvert (Developed Conditions)**



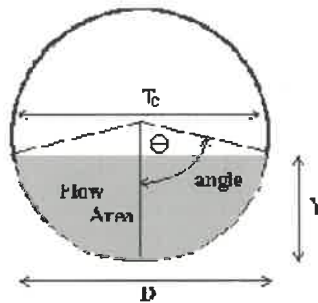
<u>Design Information (Input)</u>	
Pipe Invert Slope	So = <input type="text" value="0.0150"/> ft/ft
Pipe Manning's n-value	n = <input type="text" value="0.0120"/>
Pipe Diameter	D = <input type="text" value="18.00"/> inches
Design discharge	Q = <input type="text" value="11.60"/> cfs
<u>Full-Flow Capacity (Calculated)</u>	
Full-flow area	Af = <input type="text" value="1.77"/> sq ft
Full-flow wetted perimeter	Pf = <input type="text" value="4.71"/> ft
Half Central Angle	Theta = <input type="text" value="3.14"/> radians
Full-flow capacity	Qf = <input type="text" value="13.97"/> cfs
<u>Calculation of Normal Flow Condition</u>	
Half Central Angle ( $0 < \text{Theta} < 3.14$ )	Theta = <input type="text" value="1.97"/> radians
Flow area	An = <input type="text" value="1.31"/> sq ft
Top width	Tn = <input type="text" value="1.38"/> ft
Wetted perimeter	Pn = <input type="text" value="2.96"/> ft
Flow depth	Yn = <input type="text" value="1.04"/> ft
Flow velocity	Vn = <input type="text" value="8.84"/> fps
Discharge	Qn = <input type="text" value="11.60"/> cfs
Percent of Full Flow	Flow = <input type="text" value="83.0%"/> of full flow
Normal Depth Froude Number	Fr <sub>n</sub> = <input type="text" value="1.60"/> supercritical
<u>Calculation of Critical Flow Condition</u>	
Half Central Angle ( $0 < \text{Theta-c} < 3.14$ )	Theta-c = <input type="text" value="2.39"/> radians
Critical flow area	Ac = <input type="text" value="1.62"/> sq ft
Critical top width	Tc = <input type="text" value="1.03"/> ft
Critical flow depth	Yc = <input type="text" value="1.30"/> ft
Critical flow velocity	Vc = <input type="text" value="7.14"/> fps
Critical Depth Froude Number	Fr <sub>c</sub> = <input type="text" value="1.00"/>

# CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

*MHFD-Culvert, Version 4.00 (May 2020)*

**Project: Gunners Ridge Subdivision**

**Pipe ID: Existing 30" CMP Culvert (Developed Conditions)**



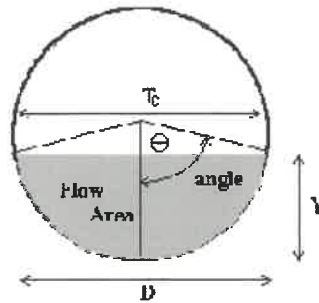
<u>Design Information (Input)</u>	
Pipe Invert Slope	So = <input style="width: 80px;" type="text" value="0.0150"/> ft/ft
Pipe Manning's n-value	n = <input style="width: 80px;" type="text" value="0.0120"/>
Pipe Diameter	D = <input style="width: 80px;" type="text" value="30.00"/> inches
Design discharge	Q = <input style="width: 80px;" type="text" value="25.18"/> cfs
<u>Full-Flow Capacity (Calculated)</u>	
Full-flow area	Af = <input style="width: 80px;" type="text" value="4.91"/> sq ft
Full-flow wetted perimeter	Pf = <input style="width: 80px;" type="text" value="7.85"/> ft
Half Central Angle	Theta = <input style="width: 80px;" type="text" value="3.14"/> radians
Full-flow capacity	Qf = <input style="width: 80px;" type="text" value="54.57"/> cfs
<u>Calculation of Normal Flow Condition</u>	
Half Central Angle ( $0 < \text{Theta} < 3.14$ )	Theta = <input style="width: 80px;" type="text" value="1.53"/> radians
Flow area	An = <input style="width: 80px;" type="text" value="2.31"/> sq ft
Top width	Tn = <input style="width: 80px;" type="text" value="2.50"/> ft
Wetted perimeter	Pn = <input style="width: 80px;" type="text" value="3.81"/> ft
Flow depth	Yn = <input style="width: 80px;" type="text" value="1.19"/> ft
Flow velocity	Vn = <input style="width: 80px;" type="text" value="10.89"/> fps
Discharge	Qn = <input style="width: 80px;" type="text" value="25.18"/> cfs
Percent of Full Flow	Flow = <input style="width: 80px;" type="text" value="46.1%"/> of full flow
Normal Depth Froude Number	Fr <sub>n</sub> = <input style="width: 80px;" type="text" value="2.00"/> supercritical
<u>Calculation of Critical Flow Condition</u>	
Half Central Angle ( $0 < \text{Theta-c} < 3.14$ )	Theta-c = <input style="width: 80px;" type="text" value="1.95"/> radians
Critical flow area	Ac = <input style="width: 80px;" type="text" value="3.58"/> sq ft
Critical top width	Tc = <input style="width: 80px;" type="text" value="2.32"/> ft
Critical flow depth	Yc = <input style="width: 80px;" type="text" value="1.71"/> ft
Critical flow velocity	Vc = <input style="width: 80px;" type="text" value="7.04"/> fps
Critical Depth Froude Number	Fr <sub>c</sub> = <input style="width: 80px;" type="text" value="1.00"/>

# CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: **Gunners Ridge Subdivision**

Pipe ID: **Existing 36" CMP Culvert (Developed Conditions)**



Design Information (Input)	
Pipe Invert Slope	So = 0.0100 ft/ft
Pipe Manning's n-value	n = 0.0120
Pipe Diameter	D = 36.00 inches
Design discharge	Q = 20.58 cfs
Full-Flow Capacity (Calculated)	
Full-flow area	Af = 7.07 sq ft
Full-flow wetted perimeter	Pf = 9.42 ft
Half Central Angle	Theta = 3.14 radians
Full-flow capacity	Qf = 72.45 cfs
Calculation of Normal Flow Condition	
Half Central Angle ( $0 < \text{Theta} < 3.14$ )	Theta = 1.30 radians
Flow area	An = 2.33 sq ft
Top width	Tn = 2.89 ft
Wetted perimeter	Pn = 3.89 ft
Flow depth	Yn = 1.09 ft
Flow velocity	Vn = 8.83 fps
Discharge	Qn = 20.58 cfs
Percent of Full Flow	Flow = 28.4% of full flow
Normal Depth Froude Number	Fr <sub>n</sub> = 1.73 supercritical
Calculation of Critical Flow Condition	
Half Central Angle ( $0 < \text{Theta-c} < 3.14$ )	Theta-c = 1.54 radians
Critical flow area	Ac = 3.40 sq ft
Critical top width	Tc = 3.00 ft
Critical flow depth	Yc = 1.46 ft
Critical flow velocity	Vc = 6.05 fps
Critical Depth Froude Number	Fr <sub>c</sub> = 1.00

## Appendix C – FEMA Floodplain Map

# National Flood Hazard Layer FIRMette



104°37'53"W 39°0'43"N



## 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, Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone J
    - 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
  - GENERAL STRUCTURES**
    - Channel, Culvert, or Storm Sewer
    - Levee, Dike, or Floodwall
  - OTHER FEATURES**
    - Cross Sections with 1% Annual Chance Water Surface Elevation
    - Coastal Transect
    - Base Flood Elevation Line (BFE)
    - Limit of Study
    - Jurisdiction Boundary
    - Coastal Transect Baseline
    - Profile Baseline
    - Hydrographic Feature
  - MAP PANELS**
    - Digital Data Available
    - No Digital Data Available
    - Unmapped
- 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.

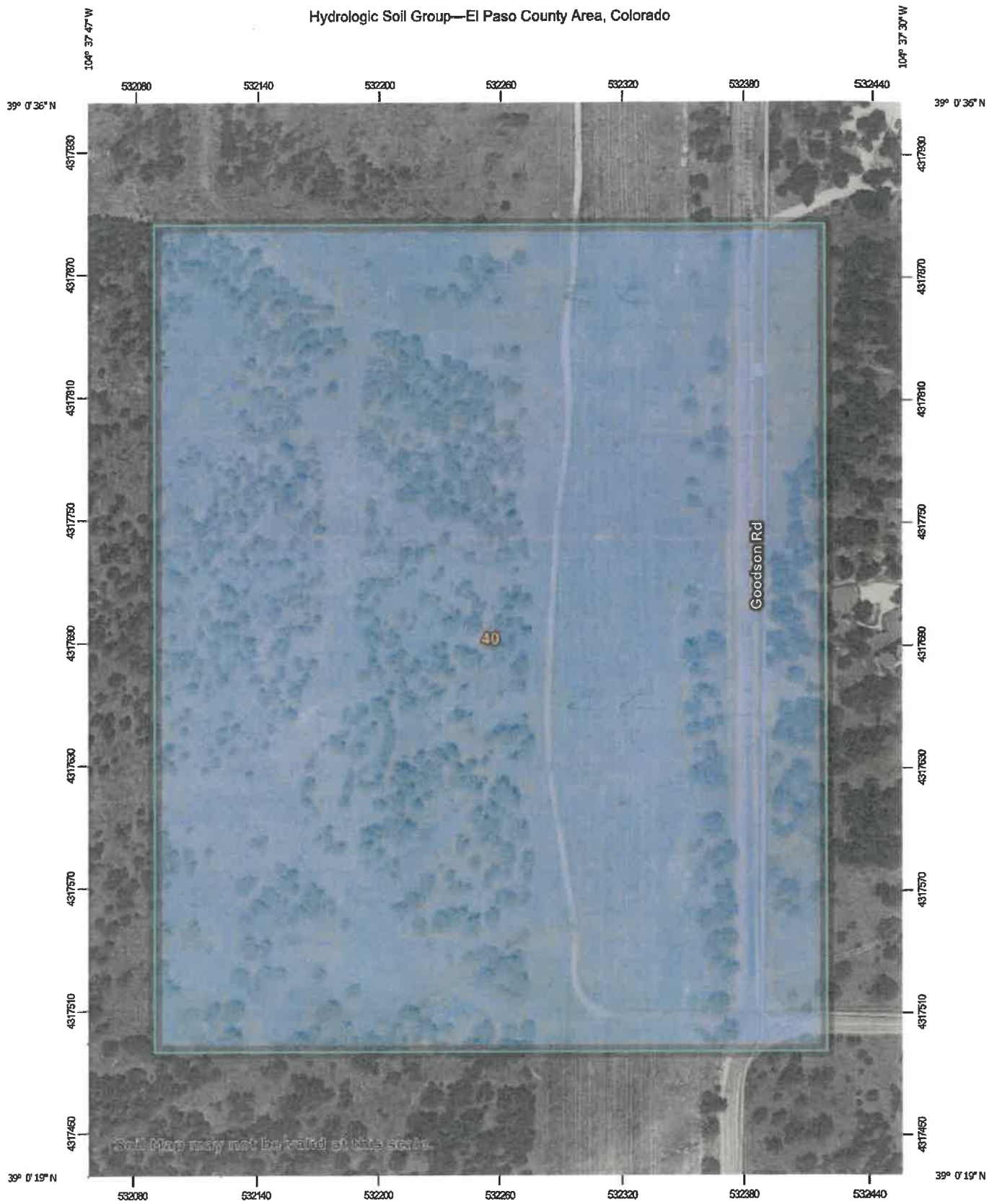
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/21/2023 at 11:22 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by 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.

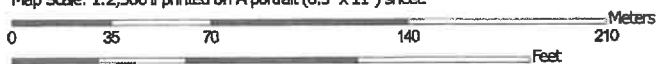


## Appendix D – USDA Soils Survey Map

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:2,560 if printed on A portrait (8.5" x 11") sheet.



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

Hydrologic Soil Group—El Paso County Area, Colorado

**MAP LEGEND**

- Area of Interest (AOI)**
- Area of Interest (AOI)
- Soils**
- Soil Rating Polygons**
- A
  - A/D
  - B
  - B/D
  - C
  - C/D
  - D
  - Not rated or not available
- Soil Rating Lines**
- A
  - A/D
  - B
  - B/D
  - C
  - C/D
  - D
  - Not rated or not available
- Soil Rating Points**
- A
  - A/D
  - B
  - B/D
- Water Features**
- Streams and Canals
- Transportation**
- Rails
  - Interstate Highways
  - US Routes
  - Major Roads
  - Local Roads
- Background**
- Aerial Photography
- Soils**
- C
  - C/D
  - D
  - Not rated or not available

**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 20, Sep 2, 2022

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

Date(s) aerial Images were photographed: Jun 9, 2021—Jun 12, 2021

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

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
40	Kettle gravelly loamy sand, 3 to 8 percent slopes	B	33.2	100.0%
<b>Totals for Area of Interest</b>			<b>33.2</b>	<b>100.0%</b>

### Description

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

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

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

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

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

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

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

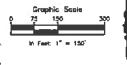
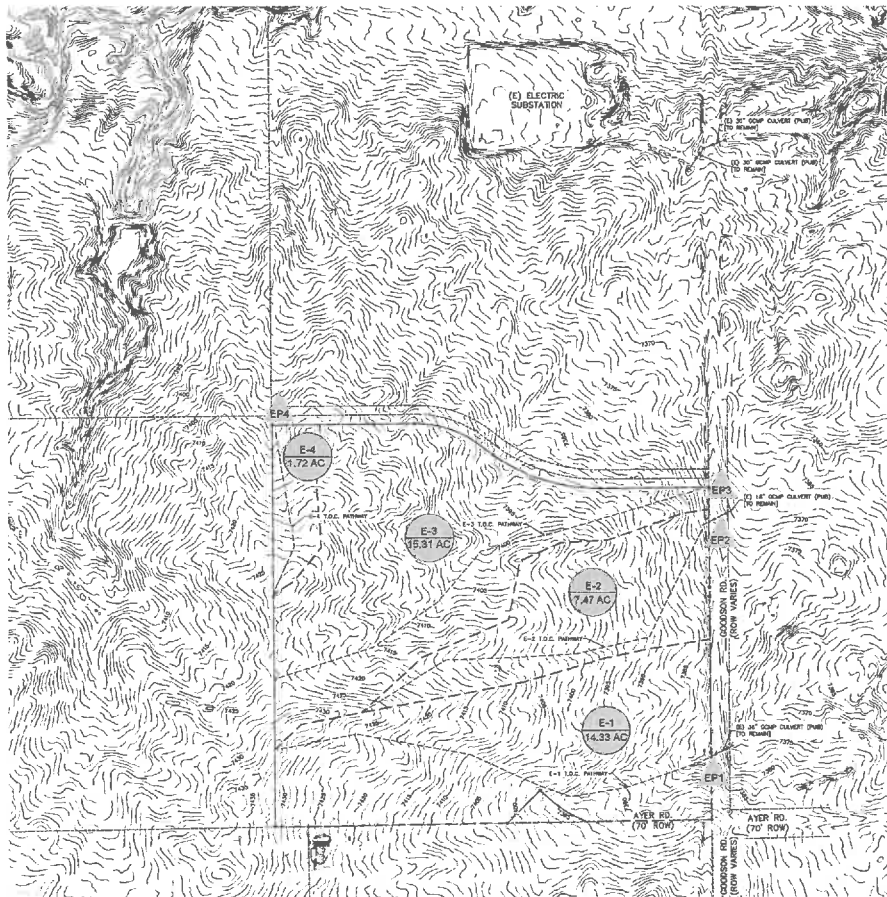
### Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule: Higher*

## **Appendix E – Drainage Maps**



**LEGEND**

- PROPERTY LINE
- EXISTING LINE
- SE BLACK LINE
- PROPERTY CORNER/ADJACENT, BOUNDARY, OR TEMPORARY BOUNDARY
- EXISTING FENCE
- EXISTING MAJOR CONTROL
- EXISTING MAJOR CONTROL
- LINE OF CONCENTRATION PATH
- BASIN DELINEATOR
- PROPOSED MAJOR CONTROL
- PROPOSED MAJOR CONTROL
- BASIN DESIGN POINT (E-1)
- BASIN BOUNDARY
- BASIN AREA

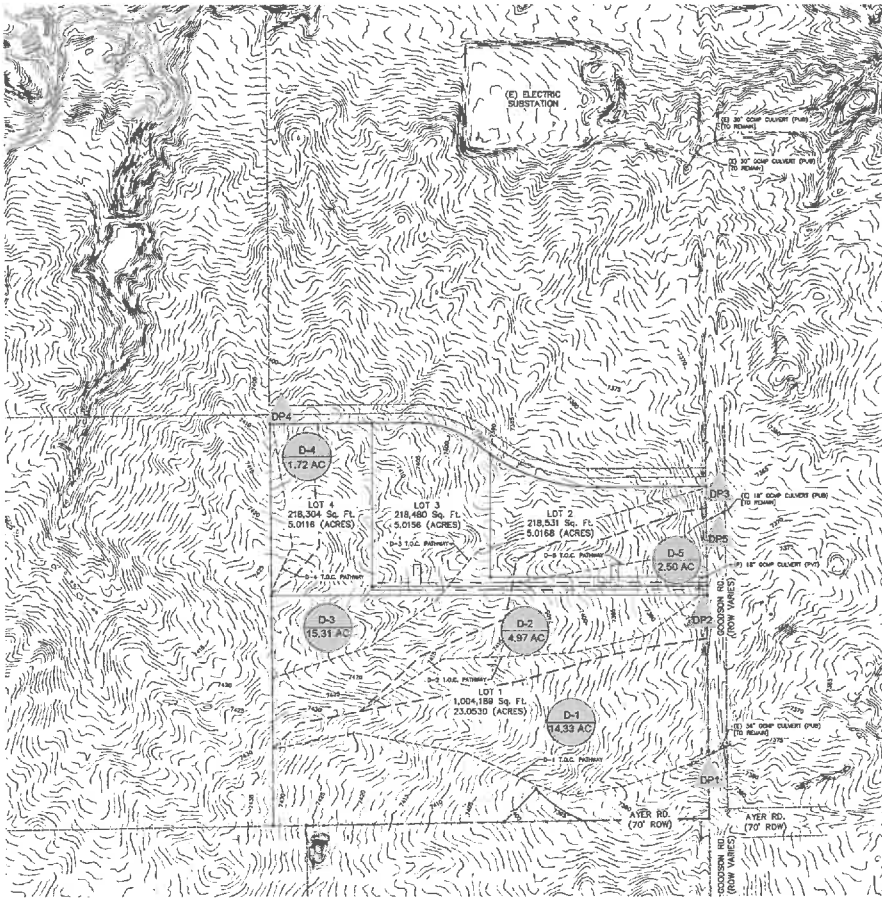
Please include an updated Basin Summary Table.

**RMG**  
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EL PASO COUNTY, COLORADO  
DREW MARKINGS

PROJECT NUMBER: 192007  
DATE: 05-10-2023  
DRAWING: DR01

EXISTING SUB-BASIN ANALYSIS  
FINAL DRAINAGE REPORT



- LEGEND**
- PROPERTY LINE
  - EXISTING LAC
  - SETBACK LAC
  - PROPERTY CORNER ADJUSTMENT, BENCHMARK, OR SURVEY POINT
  - EXISTING FENCE
  - EXISTING MAJOR DRAINAGE
  - EXISTING MAJOR CONTOUR
  - TYPE OF CONCENTRATION PATH
  - BASIN CONTOUR
  - PROPOSED MAJOR CONTOUR
  - PROPOSED MAJOR CONTOUR
  - BASIN DESIGN POINT  $\Delta$
  - BASIN IDENTIFIER
  - BASIN AREA

Please include an updated Basin Summary Table.

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NOT FOR CONSTRUCTION

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**GUNNERS RIDGE SUBDIVISION**  
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EL PASO COUNTY, COLORADO  
DREW MAKINGS

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PROPOSED SUB-BASIN ANALYSIS  
DATE: 05-10-2023  
REVISION: 190227  
DRAWN: DR02