FINAL DRAINAGE REPORT FOR NORTHERN DELIVERY SYSTEM BOOSTER PUMP STATION

PREPARED BY
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RESPEC
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PREPARED FOR
Triview Metropolitan District
16055 Old Forest Point STE 300
Monument, CO 80132

February 2023

Project 224.29

ENGINEER'S STATEMENT

This report and plan for the drainage design of Northern Delivery System Booster Pump Station, 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 according to the criteria established by the County for drainage reports and said report 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 preparing this report.

_____ _____

Richard Gallegos, P.E. Date

Registered Professional Engineer State of Colorado No. 36247

DEVELOPER'S STATEMENT

The Triview Metropolitan District hereby certifies that the drainage facilities for the Northern Delivery System Booster Pump Station 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 the drainage facilities designed and/or certified by my engineer and that are submitted to El Paso County; and cannot, on behalf of the Northern Delivery System Booster Pump Station guarantee that final drainage design review will absolve the Triview Metropolitan District 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.

_____ _____

Authorized Signature Date

_____

Printed Name

_____ Address:

Title

EL PASO COUNTY STATEMENT

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.

_____ _____

For the County Engineer Date

TABLE OF CONTENTS

APPENDIX

1.0 PURPOSE

This drainage report is for the design of the Northern Delivery System Booster Pump Station. The site is located along Highway 83, Colorado Springs, Colorado in central El Paso County. See Vicinity Map in the Appendix below for reference. It is further described as the Southwest One-Quarter of the Northwest One-Quarter of Section 3, Township 12 South, Range 66 West of the 6th P.M. This 9.75-acre site is located within the Black Squirrel Creek – FOMO3600 basin.

One Drainage Basin Planning Study for Black Squirrel Creek was found within the County's files that included the project site:

- *Black Squirrel Creek Drainage Basin Planning Study Final Report,* City of Colorado Springs and El Paso County, January of 1989

The site is bound on the west by Highway 83 and on the south by Roller Coaster Drive. Work will include the construction of a 1500 square foot (sf) pump station and asphalt driveway. With an area of disturbance less than 1 acre, detention will not be required for the site per El Paso County Engineering Criteria Manual (ECM) Appendix I.7, 1.B. No portion of the site is located within a FEMA designated 100-year floodplain per Map No. 08041C0295G that was effective on December 7th, 2018.

2.0 SOIL CONDITIONS

According to the El Paso County Area Soil Survey, the soil on the site is classified as follows:

SOIL #	SOIL TYPE	HYDROLOGIC CLASSIFICATION	PERCENT OF SITE
41	Kettle Gravelly Loamy Sand, 8 to 40 Percent Slopes	B	10.8%
69	Peyton-Pring Complex, 8 to 15 Percent Slopes	B	0.0%
71	Pring Coarse Sandy Loam, 3 to 8 Percent Slopes	B	89.2%

The Kettle Gravelly soil can be described as having a high permeability, low surface runoff, and slight hazard of erosion. The Pring Coarse Sandy soils is described, similarly, as having high permeability and low surface runoff. The hydrologic soil classification used for this study is 'B'. See Soils Map in the Appendix for reference.

3.0 HYDROLOGIC CRITERIA

The methodology utilized for this report is in accordance with the *El Paso County Drainage Criteria Manual.* All references from the *El Paso County Drainage Criteria Manual* can be found in Appendix C. The Rational Method for computation of runoff was used.

Q = cia

Where
Q = maximum rate of runoff in cubic feet per second
c = runoff coefficient representing drainage area characteristics
i = average rainfall intensity, in inches per hour, for the duration required for the runoff to become established
a = drainage basin size in acres

The storm recurrence intervals, used to determine swale capacity, for this study were the 10-year storm and the 100-year storm. ManningSolver Version 1.019 was used in this analysis to calculate the Manning's normal depth.

4.0 EXISTING DRAINAGE CONDITIONS

The overall site consists of 9.75 acres. The site includes an existing water storage tank and gravel driveway. The areas of the site not covered by the potable water tank or gravel driveway are covered with scrub oak, grass, willows and pine trees. These undeveloped areas include slopes that range from 4.9% to 34.1%. The overall existing site is 3.5% impervious. See Existing Drainage Map in the Back Pocket for reference.

Flows from Sub-basin OS1, Sub-basin OS2, and Sub-basin Aex through Sub-basin Gex are tributary to the Black Squirrel Creek – FOMO3600 drainage basin.

Sub-basin OS1 contains 2.74 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. This sub-basin produces existing flows of 3.0 cfs for the 10-year storm and 7.3 cfs for the 100-year storm. These flows sheetflow to the southeast over nearly bare ground.

Sub-basin OS2 consists of 3.69 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. This sub-basin produces existing flows of 2.8 cfs for the 10-year storm and 8.5 cfs for the 100-year storm. These flows sheetflow to the southeast. Flows from Sub-basin OS2 combine with flows from Sub-basin Eex, Sub-basin Fex, and Sub-basin Gex to produce total flows of 7.5 cfs for the 10-year storm and 20.8 cfs for the 100-year storm at Design Point 1 (DP1). These flows proceed into the stream tributary to Black Squirrel Creek that is located southeast of the site.

Sub-basin Aex contains 3.89 acres and drains south towards a private access road. This sub-basin produces existing flows of 2.4 cfs for the 10-year storm and 7.8 cfs for the 100-year storm. These flows sheetflow to the south.

Sub-basin Bex consists of 2.37 acres and drains south along a private access road. This sub-basin produces existing flows of 2.1 cfs for the 10-year storm and 5.9 cfs for the 100-year storm. These flows sheetflow in the southerly direction.

Sub-basin Cex contains 7.96 acres and drains south towards a private access road. This sub-basin produces existing flows of 5.4 cfs for the 10-year storm and 17.4 cfs for the 100-year storm. These flows sheetflow to the south.

Sub-basin Dex consists of 5.12 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. It produces flows of 3.5 cfs for the 10-year storm and 11.9 cfs for the 100-year storm. These flows sheetflow to the southeast, ultimately ending up in the stream noted on the Existing Drainage Plan in the Back Pocket. Flows from Sub-basin Dex combine with flows from Sub-basin Cex, Sub-basin OS1, and Design Point 1 (DP1) to produce total flows of 15.9 cfs for the 10-year storm and 46.9 cfs for the 100-year storm at Design Point 2 (DP2). These flows continue along the stream towards Black Squirrel Creek.

Sub-basin Eex contains 2.79 acres and drains east towards Sub-basin OS2. It produces flows of 3.3 cfs for the 10-year storm and 8.3 cfs for the 100-year storm. These flows sheetflow to the east, ultimately ending up in the stream that is tributary to Black Squirrel Creek.

Sub-basin Fex contains 1.15 acres and drains southeast towards Sub-basin OS2. It produces flows of 1.4 cfs for the 10-year storm and 3.4 cfs for the 100-year storm. These flows sheetflow to the southeast, ultimately ending up in the stream that is tributary to Black Squirrel Creek.

Sub-basin Gex consists of 0.96 acres and drains southeast towards Sub-basin OS1. It produces flows of 0.7 cfs for the 10-year storm and 2.5 cfs for the 100-year storm. These flows sheetflow to the southeast into the stream that is tributary to Black Squirrel Creek.

The estimated runoff amounts produced for the project under Existing Conditions are shown in Table 1 below.

TABLE 1 – EXISTING CONDITIONS

Sub-basin	Q_{10} (CFS)	Q_{100} (CFS)
OS1	3.0	7.3
OS2	2.8	8.5
Aex	2.4	7.8
Bex	2.1	5.9
Cex	5.4	17.4
Dex	3.5	11.9
Eex	3.3	8.3
Fex	1.4	3.4
Gex	0.7	2.5
DP1 (Eex + Fex + Gex + OS2)	7.5	20.8
DP2 (DP1 + Cex + Dex + OS1)	15.9	46.9

5.0 DEVELOPED DRAINAGE CONDITIONS

The overall site consists of 9.75 acres, of which 0.9 acres will be disturbed for permanent improvements as part of this project. A booster pump station building and 15' wide asphalt access road is proposed on the east side of the site. A secondary gate access road is also proposed on the south end of the site

along that connects the site to the existing private asphalt driveway . Proposed Conditions Map is located below in the Back Pocket for reference.

Proposed site imperviousness is 5.4%, versus 3.5% in the existing conditions. Proposed flows are tributary to the Black Squirrel Creek – FOMO3600 drainage basin.

Sub-basin OS1 contains 2.74 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. This sub-basin produces existing flows of 3.0 cfs for the 10-year storm and 7.3 cfs for the 100-year storm. These flows sheetflow to the southeast over nearly bare ground.

Sub-basin OS2 contains 3.69 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. This sub-basin produces existing flows of 2.8 cfs for the 10-year storm and 8.5 cfs for the 100-year storm. These flows sheetflow to the southeast. Flows from Sub-basin OS2 combine with flows from Sub-basin E, Sub-basin F, and Sub-basin G to produce total flows of 8.2 cfs for the 10-year storm and 22.0 cfs for the 100-year storm at Design Point 1 (DP1). These flows proceed into the stream tributary to Black Squirrel Creek that is located southeast of the site.

Sub-basin A consists of 3.89 acres and drains south towards a private access road. This sub-basin produces existing flows of 2.4 cfs for the 10-year storm and 7.8 cfs for the 100-year storm. These flows sheetflow to the south.

Sub-basin B contains 2.37 acres and drains south along a private access road. This sub-basin produces existing flows of 2.3 cfs for the 10-year storm and 6.1 cfs for the 100-year storm. These flows sheetflow in the southerly direction.

Sub-basin C consists of 7.96 acres and drains south towards a private access road. This sub-basin produces existing flows of 5.4 cfs for the 10-year storm and 17.4 cfs for the 100-year storm. These flows sheetflow to the south over all roads (existing and proposed).

Sub-basin D contains 5.12 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. It produces flows of 3.9 cfs for the 10-year storm and 12.1 cfs for the 100-year storm. These flows sheetflow to the southeast over the proposed access road, ultimately ending up in the stream noted on the Existing Drainage Plan in the Back Pocket. Flows from Sub-basin D combine with flows from Sub-basin C, Sub-basin OS1, and Design Point 1 (DP1) to produce total flows of 16.8 cfs for the 10-year storm and 48.4 cfs for the 100-year storm at Design Point 2 (DP2). These flows continue along the stream towards Black Squirrel Creek.

Sub-basin E contains 2.79 acres and drains east towards the proposed pump station. It produces flows of 3.8 cfs for the 10-year storm and 9.1 cfs for the 100-year storm. Two 1.25′ deep triangular swales with 4:1 side slopes route these flows around the proposed pump station. These flows sheetflow to the east, ultimately ending up in the stream that is tributary to Black Squirrel Creek.

Sub-basin F consists of 1.15 acres and drains southeast towards Sub-basin OS2. It produces flows of 1.4 cfs for the 10-year storm and 3.4 cfs for the 100-year storm. These flows sheetflow to the southeast, ultimately ending up in the stream that is tributary to Black Squirrel Creek.

Sub-basin G contains 0.96 acres and drains southeast towards Sub-basin OS1. It produces flows of 1.1 cfs for the 10-year storm and 3.0 cfs for the 100-year storm. These flows sheetflow to the southeast over the proposed access road and into the stream that is tributary to Black Squirrel Creek.

The estimated runoff amounts produced for the project under Proposed Conditions are shown in Table 2 below.

TABLE 2 – PROPOSED CONDITIONS		
Sub-basin	Q_{10} (CFS)	Q_{100} (CFS)
OS1	3.0	7.3
OS2	2.8	8.5
A	2.4	7.8
B	2.3	6.1
C	5.4	17.4
D	3.9	12.1
E	3.8	9.1
F	1.4	3.4
G	1.1	3.0
DP1 (E + F + G + OS2)	8.2	22.0
DP2 (DP1 + C + D +OS1)	16.8	48.4

6.0 WATER QUALITY

The total disturbance for this development will be 0.9 acres. According to the El Paso County Engineering Criteria Manual (ECM), "The following types of sites and associated land disturbances are excluded from the requirements of this Section 1.7". Furthermore, in El Paso County ECM Appendix I.7, 1.B, a "County Growth Areas" are excluded from the requirements defined in Section 1.7. Since this site will be considered a "Commercial or industrial development site or larger common plans of development for which associated construction activities results in a land disturbance of less than or equal to 10 acres, the site can be excluded from water quality control measure requirements.

7.0 EROSION CONTROL PLAN

The site construction consists of constructing a new pump station and an asphalt access road, disturbing 0.9 acres of area. This does not require an Erosion and Stormwater Quality Control Permit. However, a Grading and Erosion Control Plan will be submitted in separate Construction Plans.

8.0 FLOODPLAIN STATEMENT

No portion of the developed site is located within a designated FEMA 100-year floodplain according to the information published in the Federal Emergency Management Agency Flood Plain Map No.

08041C0295G dated December 7th, 2018. No portion of the site lies within the Zone 'A' of Black Squirrel Creek as noted on Map No. 08041C0295G.

9.0 DRAINAGE BASIN FEES

The proposed development is located within the Black Squirrel Drainage Basin, which assesses drainage and bridge fees at the time of platting. A plat is not proposed as part of this project, so do drainage or bridge fees are due.

10.0 CONSTRUCTION COST OPINION

Flows will either sheet flow or be directed to outfall points via ditch. A single 12" HDPE culvert will be needed at the 15' wide access road. A cost opinion is as follows:

Item	Quantity	Unit	Unit Cost	Total
12" HDPE	34	LF	$20	$680
			15% Engineering & Cont.	$102
			Grand Total	$782

11.0 CONCLUSIONS

For this 9.75-acre site, work will include constructing a booster pump station and 15' wide asphalt access road. Additionally, a secondary gate access road will be constructed that will allow access from the site from the private driveway south of the property. The total anticipated disturbance of the site will be 0.9 acres. The development increases total routed flows exiting the site at Design Point 2 (DP2) from 15.9 cfs to 16.8 cfs for the 10-year storm, while the 100-year storm flow increases from 46.9 cfs to 48.4 cfs. These increases do not warrant the need for detention. All developed flows will continue to flow along existing drainage patterns.

Disturbed areas shall be permanently stabilized as soon as construction activities are completed. Areas to be re-vegetated shall be treated with soil amendments to provide an adequate growth medium to sustain vegetation and shall match the pre-existing, pre-disturbed vegetation cover. Erosion control measures will be installed during construction of the proposed site per the approved Grading and Erosion Control Plan to be submitted separately for review and approval. Site runoff, storm drains, and appurtenances associated with the development of the Triview Metropolitan District Northern Delivery System Booster Pump Station will not adversely affect the downstream and surrounding developments.

12.0 REFERENCES

Black Squirrel Creek Drainage Basin Planning Study Final Report, City of Colorado Springs and El Paso County, January of 1989

Flood Insurance Rate Map Number 08041C0295G, Federal Emergency Management Agency Floodplain Data, revised December 7, 2018

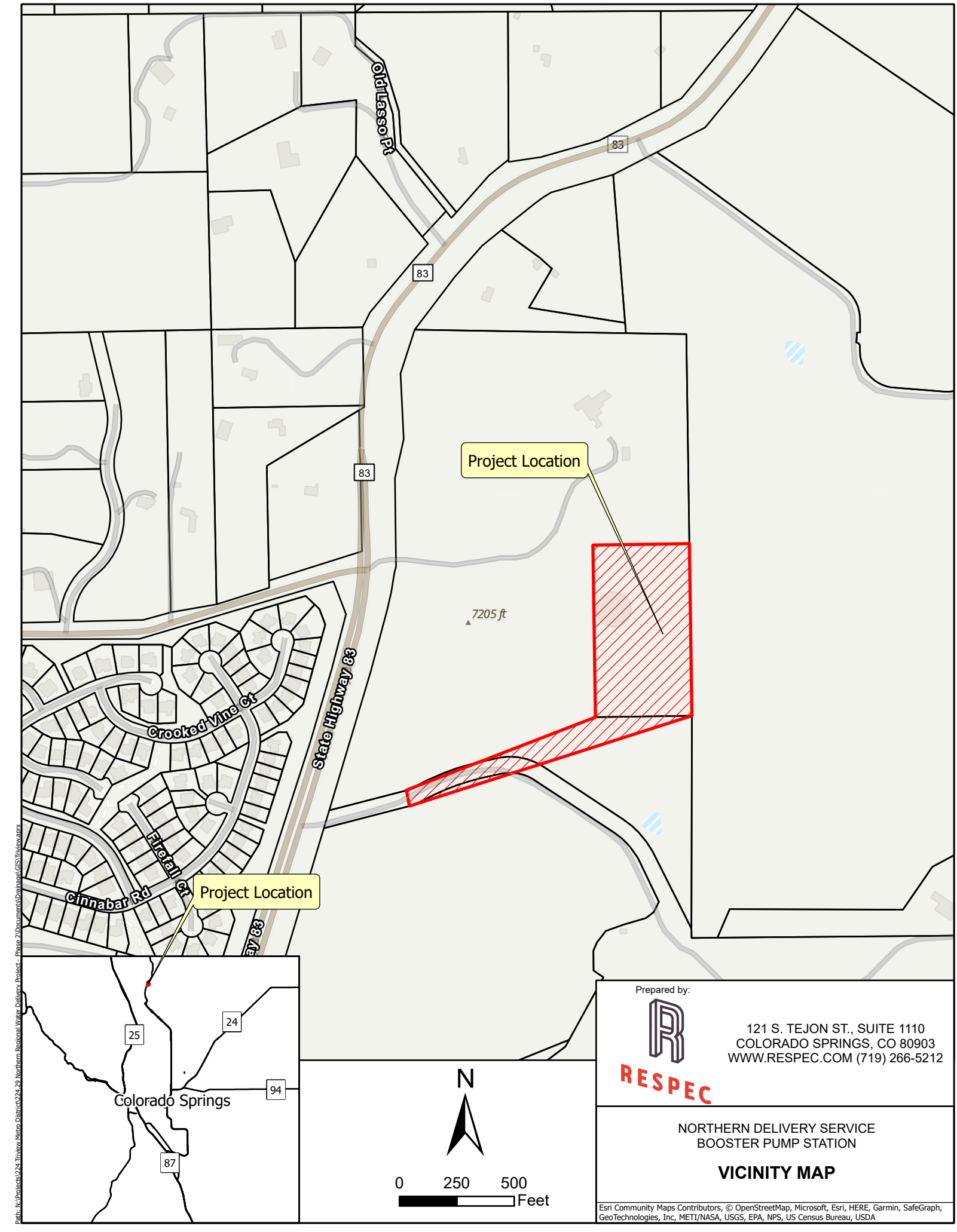
Municipal Code Corporation (2018). *Drainage Criteria Manual of El Paso County, Colorado (DPM)*

Urban Drainage and Flood Control District (June 2017). *Urban Storm Drainage Criteria Manual, Volume 1-3.*

USDA, NRCS. Soil Survey of El Paso County Area, Colorado.

APPENDIX A

MAPS



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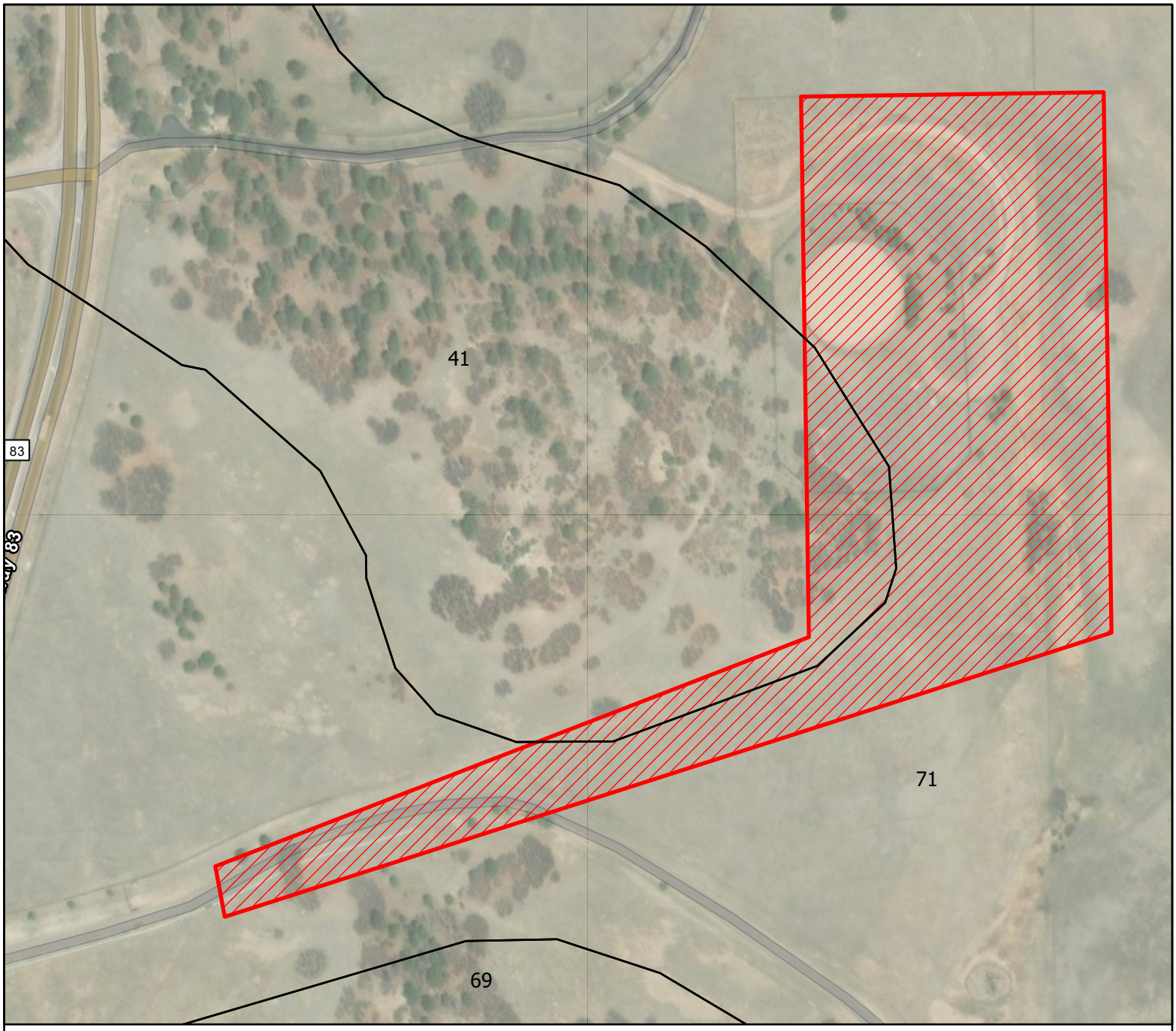
NORTHERN DELIVERY SERVICE
BOOSTER PUMP STATION

VICINITY MAP

Path: N:\Projects\224-Triview Metro District\224.29 Northern Regional Water Delivery Project - Phase 2\Documents\Drainage\GIS\Trivewmxd



Map Unit Symbol	Map Unit Name	Rating	Percent of Site, %
41	Kettle gravelly loamy sand, 8 to 40 perent slopes	B	10.8
69	Peyton-Pring complex, 8 to 15 percent slopes	B	0.0
71	Pring coarse sandly loam, 3 to 8 percent slopes	B	89.2

N

0 100 200 Feet

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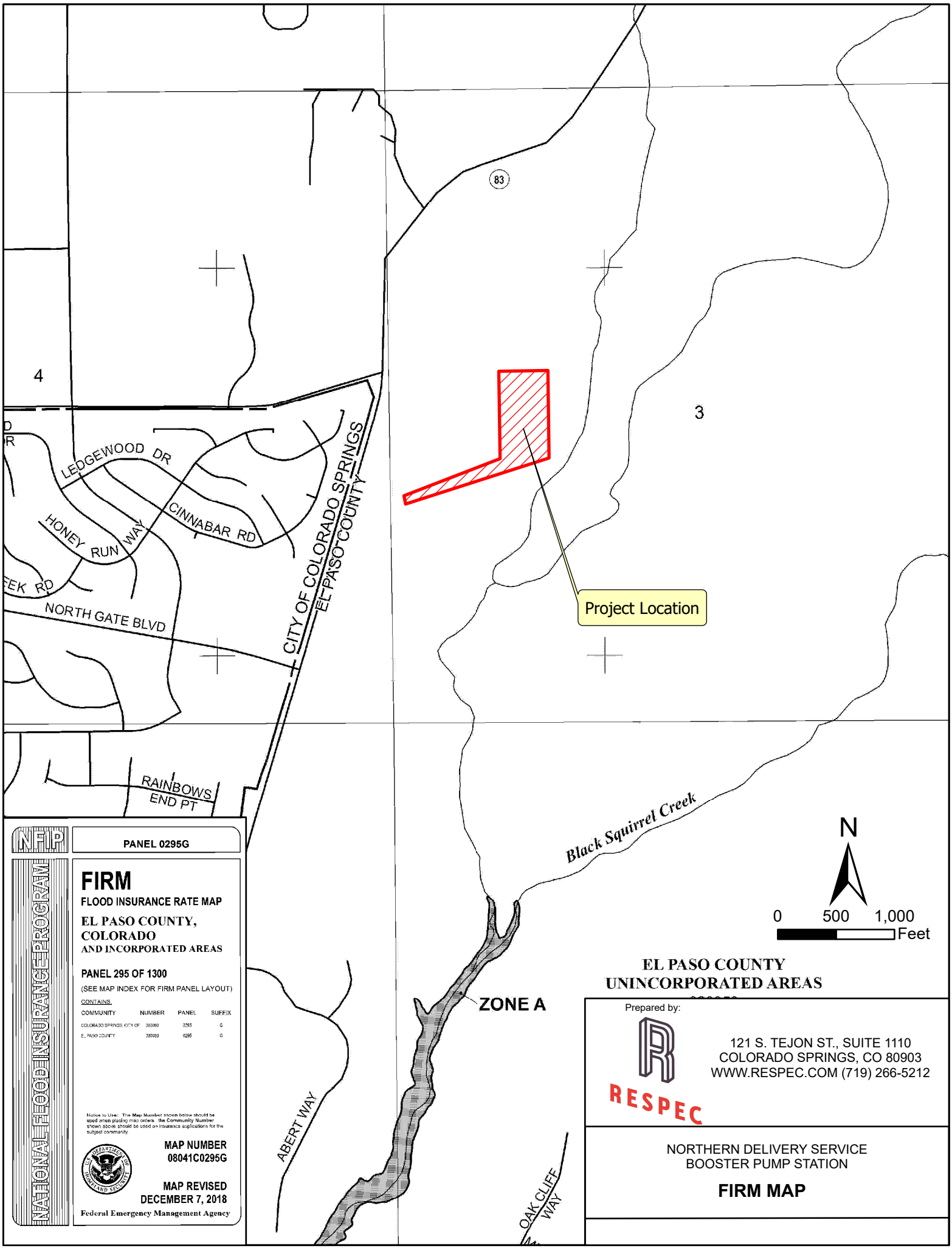
NORTHERN DELIVERY SERVICE
BOOSTER PUMP STATION

SOILS MAP



NFIP

PANEL 0295G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 295 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0295	G
EL PASO COUNTY	080059	0295	G

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0295G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

EL PASO COUNTY
UNINCORPORATED AREAS

Prepared by:

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NORTHERN DELIVERY SERVICE
BOOSTER PUMP STATION

FIRM MAP

APPENDIX B

CALCULATIONS

Northern Delivery Service Booster Pump Station

PROJ.224.29

C FACTOR CALCULATION SHEET

EXISTING CONDITIONS

RUNOFF COEFICIENT

TYPE A/B SOILS

LAND USE	**Imperv %**	**10 YR**	**100 YR**
UNDEV	0	0.15	0.35
GRAVEL ROAD	80	0.63	0.7
ASPHALT ROAD	100	0.92	0.96
ROOFS	90	0.75	0.81

EXISTING CONDITIONS

	TOTAL	SURFACE CONDITION AREAS				CALCULATED C			
AREA	AREA	UNDEV	GRAVEL	ASPHALT	ROOFS	10	100	% IMPERVIOUS	
DESIG.	(acre)		ROAD	ROAD		YR	YR		
OS1	2.74	2.16	0.58	0.00	0.00	**0.25**	**0.42**		**16.93**
OS2	3.68	3.54	0.14	0.00	0.00	**0.17**	**0.36**		**3.04**
Aex	3.89	3.79	0.10	0.00	0.00	**0.16**	**0.36**		**2.06**
Bex	2.37	2.15	0.22	0.00	0.00	**0.19**	**0.38**		**7.43**
Cex	7.96	7.75	0.21	0.00	0.00	**0.16**	**0.36**		**2.11**
Dex	5.12	5.12	0.00	0.00	0.00	**0.15**	**0.35**		**0.00**
Eex	2.79	2.52	0.02	0.00	0.25	**0.22**	**0.39**		**8.64**
Fex	1.15	0.99	0.03	0.00	0.13	**0.25**	**0.41**		**12.26**
Gex	0.96	0.96	0.00	0.00	0.00	**0.15**	**0.35**		**0.00**
Site Percent Impervious, %		3.33							

PROPOSED CONDITIONS									
RUNOFF COEFICIENT									
TYPE A/B SOILS									
LAND USE		**Imperv %**	**10 YR**	**100 YR**					
UNDEV		0	0.15	0.35					
GRAVEL ROAD		80	0.63	0.7					
ASPHALT ROAD		100	0.92	0.96					
ROOFS		90	0.75	0.81					

PROPOSED CONDITIONS

	TOTAL	SURFACE CONDITION AREAS				CALCULATED C			
AREA	AREA	UNDEV	GRAVEL	ASPHALT	ROOFS	10	100	% IMPERVIOUS	
DESIG.	(acre)		ROAD	ROAD		YR	YR		
OS1	2.74	2.16	0.58	0.00	0.00	**0.25**	**0.42**		**16.93**
OS2	3.72	3.58	0.14	0.00	0.00	**0.17**	**0.36**		**3.01**
A	3.89	3.79	0.10	0.00	0.00	**0.16**	**0.36**		**2.06**
B	2.37	2.12	0.21	0.04	0.00	**0.21**	**0.39**		**8.78**
C	7.96	7.72	0.21	0.03	0.00	**0.16**	**0.36**		**2.49**
D	5.12	4.97	0.00	0.15	0.00	**0.17**	**0.37**		**2.93**
E	2.83	2.45	0.00	0.10	0.28	**0.25**	**0.42**		**12.44**
F	1.15	0.99	0.03	0.00	0.13	**0.25**	**0.41**		**12.26**
G	0.96	0.85	0.00	0.11	0.00	**0.22**	**0.42**		**11.46**
Site Percent Impervious, %		5.10							

Northern Delivery Service Booster Pump Station
PROJ.224.29
DRAINAGE CALCULATION SHEET
file:North Delivery Service Booster Pump Station.xlsx
OCTOBER 2022

							Initial Tci			Travel Time								
AREA	AREA	C10	C100	C10 X A	C100 X A		Slope	ti		Slope	V	Tt	TC	I10	I100	Q10	Q100	AREA
DESIG.	(acre)	(10 yr)	(100 yr)			L (ft)	(%)	(min)	L (ft)	(%)	(fps)	(min)	(min)	(in/hr)	(in/hr)	(cfs)	(cfs)	DESIG.
EXISTING CONDITIONS																		
OS1	2.74	0.25	0.42	0.69	1.15	100	5.50	9.06	540	6.10	2.40	3.75	12.81	4.38	6.31	3.0	7.3	OS1
OS2	3.69	0.17	0.36	0.63	1.33	100	7.40	8.98	495	6.60	2.50	3.30	12.28	4.46	6.41	2.8	8.5	OS2
Aex	3.89	0.16	0.36	0.62	1.40	100	7.20	9.16	1125	5.90	2.40	7.81	16.98	3.89	5.60	2.4	7.8	Aex
Bex	2.37	0.19	0.38	0.45	0.90	80	11.40	6.82	635	5.70	2.20	4.81	11.63	4.55	6.55	2.1	5.9	Bex
Cex	7.96	0.16	0.36	1.27	2.87	100	10.60	8.07	1000	8.60	2.80	5.95	14.02	4.23	6.08	5.4	17.4	Cex
Dex	5.12	0.15	0.35	0.77	1.79	100	10.20	8.26	560	9.70	3.10	3.01	11.27	4.61	6.63	3.5	11.9	Dex
Eex	2.79	0.22	0.39	0.61	1.09	70	24.20	4.81	535	10.20	3.20	2.79	7.60	5.30	7.62	3.3	8.3	Eex
Fex	1.15	0.25	0.41	0.29	0.47	55	3.20	8.03	180	14.40	3.30	0.91	8.94	5.01	7.21	1.4	3.4	Fex
Gex	0.96	0.15	0.35	0.14	0.34	100	12.00	7.82	155	12.90	3.20	0.81	8.63	5.08	7.30	0.7	2.5	Gex
DP1 (Eex + Fex + Gex + OS2)	8.59	0.19	0.38	1.67	3.22	100	12.00	7.46	750	7.90	2.70	4.63	12.09	4.49	6.46	7.5	20.8	DP1 (Eex + Fex + Gex + OS2)
DP2 (DP1 + Cex + Dex + OS1)	24.41	0.18	0.37	4.40	9.03	100	10.60	7.89	1880	7.30	2.60	12.05	19.94	3.61	5.19	15.9	46.9	DP2 (DP1 + Cex + Dex + OS1)
PROPOSED CONDITIONS																		
OS1	2.74	0.25	0.42	0.69	1.15	100	5.50	9.06	540	6.10	2.40	3.75	12.81	4.38	6.31	3.0	7.3	OS1
OS2	3.68	0.17	0.36	0.63	1.32	100	7.40	8.98	495	6.60	2.50	3.30	12.28	4.46	6.41	2.8	8.5	OS2
A	3.89	0.16	0.36	0.62	1.40	100	7.20	9.16	1125	5.90	2.40	7.81	16.98	3.89	5.60	2.4	7.8	A
B	2.37	0.21	0.39	0.50	0.92	80	11.40	6.67	635	5.70	2.20	4.81	11.48	4.58	6.58	2.3	6.1	B
C	7.96	0.16	0.36	1.27	2.87	100	10.60	8.07	1000	8.60	2.80	5.95	14.02	4.23	6.08	5.4	17.4	C
D	5.12	0.17	0.37	0.87	1.89	100	10.20	8.08	800	9.70	3.10	4.30	12.38	4.44	6.39	3.9	12.1	D
E	2.83	0.25	0.42	0.71	1.19	70	24.20	4.65	535	10.20	3.20	2.79	7.43	5.34	7.68	3.8	9.1	E
F	1.15	0.25	0.41	0.29	0.47	55	3.20	8.03	180	14.40	3.30	0.91	8.94	5.01	7.21	1.4	3.4	F
G	0.96	0.22	0.42	0.21	0.40	100	12.00	7.25	155	12.90	3.20	0.81	8.05	5.20	7.48	1.1	3.0	G
DP1 (E + F + G + OS2)	8.62	0.21	0.39	1.82	3.39	100	12.00	7.32	750	7.90	2.70	4.63	11.95	4.51	6.48	8.2	22.0	DP1 (E + F + G + OS2)
DP2 (DP1 + C + D + OS1)	24.44	0.19	0.38	4.65	9.30	100	10.60	7.80	1880	7.30	2.60	12.05	19.86	3.62	5.20	16.8	48.4	DP2 (DP1 + C + D + OS1)

Manning Formula: Proposed Swale 10-Year Flows

Irregular Section

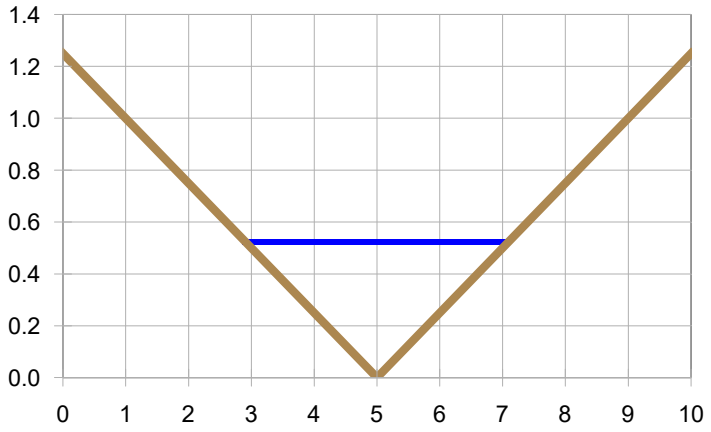
Input

Flow	3.8 cfs
Slope	0.085 ft/ft

Sta	Elev	n	Sta	Elev	n	Sta	Elev	n	Sta	Elev	n
0	1.25	0.05	5	0	0.05	10	1.25	0.05			

Output

WSElev	0.523 ft
Flow Area	1.09 sf
Velocity	3.47 fps
Velocity Head	0.187 ft
Top Width	4.18 ft
Froude Number	1.20
Critical WSElev	0.562 ft
Critical Slope	ft/ft



Manning Formula: Proposed Swale 100-Year Flows

Irregular Section

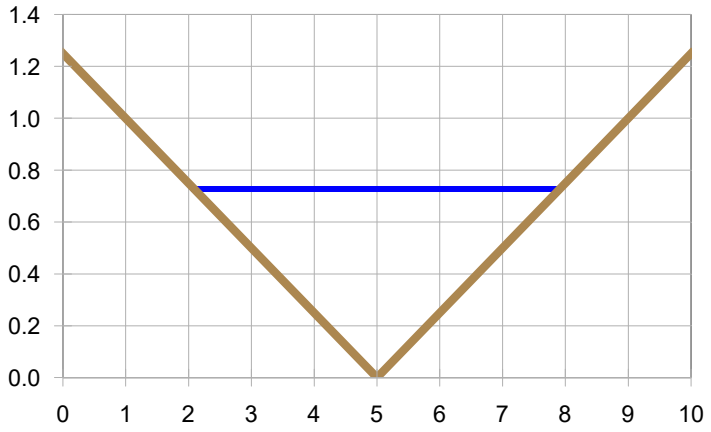
Input

Flow	9.1 cfs
Slope	0.085 ft/ft

Sta	Elev	n	Sta	Elev	n	Sta	Elev	n	Sta	Elev	n
0	1.25	0.05	5	0	0.05	10	1.25	0.05			

Output

WSElev	0.726 ft
Flow Area	2.11 sf
Velocity	4.32 fps
Velocity Head	0.290 ft
Top Width	5.81 ft
Froude Number	1.26
Critical WSElev	0.797 ft
Critical Slope	ft/ft



APPENDIX C

DESIGN CHARTS

3.1. - Rational Method Runoff Coefficient (C)

The runoff coefficient represents the integrated effects of infiltration, detention storage, evaporation, retention, flow routing, and interception, all of which affect the time distribution and peak rate of runoff. Runoff coefficients are based on the imperviousness of a particular land use and the hydrologic soil type of the area and are to be selected in accordance with Table 6-6.

The procedure for determining the runoff coefficient includes these steps:

1. Categorize the site area into one or more similar land uses, each with a representative imperviousness, according to the information in Table 6-6.
2. Based on the dominant hydrologic soil type in the area, use Table 6-6 to estimate the runoff coefficient for the particular land use category for the design storms of interest.
3. Calculate an area-weighted average runoff coefficient for the site based on the runoff coefficients from individual land use areas of the site.

When analyzing an area for design purposes, urbanization of the full watershed, including both on-site and off-site areas, shall be assumed.

Gravel parking areas, storage areas, and access drives proposed on Site Improvement Plans shall be analyzed based on an imperviousness of 80%. This is due to the potential for gravel areas being paved over time by property owners and the resulting adverse impacts on the stormwater management facilities and adjacent properties.

There are some circumstances where the selection of impervious percentage values may require additional investigation due to unique land characteristics (e.g., recent burn areas). When these circumstances arise, it is the designer's responsibility to verify that the correct land use assumptions are made.

When multiple sub-basins are delineated, the composite C value calculation is:

$$C_c = (C_1 A_1 + C_2 A_2 + C_3 A_3 + \ldots C_i A_i)/A_t \qquad \text{(Eq. 6-6)}$$

Where:

C_c = composite runoff coefficient for total area

C_i = runoff coefficient for subarea corresponding to surface type or land use

A_i = area of surface type corresponding to Ci (units must be the same as those used for total area)

A_t = total area of all subareas for which composite runoff coefficient applies

i = number of surface types in the drainage area

Table 6-6. Runoff Coefficients for Rational Method

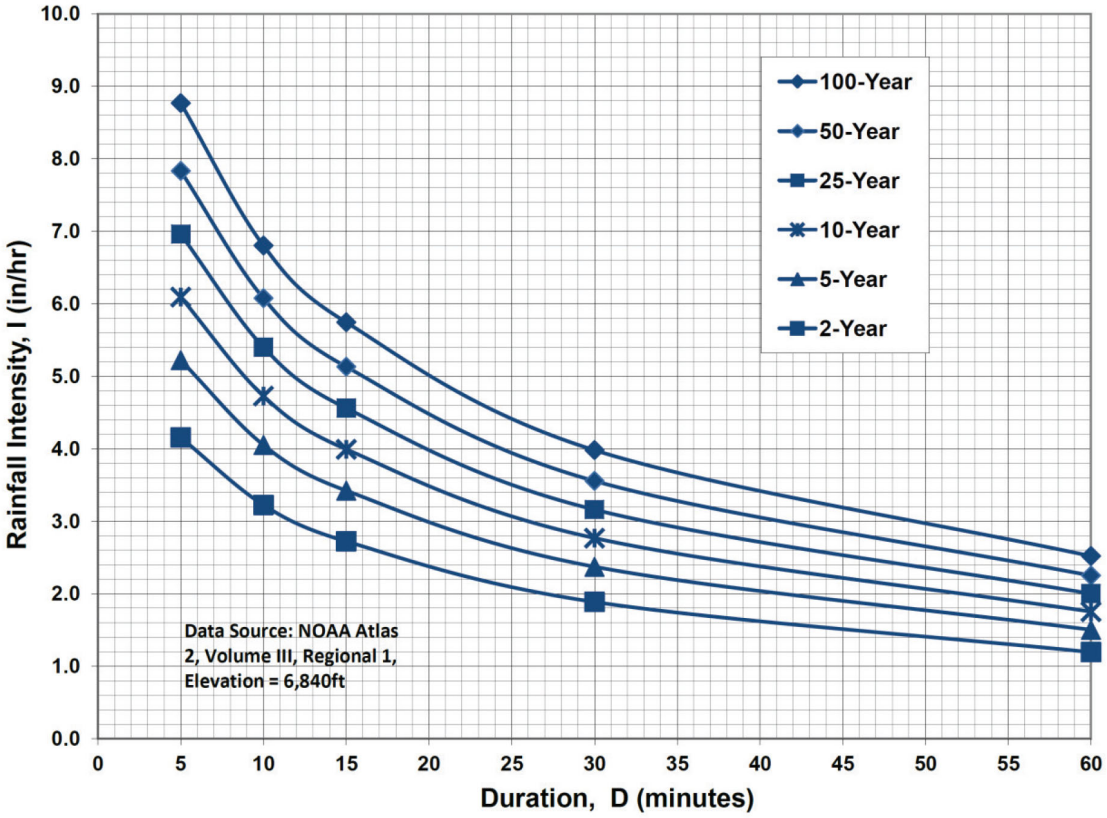
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients					
		2-year	5-year	10-year	25-year	50-year	100-year

		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
⅛ Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
¼ Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
⅓ Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
½ Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													

Historic Flow Analysis—Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

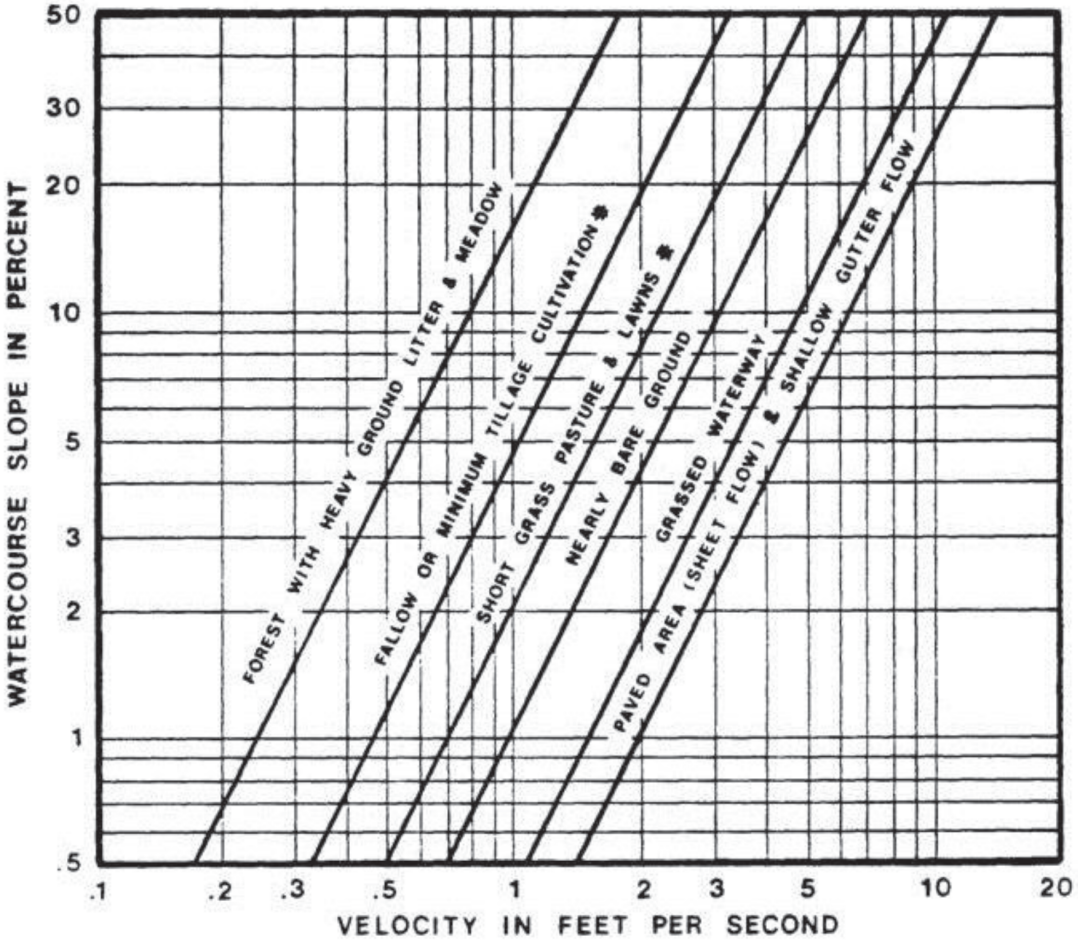
$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

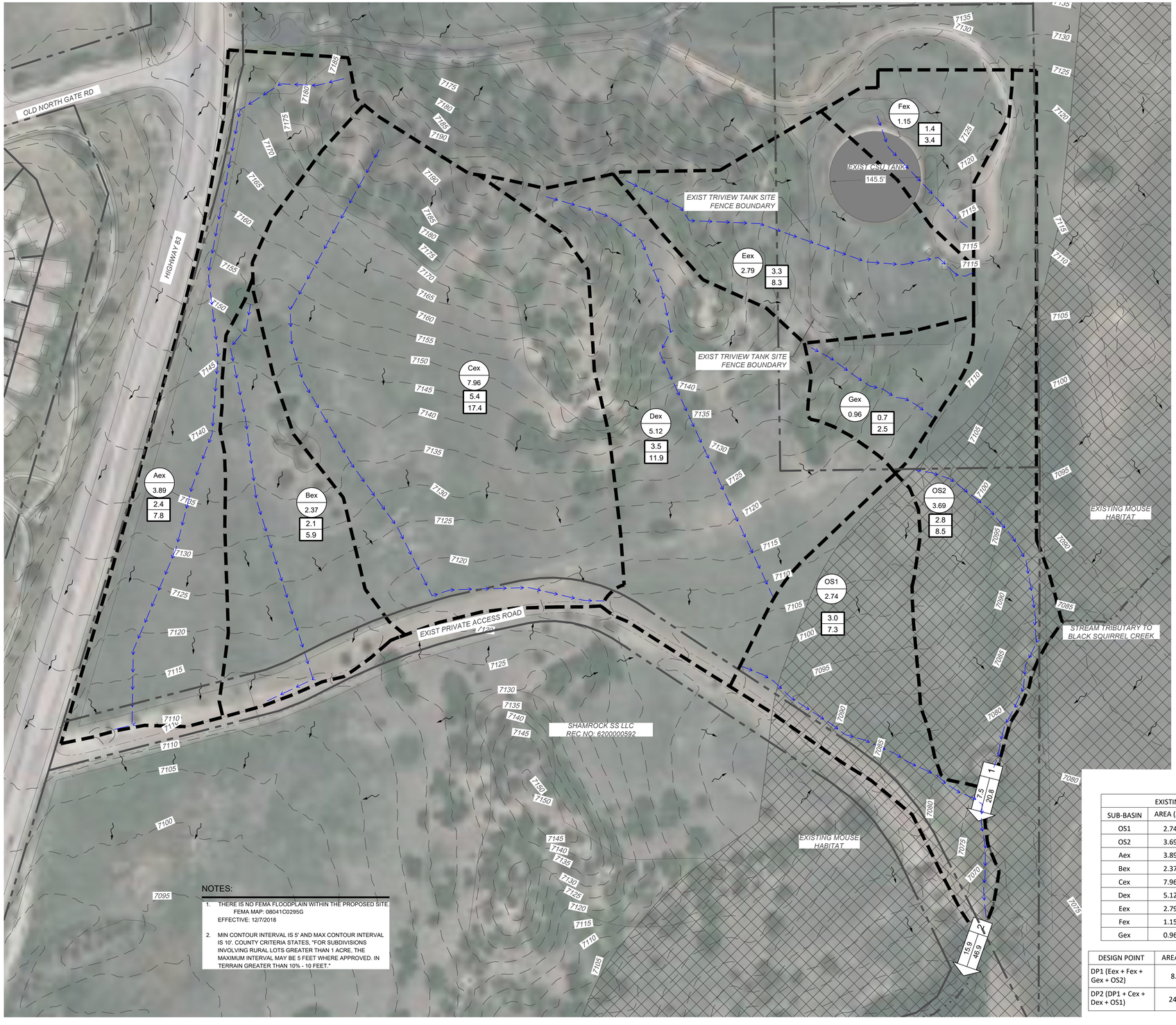
$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Figure 6-25. Estimate of Average Concentrated Shallow Flow



BACK POCKET



NOTES:

1. THERE IS NO FEMA FLOODPLAIN WITHIN THE PROPOSED SITE
   FEMA MAP: 08041C0295G
   EFFECTIVE: 12/7/2018
2. MIN CONTOUR INTERVAL IS 5' AND MAX CONTOUR INTERVAL IS 10'. COUNTY CRITERIA STATES, "FOR SUBDIVISIONS INVOLVING RURAL LOTS GREATER THAN 1 ACRE, THE MAXIMUM INTERVAL MAY BE 5 FEET WHERE APPROVED. IN TERRAIN GREATER THAN 10% - 10 FEET."

VICINITY MAP
N.T.S.

BENCHMARKS

TOPOGRAPHY SURVEY CENTENNIAL LAND SURVEYING, LLC. SEE SURVEY FOR ESTABLISHED CONTROL. THE FOLLOWING COORDINATE SYSTEM AND DATUM RECORD IS AS FOLLOWS:

HORIZONTAL DATUM: HORIZONTAL COORDINATES ARE MODIFIED COLORADO STATE PLANE CENTRAL BASED UPON THE FOLLOWING: COORDINATES ARE SCALED FROM CONTROL POINT 5052 BEING A 2-INCH ALUMINUM CAP STAMPED AZTEC CP 52 SET AT THE TOP OF A DIRT BANK ALONG THE EAST SIDE OF GLEN EAGLE DR. APPROXIMATELY 380+- FEET NORTHERLY OF ST. LAWRENCE WAY. VALUES ARE BASED UPON A STATIC SURVEY SESSION WITH THE FOLLOWING RESULTS:
LATITUDE: 39-04-05916N; LONGITUDE: 104-49-24.82486 W
STATE PLANE NORTHING: 1,450,401.759; STATE PLANE EASTING: 3,192,049.712
SCALE FACTOR: 1.0004063250
TRUNCATE NORTHING: 1,000,000.00; TRUNCATE EASTING: 3,000,000.00
PROJECT NORTHING: 450,401.759; PROJECT EASTING: 192,049.712

VERTICAL DATUM: NAVD 88 WITH GEOID G18US; BENCHMARK: CP 5052 EL: 7213.70
BENCHMARK: NGS CS110/DM3842 EL: 6843.25;BENCHMARK: NGS S294/KK0272 EL: 7116.72

LEGEND

- EXIST BASIN DESIGNATION (A1A) / EXIST BASIN AREA, ACRES (XX) — EXIST BASIN CALLOUT
- EXIST 10 YEAR STORM, CFS (XX) / EXIST 100 YEAR STORM, CFS (XX) — EXIST BASIN INFORMATION
- EXIST DESIGN POINT (XX) — EXIST 10 YEAR ACCUMULATED FLOW, CFS (XX.X) / EXIST 100 YEAR ACCUMULATED FLOW, CFS (XX.X)
- EXISTING DIRECTION OF DRAINAGE FLOW
- EXISTING EASEMENT LINE
- EXISTING SUB-BASIN BOUNDARY
- EXISTING MAJOR CONTOUR (7290)
- EXISTING MINOR CONTOUR (7291)
- EXISTING TIME OF CONCENTRATION PATH
- EXISTING PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING STREAM CENTERLINE
- EXISTING PROPERTY BOUNDARY
- EXISTING MOUSE HABITAT

EXISTING CONDITIONS			
SUB-BASIN	AREA (AC)	Q10 (CFS)	Q100 (CFS)
OS1	2.74	3.0	7.3
OS2	3.69	2.8	8.5
Aex	3.89	2.4	7.8
Bex	2.37	2.1	5.9
Cex	7.96	5.4	17.4
Dex	5.12	3.5	11.9
Eex	2.79	3.3	8.3
Fex	1.15	1.4	3.4
Gex	0.96	0.7	2.5

DESIGN POINT	AREA (AC)	Q10 (CFS)	Q100 (CFS)
DP1 (Eex + Fex + Gex + OS2)	8.59	7.5	20.8
DP2 (DP1 + Cex + Dex + OS1)	24.41	15.9	46.9

0 60 120
SCALE IN FEET

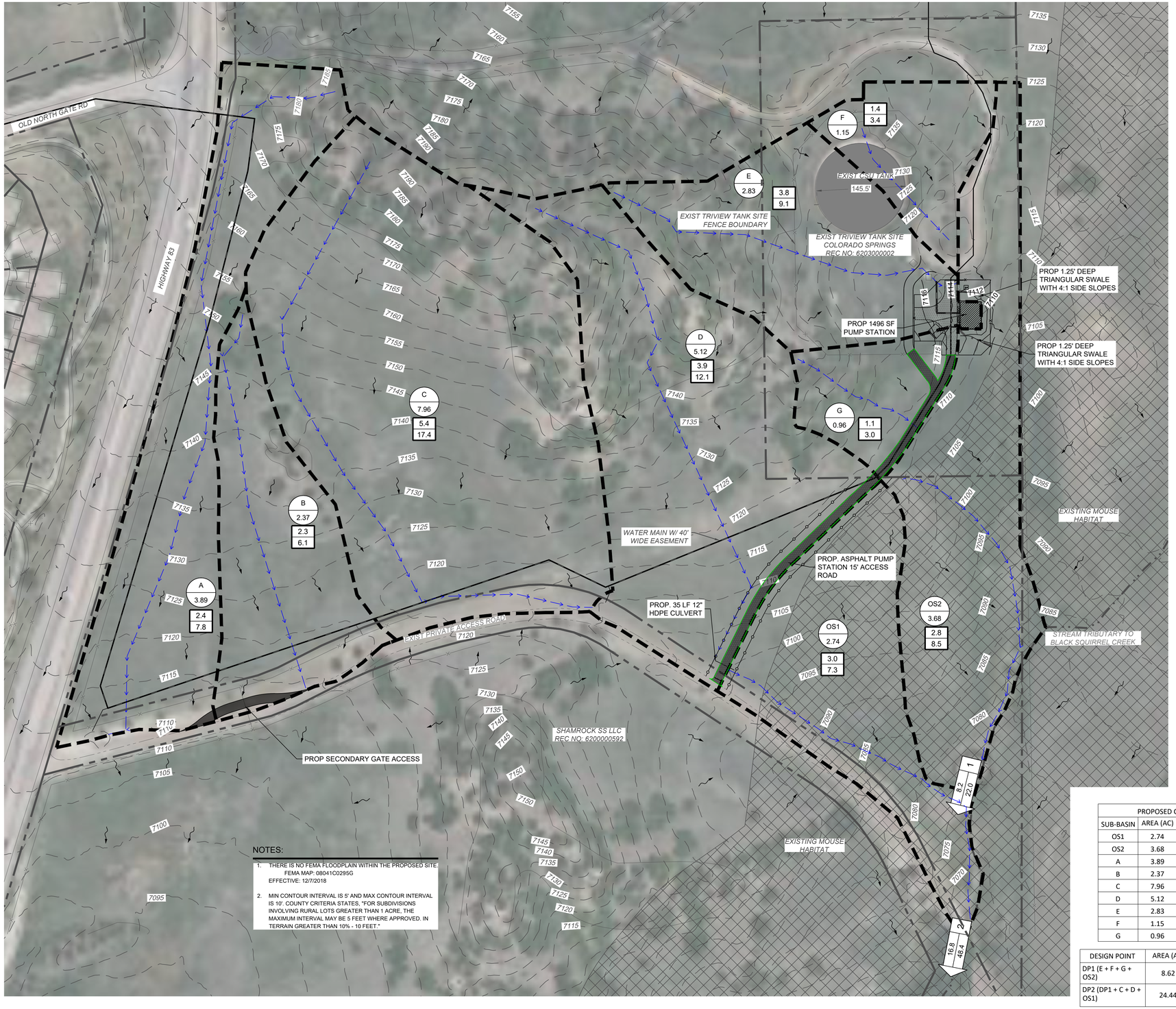
JDS-HYDRO a Division of RESPEC
5540 TECH CENTER DR., SUITE 100
COLORADO SPRINGS, COLORADO 80919
(719) 227-0072

TRIVIEW METROPOLITAN DISTRICT
NORTHERN DELIVERY SYSTEM BOOSTER PUMP STATION
EXISTING DRAINAGE PLAN

REVISIONS				
NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

Project No.: 224.29
Date: 10/2022
Design: CTD
Drawn: CTD
Check: RGG

DR1
SHEET 1 OF 2



NOTES:

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VICINITY MAP
N.T.S.

BENCHMARKS

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SCALE FACTOR: 1.0004063250

TRUNCATE NORTHING: 1,000,000.00; TRUNCATE EASTING: 3,000,000.00

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VERTICAL DATUM: NAVD 88 WITH GEOID G18US; BENCHMARK: CP 5052 EL: 7213.70

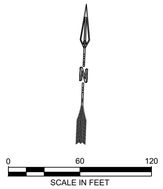
BENCHMARK: NGS CS110/DM9842 EL: 6843.25; BENCHMARK: NGS 5294/KK0272 EL: 7116.72

LEGEND

- A1A / XX — PROPOSED BASIN DESIGNATION; PROPOSED BASIN AREA, ACRES — PROPOSED BASIN CALLOUT
- XX / XX — PROPOSED 10 YEAR STORM, CFS; PROPOSED 100 YEAR STORM, CFS — PROPOSED BASIN INFORMATION
- PROPOSED DESIGN POINT — XX / XX.X / XX.X — PROPOSED 10 YEAR ACCUMULATED FLOW, CFS; PROPOSED 100 YEAR ACCUMULATED FLOW, CFS
- PROPOSED DIRECTION OF DRAINAGE FLOW
- EXISTING EASEMENT LINE
- PROPOSED SUB-BASIN BOUNDARY
- PROPOSED ASPHALT PAVEMENT
- 7290 — PROPOSED MAJOR CONTOUR
- 7291 — PROPOSED MINOR CONTOUR
- —7290— EXISTING MAJOR CONTOUR
- —7291— EXISTING MINOR CONTOUR
- PROPOSED TIME OF CONCENTRATION PATH
- EXISTING PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING STREAM CENTERLINE
- EXISTING MOUSE HABITAT
- PROPOSED WATERLINE
- UGE — PROPOSED UNDERGROUND ELECTRIC LINE

PROPOSED CONDITIONS			
SUB-BASIN	AREA (AC)	Q10 (CFS)	Q100 (CFS)
OS1	2.74	3.0	7.3
OS2	3.68	2.8	8.5
A	3.89	2.4	7.8
B	2.37	2.3	6.1
C	7.96	5.4	17.4
D	5.12	3.9	12.1
E	2.83	3.8	9.1
F	1.15	1.4	3.4
G	0.96	1.1	3.0

DESIGN POINT	AREA (AC)	Q10 (CFS)	Q100 (CFS)
DP1 (E + F + G + OS2)	8.62	8.2	22
DP2 (DP1 + C + D + OS1)	24.44	16.8	48.4



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Project No.: 224.29
Date: 10/2022
Design: CTD
Drawn: CTD
Check: RGG

DR2
SHEET 2 OF 2

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2023/02/10 2:29 PM By: Richard Gallegos