

Final Drainage Report

El Paso County

Package 3 - Pedestrian Crossings Project

El Paso County

October 30, 2025



Design Engineer's Statement:

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

Registered Professional Engineer
State of Colorado
No.



EL PASO COUNTY:

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

County Engineer

Date

Conditions:

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Introduction

Purpose

The purpose of the overall project is to improve pedestrian safety for 24 intersections throughout El Paso County (county) and includes updates to sidewalks and crosswalks. This report focuses on Package 3 the intersections where drainage patterns will be changed due to bump outs, raised cross walks, addition of curb and gutter, etc. Therefore Fontaine Boulevard at Fountain Mesa Road and Fontaine Boulevard at Metropolitan Street are not needed in the analysis. The analysis for all the other intersections checks whether proposed design still meets county criteria or if further changes need to be made.

General Location

The project locations included in the Package 3 analysis are:

- Fontaine Boulevard (Blvd) at Dartmouth Street (Basin 5)
- Peterson Road mid-block crossing near Sequoyah Way (Basin 6)
- Constitution Avenue at Piros Drive (Basin 11)
- Black Forest at Shoup (Basin 14)
- Crestridge Avenue at B Street (Basin 17)
- Galley Road at Hathaway Drive (Basin 20)
- Security Boulevard at Grand Boulevard (Basin 22)

The project locations included in Package 3 that did not require spread and depth analysis are:

- Fontaine Boulevard at Fountain Mesa Road (Basin 23)
- Fontaine Boulevard at Metropolitan Street (Basin 24)

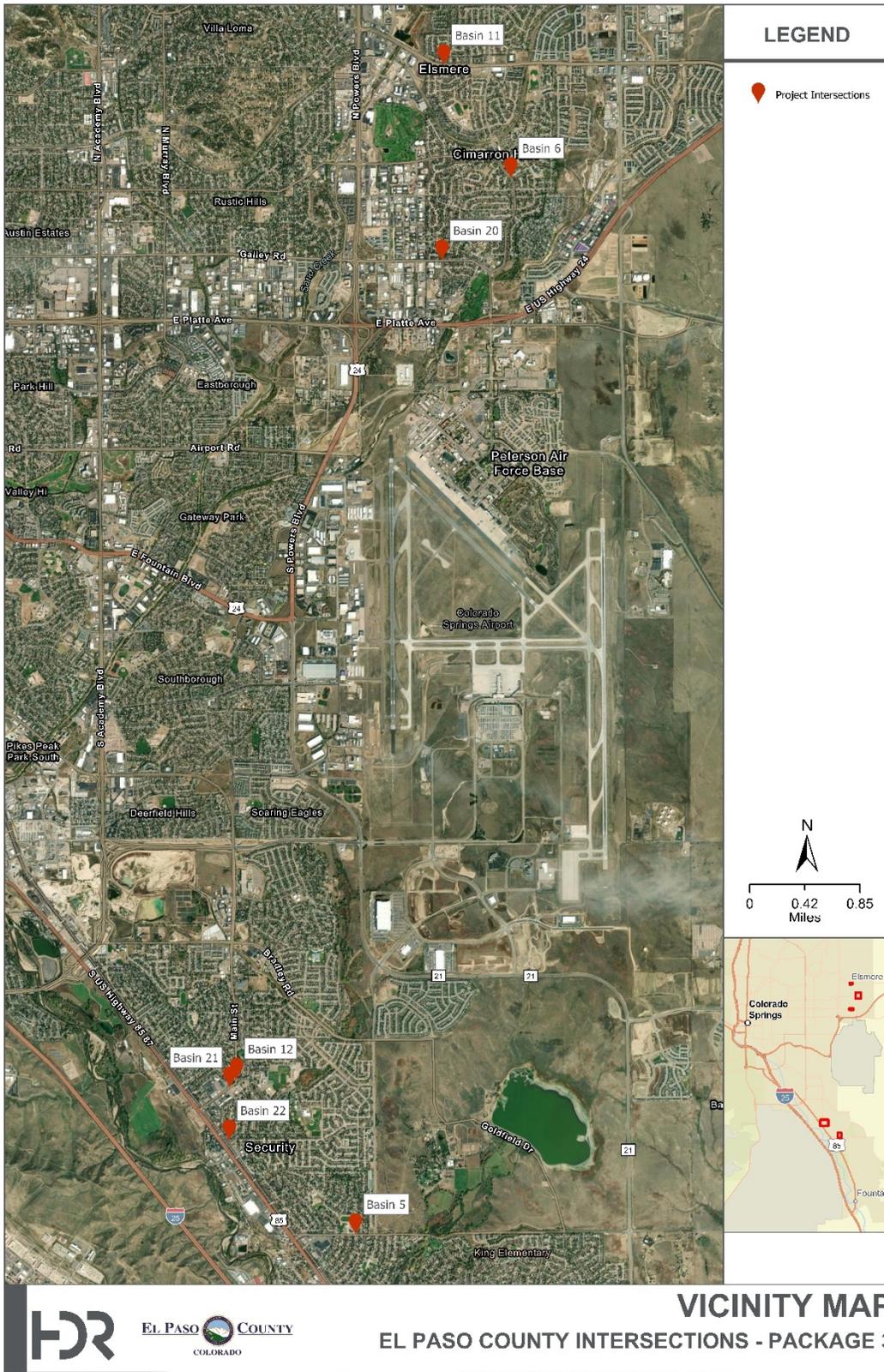


Figure 1: Vicinity Map



Drainage Design Criteria

Pedestrian improvements resulting in potential changes to existing flow patterns for this project will be analyzed against and designed to meet criteria from the El Paso County (EPC) Drainage Criteria Manual (DCM) and Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual (USDCM). The references used for the on-site drainage, off-site drainage, and water quality are listed below.

- Drainage Criteria Manual, Volume I and Volume II, El Paso County, October 31, 2018.
- Urban Storm Drainage Criteria Manual Volume 2, revised January 2016 and Volume 3, March 2024.
- Drainage Criteria Manual, Volume II, City of Colorado Springs, December 2020.

Hydrologic Criteria

Hydrology will be developed at each site using the rational method. This method is accepted by El Paso County for sites less than 100 acres (Section 5.1 EPC-DCM). Soil information will be obtained from the National Resource Conservation Service (NRCS) Websoil Survey. Rainfall data will be determined by using NOAA Atlas-14 since it is more recent than the Intensity-Frequency Curves (Figure 5-1 EPC-DCM). Hydrologic criteria has been summarized below in Table 6-2.

Table 1: Hydrologic Criteria Summary Table

Hydrology	El Paso County Drainage Criteria Manual
Acceptable Methods	Rational Method for Basins <100acres
Precipitation Data	NOAA Atlas-14
Design Storms	Major: 100-Year Minor: 10-Year
C-Value	Table 5-1



Hydraulic Criteria

A summary of the hydraulic criteria in accordance with the EPC DCM has been outlined below in Table 6-1.

TABLE 2: HYDRAULIC CRITERIA SUMMARY TABLE

Roadway Classification	El Paso County Drainage Criteria Manual
Arterial	Minor: No curb overtopping. Flow may encroach only onto one outside lane in each direction and must leave at least one 12-foot lane free of water in each direction. Major: The depth of water shall not exceed 8 inches at the gutter flow line with no curb overtopping. Residential dwellings, public, commercial, or industrial shall not be inundated at the ground line. (Ch.6, Table 6-1)
Residential/Local	Minor: Minor: No curb overtopping, flow may spread to crown of street or top of curb (whichever is most limiting) Major: Depth of water at gutter flow line shall not exceed 12". Residential dwellings, public, commercial, or industrial shall not be inundated at the ground line. (Ch.6, Table 6-1)
Collector or Minor Arterial	Minor: No curb overtopping. Flow spread must be limited to a maximum 20 foot spread from each curb face. Major: Depth of water at gutter flow line shall not exceed 12". Residential dwellings, public, commercial, or industrial shall not be inundated at the ground line. (Ch.6, Table 6-1)

Water Quality Criteria

Water quality treatment is not anticipated to be needed due to the following exemptions, according to El Paso County Engineering Criteria Manual Appendix I.7. Post-Construction Stormwater Management:

- Each intersection site will involve well below the 1 acre of soil disturbance that is the threshold for water quality treatment. Furthermore, each site is greater than a quarter mile away from each other such that they will not constitute as a larger common plan of development (LCPD) (ie: their respective disturbances would not be additive towards the 1 acre threshold).



Location	Total Proposed Disturbed Area (ac)	Disturbed Area Excluded from WQ per ECM App I.7.1.B.# (ac)	Non-Excluded Disturbances (ac)	Applicable WQ Exclusions (App I.7.1.B.#)	Distance from Nearest Intersection Included with this Project (mi)	Notes
Fontaine Boulevard at Dartmouth Street	0.229	0.229	0	3,2	0.88	
Peterson Road mid-block crossing near Sequoyah Way	0.110	0.109	0.001	3,2	0.17	<0.25 miles from an adjacent Package 2 project
Constitution Ave at Piros Drive	0.194	0.194	0	3,2	0.77	
Black Forest Road at Shoup Road	0.053	0.027	0.026	3,2	9.98	
Crestridge Avenue at B Street	0.153	0.098	0.055	3,2	1.84	
Galley Road at Hathaway Drive	0.415	0.365	0.050	3,2	0.79	
Fontaine Boulevard at Fountain Mesa Road	0.246	0.101	0.145	3,2	0.20	<0.25 miles from an adjacent Package 1 project
Fontaine Boulevard at Metropolitan Street	0.510	0.441	0.069	3,2,9	0.17	<0.25 miles from an adjacent Package 1 project
Security Boulevard at Grand Boulevard	0.056	0.056	0	3,2	0.43	

Furthermore, each site is applicable to the following PCM exclusions:

- Site adds less than 1 acre of paved area per mile
- Site adds 8.35 ft or less of paved width at any location throughout the project
- Project increases the width of the existing roadway by less than two times the existing width

In the case that the soil disturbance at a site or sites part of a LCPD exceeds 1 acre and no PCM exclusions apply then none of these exemptions apply at a location, post-construction stormwater management may be required per the El Paso County Post Construction Stormwater Management Applicability Evaluation Form.

Erosion and Stormwater Quality Control Permit (ESQCP) will not be necessary due to disturbance being less than one acre.

Floodplain

Each site will be compared with Flood Insurance Rate Maps found in the FEMA Flood Map Service Center to ensure floodplains are noted and considered in design. No Floodplain impacts are anticipated with this project.

Roadway Drainage Analysis

Project Description

The project consists of various sites located throughout El Paso County. The project scope focuses on pedestrian safety improvements for multiple intersections throughout the county. This analysis focuses on how the pedestrian safety improvements affect drainage patterns and examines whether spread and/or depth have improved or worsened. This project will not address existing drainage issues, but checks that conditions are not worsened.

Sub- Basin Delineation

The sub-basins for project were delineated using El Palso County LiDAR set to a horizontal projection of NAD (1983 2011) State Plane Colorado Central FIPS 0502 Ft US and vertical projection of North American Datum 1988.

Drainage Basin Descriptions

The 10-Year and 100-Year peak discharge events (Minor and Major storm events) were analyzed for each intersection where the proposed designed reduced the travel width of the existing roadway. It is assumed that the longitudinal slope, transverse slope, and gutter pan are the same the existing and proposed conditions with the only alteration coming from a bump out in the sidewalk curb thus reducing the travel lane width.

Basin 5 - Fontaine Blvd at Dartmouth Street

This intersection includes the following basins:

- 5a
 - Subbasin 5a drains to the southbound lane at the northwest corner of Fontaine Blvd at Dartmouth Street and made up primarily of parks. The basin slope is approximately 2.7% with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group B.
- 5b
 - Subbasin 5b drains to the northbound lane at the northeast corner of Fontaine Blvd at Dartmouth Street and made up primarily of residential homes. The basin slope is approximately 2.7% with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group B.
- 5c
 - Subbasin 5c was delineated to examine potential effects of the proposed median. Flow drains to the westbound lane at the northeast corner of Fontaine Blvd at Dartmouth Street and made up primarily of residential homes. The basin slope is approximately 3.2% with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group A.
- 5d
 - Subbasin 5d drains to the southeast corner of Fontaine Blvd at Dartmouth Street and made up primarily of paved streets. The basin slope is approximately 2.6%

with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group A.

- 5e
 - Subbasin 5e drains to the southwest corner of Fontaine Blvd at Dartmouth Street and made up primarily of paved streets. The basin slope is approximately 8.1% with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group A.
- 5f
 - Subbasin 5f was delineated to examine potential effects of the proposed median. Flow drains to the westbound lane at the northwest corner of Fontaine Blvd and Dartmouth Street and made up primarily of residential homes. The basin slope is approximately 3% with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group B.

Basin 6 - Peterson Road mid-block crossing near Sequoyah Way

This intersection includes the following basins:

- 6a
 - Subbasin 6a drains to the Southwest bound lane to the southeast corner of the Peterson Road mid-block crossing near Sequoyah Way and made up primarily of residential homes. The basin slope is approximately 3.6% with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group A.
- 6b
 - Subbasin 6b was delineated to examine potential effects of the proposed median. Flow drains to the northwest bound lane to the northeast corner of the Peterson Road mid-block crossing near Sequoyah Way and made up primarily of residential homes. The basin slope is approximately 3.9% with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group A.
- 6c
 - Subbasin 6c was delineated to examine potential effects of the proposed median. Flow drains to the southeast bound lane to the south curb at Peterson Road mid-block crossing near Sequoyah Way and made up primarily of residential homes. The basin slope is approximately 3.8% with an approximate width of feet and feet. The soil type in this subbasin is hydrologic soil group A.

Basin 11 - Constitution Ave at Piros Drive

This intersection includes the following basins:

- 11a
 - Subbasin 11a drains to the northwest corner of Constitution Ave at Piros Dr and made up primarily of paved streets. The basin slope is approximately 5.1% with an approximate width of 85 feet and length of 129 feet. The soil type in this subbasin is hydrologic soil group A.
- 11b

- Subbasin 11c drains to the southeast corner of Constitution Ave at Piros Dr and made up primarily of paved streets. The basin slope is approximately 3.7% with an approximate width of 35 feet and length of 550 feet. The soil type in this subbasin is hydrologic soil group A.
- 11e
 - Subbasin 11e drains to the west median on Constitution Ave at Piros Dr and made up primarily of paved streets. The basin slope is approximately 4.6% with an approximate width of 25 feet and length of 160 feet. The soil type in this subbasin is hydrologic soil group A.

Basin 14 - Black Forest Road at Shoup Road

This intersection includes the following basins:

- 14c
 - Subbasin 14c drains to the northwest corner in the southbound lane of Black Forest Road at Shoup Road and made up primarily of paved streets. The basin slope is approximately 4.1% with an approximate width of 40 feet and length of 75 feet. The soil type in this subbasin is hydrologic soil group B.
- 14d
 - Subbasin 14d drains to the southwest corner of Black Forest Road at Shoup Road and made up primarily of paved streets. The basin slope is approximately 1.6% with an approximate width of 50 feet and length of 135 feet. The soil type in this subbasin is hydrologic soil group B.

Basin 20 - Galley Road at Hathaway Drive

This intersection includes the following basins:

- 20a
 - Subbasin 20a drains to the northeast corner of Galley Road at Hathaway Drive and made up primarily of residential homes. The basin slope is approximately 2.7% with an approximate width of 70 feet and length of 885 feet. The soil type in this subbasin is hydrologic soil group A.
- 20b
 - Subbasin 20b drains to the southwest corner, of Galley Road at Hathaway Drive and made up primarily of residential homes. The basin slope is approximately 3% with an approximate width of 220 feet and length of 2000 feet. The soil type in this subbasin is hydrologic soil group A.
- 20c
 - Subbasin 20c drains to the southeast corner of Galley Road at Hathaway Drive and made up primarily of residential homes. The basin slope is approximately 2.5% with an approximate width of 200 feet and length of 800 feet. The soil type in this subbasin is hydrologic soil group A.
- 20d
 - Subbasin 20d drains to the northwest corner of Galley Road at Hathaway Drive and made up primarily of paved streets. The basin slope is approximately 2.4%

with an approximate width of 25 feet and length of 110 feet. The soil type in this subbasin is hydrologic soil group A.

Basin 22 – Security Boulevard at Grand Boulevard

This intersection includes the following basins:

- 22c
 - Subbasin 22c was delineated to examine potential effects of the proposed bump out. Flow drains in the northwest bound lane to the crosswalk on Security Boulevard near Grand Boulevard and made up primarily of residential homes. The basin slope is approximately 1.6% with an approximate width of 1,000 feet and length of 6700 feet. The soil type in this subbasin is hydrologic soil group A and group B.
- 22d
 - Subbasin 22d was delineated to examine potential effects of the proposed median. Flow drains in the northeast bound lane to the crosswalk on Main Street near Marquette Drive and made up primarily of residential homes. The basin slope is approximately 0.3% with an approximate width of 100 feet and length of 150 feet. The soil type in this subbasin is hydrologic soil group A and group B.

Intersection Analysis

Proposed pedestrian improvements were analyzed at locations where bump outs and/or medians resulted in reduction of roadway width. The proposed design's spread and depth results were initially checked against El Paso County Criteria using Bentley FlowMaster by modeling a standard gutter channel. Spread was measured from the edge of pavement to the crown and depth was measured at the gutter flowline.

For proposed design, curb and gutter dimensions were assumed to be Type A standard dimensions from El Paso County's Roadway Criteria.

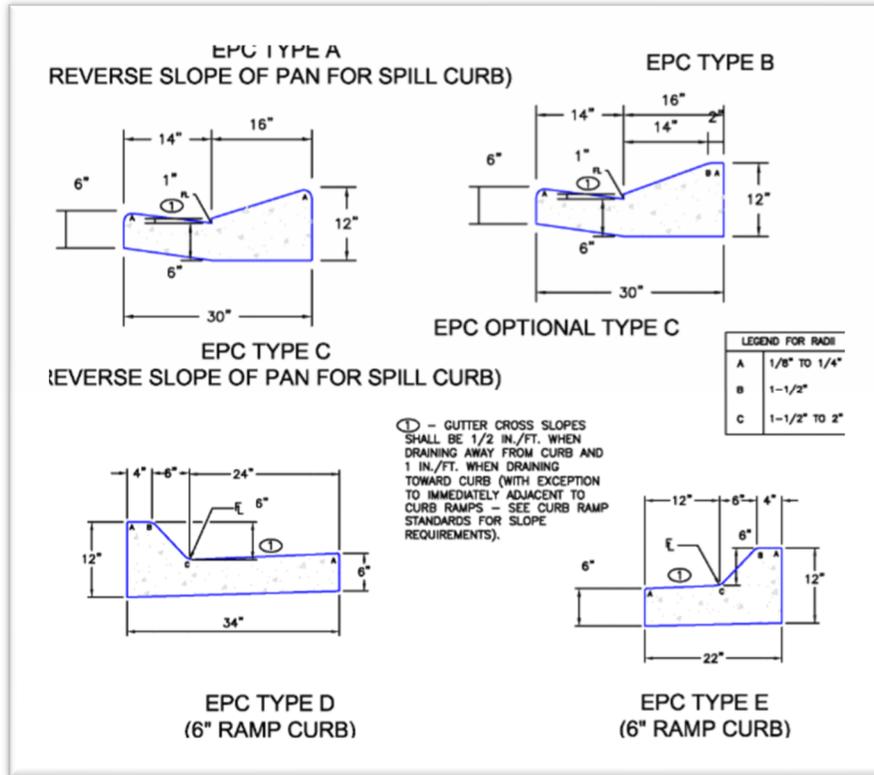


Figure 2: Standard El Paso County Curb and Gutter

Any locations where the proposed spread and depth met the criteria were considered acceptable. In situations where the criteria was not met, a secondary analysis that utilized a more detailed model of the roadway cross section was created in FlowMaster to verify the initial result and to compare the existing conditions versus proposed conditions. The results evaluated whether the proposed design improved or worsened the spread and depth or if conditions remained the same.

Proposed Conditions Results

20 design points over 5 intersections were examined where spread and depth were analyzed and checked against El Paso County’s Drainage Criteria. A detailed analysis of all design points can be seen in Appendix D and Appendix E.

In the minor, 10-year storm event, 4 design points did not pass the initial curb and gutter analysis and were further evaluated in more detail. Spread and Depth results for the secondary analysis can be found in Tables 3 and 4 below. In the major, 100-year storm event, all design points passed the initial curb and gutter analysis and did not need further evaluation.

Once the proposed design for these design points were modeled in more detail, they were compared to the existing conditions. Most results show that spread and depth do not meet criteria, however they do show either improved conditions or conditions that remained the same, therefore the results are acceptable. One result, at design point 22c, shows slightly worsened conditions, however the change is less than an inch and therefore negligible.

TABLE 3: 10-YEAR SPREAD RESULTS FOR PROPOSED LOCATIONS NOT MEETING CRITERIA STANDARDS

Intersection And Proposed Structure	Basin ID	Discharge (cfs)	Existing Distance from Edge of Road to Crown (ft)	Existing Spread (ft)	Proposed Distance from Edge of Road to Crown (ft)	Proposed Spread (ft)	Spread Criteria Overage (ft)	Street Type and Spread/Depth Criteria
Fontaine Blvd at Dartmouth Street Median	5c	11.6	18.1	10.6	25.0	10.6	No	Collector or Minor Arterial Max 20' spread
Fontaine Blvd at Dartmouth Street Median	5f	27.3	21.3	15.0	13.9	13.9	No	Collector or Minor Arterial Max 20' spread

TABLE 4: 10-YEAR DEPTH RESULTS FOR PROPOSED LOCATIONS NOT MEETING CRITERIA STANDARDS

Intersection And Proposed Structure	Basin ID	Discharge (cfs)	Existing Depth at Flowline (in)	Proposed Depth at Flowline (in)	Depth Criteria Overage (in)	Street Type and Spread/Depth Criteria
Fontaine Blvd at Dartmouth Street Median	5c	11.6	6.9	6.9	0.9**	Collector or Minor Arterial Max 6"
Fontaine Blvd at Dartmouth Street	5f	27.3	8.3	8.2	Yes**	Collector or Minor Arterial Max 6"
Security Blvd at Grand Blvd	22c	30.20	8.2	8.8	Yes***	Collector or Minor Arterial Max 6"

**Depth exceeds criteria, but the increase from existing conditions is considered negligible

* Depth overtops back of curb

Conclusion

This project is focused on the improvements to existing pedestrian facilities including work such as sidewalks, cross walks, curb ramps, and medians that generally have minimal stormwater impacts. Due to concrete bump out structures and medians, roadway travel lanes were reduced at multiple locations which were the major focuses for this analysis.

In proposed conditions, runoff will drain around the bump outs via standard curb and gutter. In most locations, the proposed results meet criteria for the 10-year and 100-year storm events. Other locations which do not meet criteria in proposed conditions show improved or unchanged results for depth and spread, therefore the proposed improvements are acceptable.

References

1. Colorado Department of Transportation, 2019 Drainage Design Manual, <https://www.codot.gov/business/hydraulics/drainage-design-manual>
2. El Paso County, Drainage Criteria Manual, Version: Oct. 31, 2018 (Current), <https://publicworks.elpasoco.com/stormwater/>
3. El Paso County, Engineering Criteria Manual, Version: Oct. 14, 2020 (Current), <https://publicworks.elpasoco.com/stormwater/>
4. Mile High Flood District, Detention Design – MHFD-Detention v4.04, Feb. 2021, <https://mhfd.org/resources/software>



Appendices

Appendix A: Drainage Basin Maps

Appendix B: Soil Survey

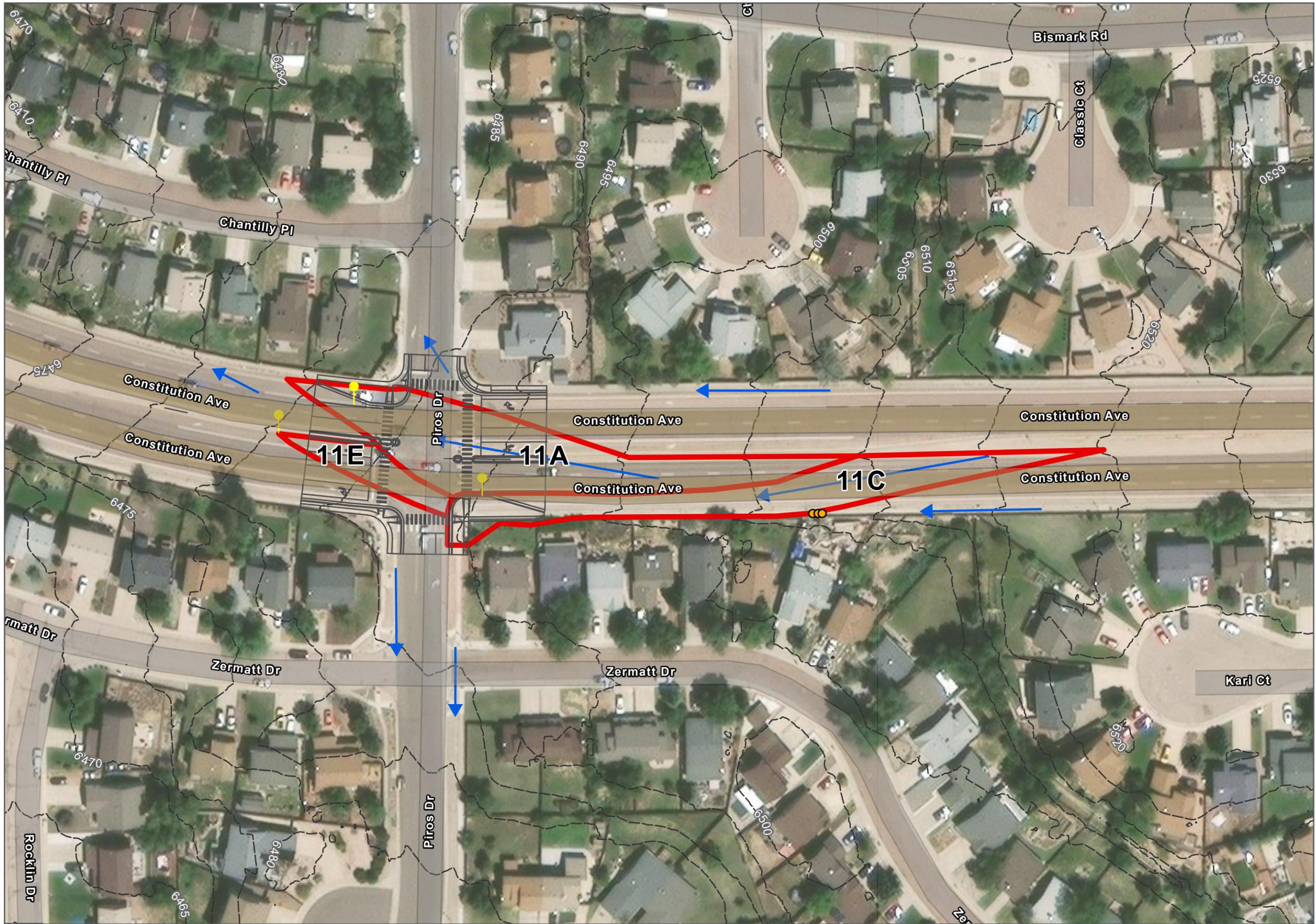
Appendix C: Precipitation Information

Appendix D: Rational Method Calculations

Appendix E: Flow Master Results



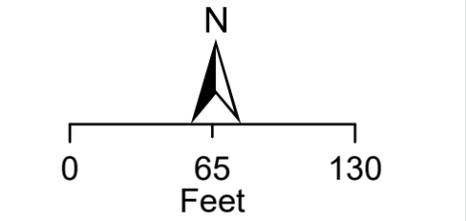
Appendix A: Drainage Basin Maps



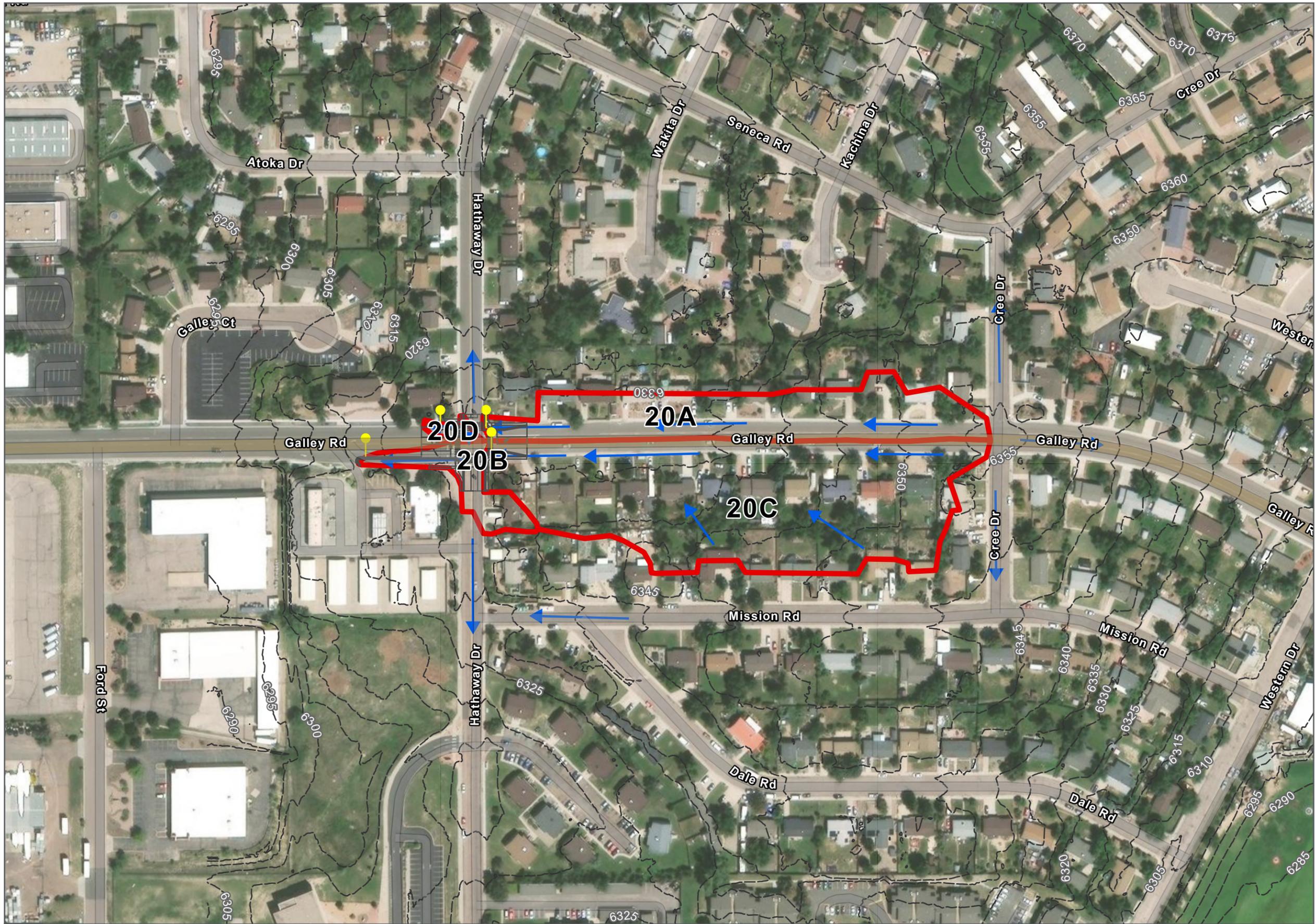
LEGEND

SUBBASIN	DesignPoints
EXISTING CONTOUR 5FT	DesignLinework
FLOW ARROW	Existing Inlet

Intersection Description
 Constitution Ave at Piros Dr



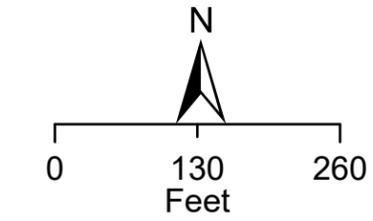
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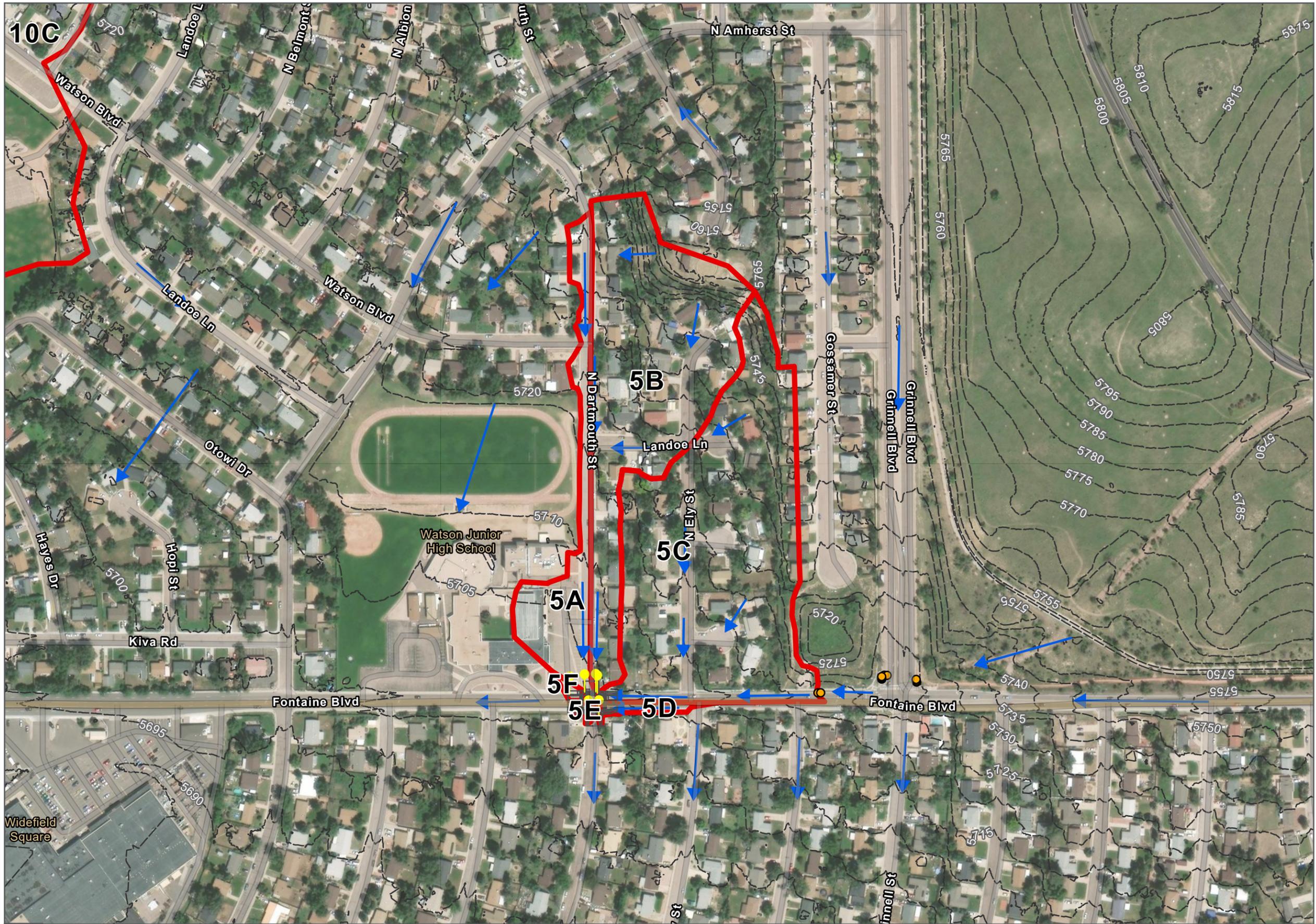
LEGEND

- ▬ SUBBASIN
- ▬ EXISTING CONTOUR 5FT
- ▶ FLOW ARROW
- DesignPoints
- ▬ DesignLinework
- Existing Inlet

Intersection Description
Galley Road at Hathaway Drive



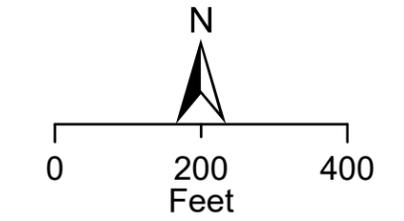
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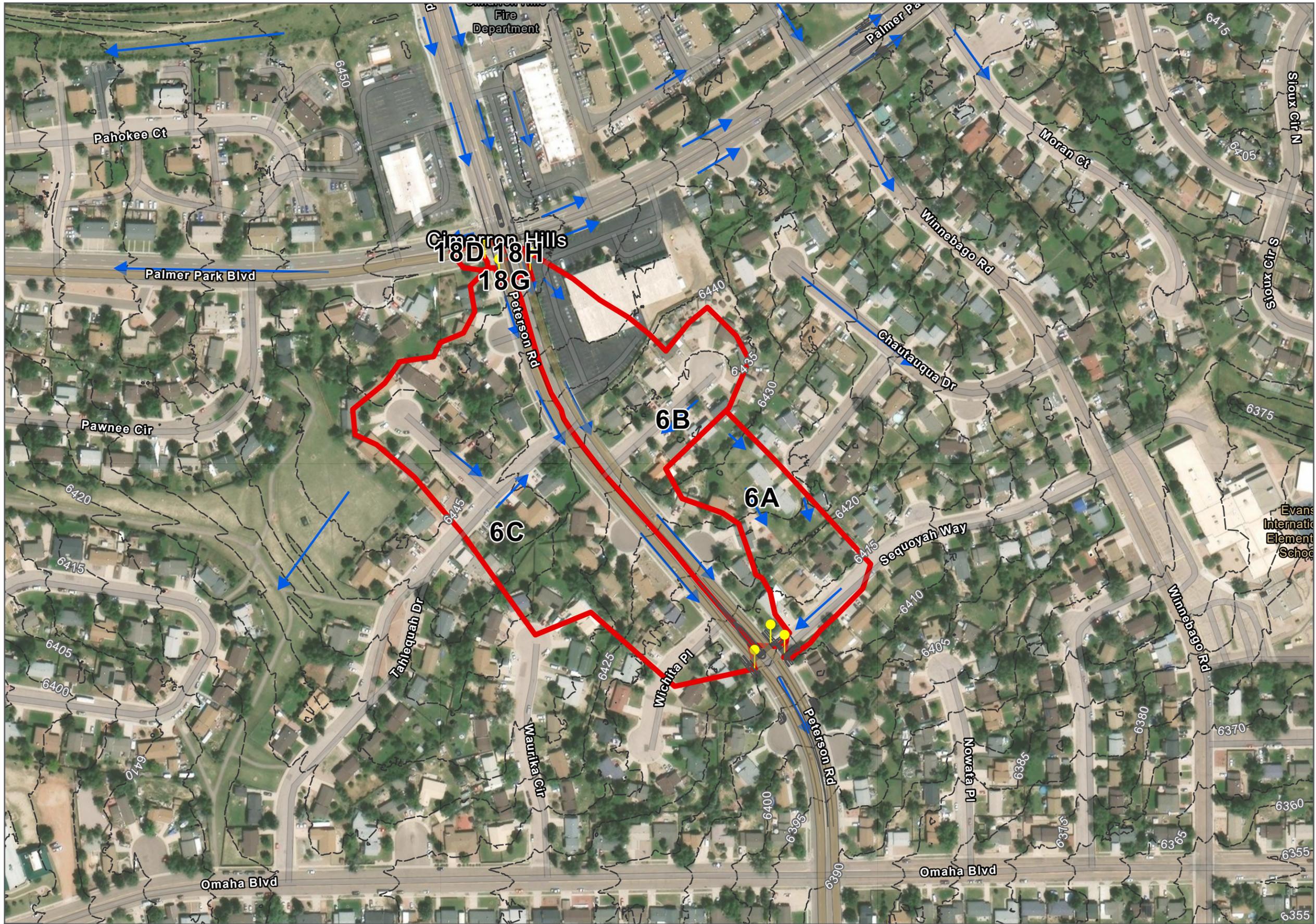
LEGEND

- ▬ SUBBASIN
- - - EXISTING CONTOUR 5FT
- ▶ FLOW ARROW
- DesignPoints
- DesignLinework
- Existing Inlet

Intersection Description
 Fontaine Boulevard at Dartmouth Street (Watson Jr. High)



DATA SOURCE:

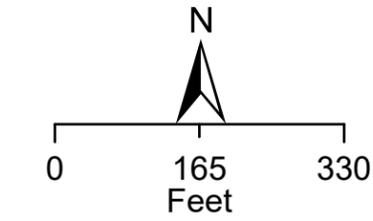


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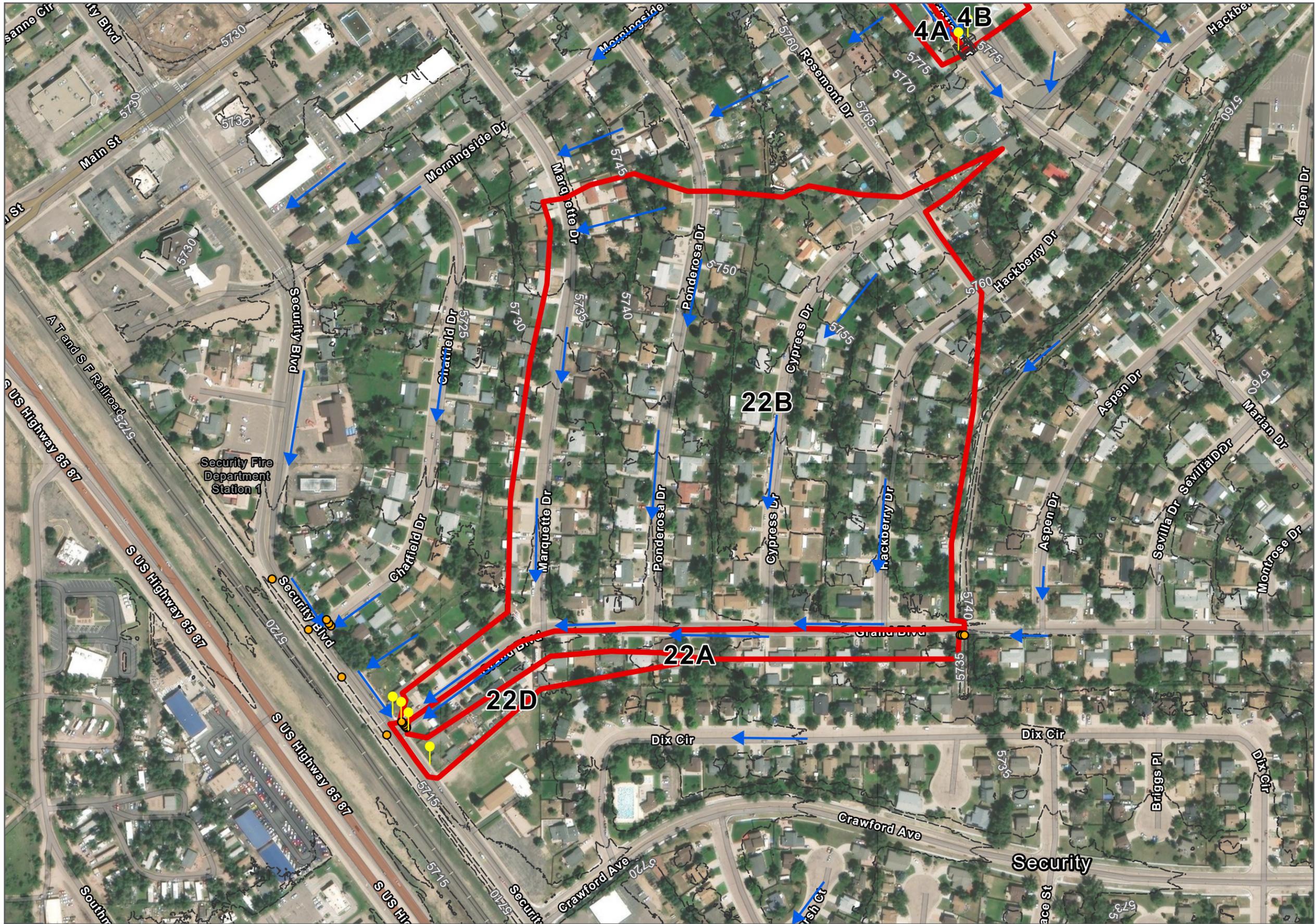
- DesignPoints
- SUBBASIN
- ▶ FLOW ARROW
- EXISTING CONTOUR 5FT
- Existing Inlet
- DesignLinework

Intersection Description

Basin 6: Peterson Road mid-block crossing near Sequoyah Way
 Basin 18: Palmer Park Boulevard at Peterson Road



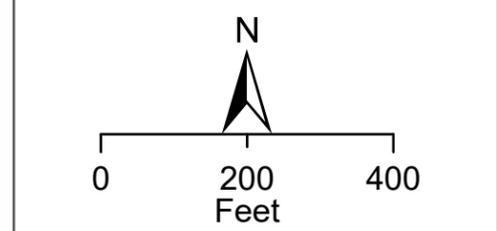
DATA SOURCE:



LEGEND

- DesignPoints
- Subbasin
- Flow Arrows
- Existing Inlet
- Existing 5' Contours
- Design Linework

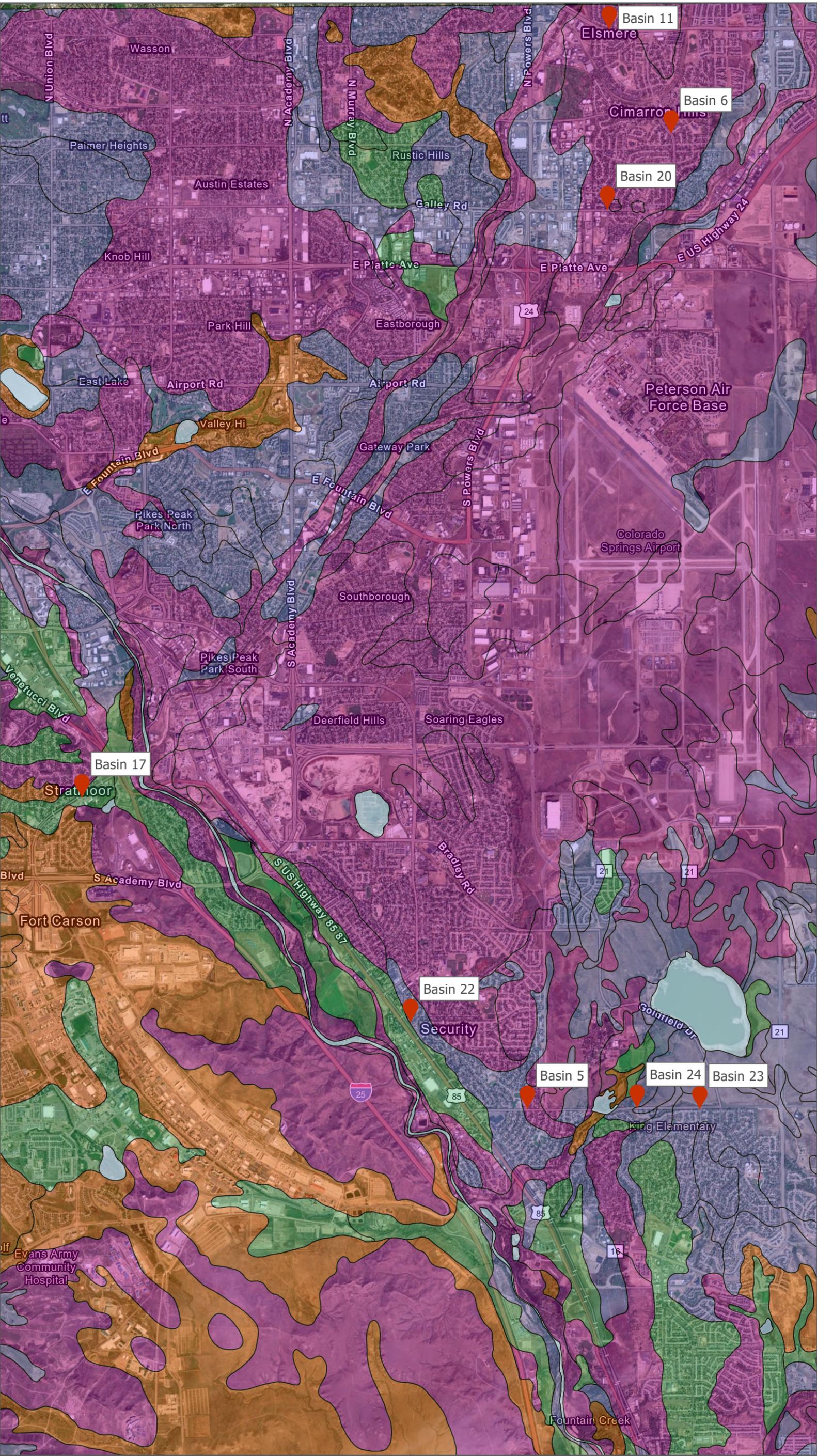
Intersection Description
Security Blvd at Grand Blvd



DATA SOURCE:



Appendix B: Soil Survey



LEGEND

Project Intersections

- Project Intersections (Red dot)

Hydrologic Soil Group

Soil Type

- Water (Light blue)
- A (Purple)
- B (Dark purple)
- C (Green)
- D (Orange)

0 0.5 1 Miles

N



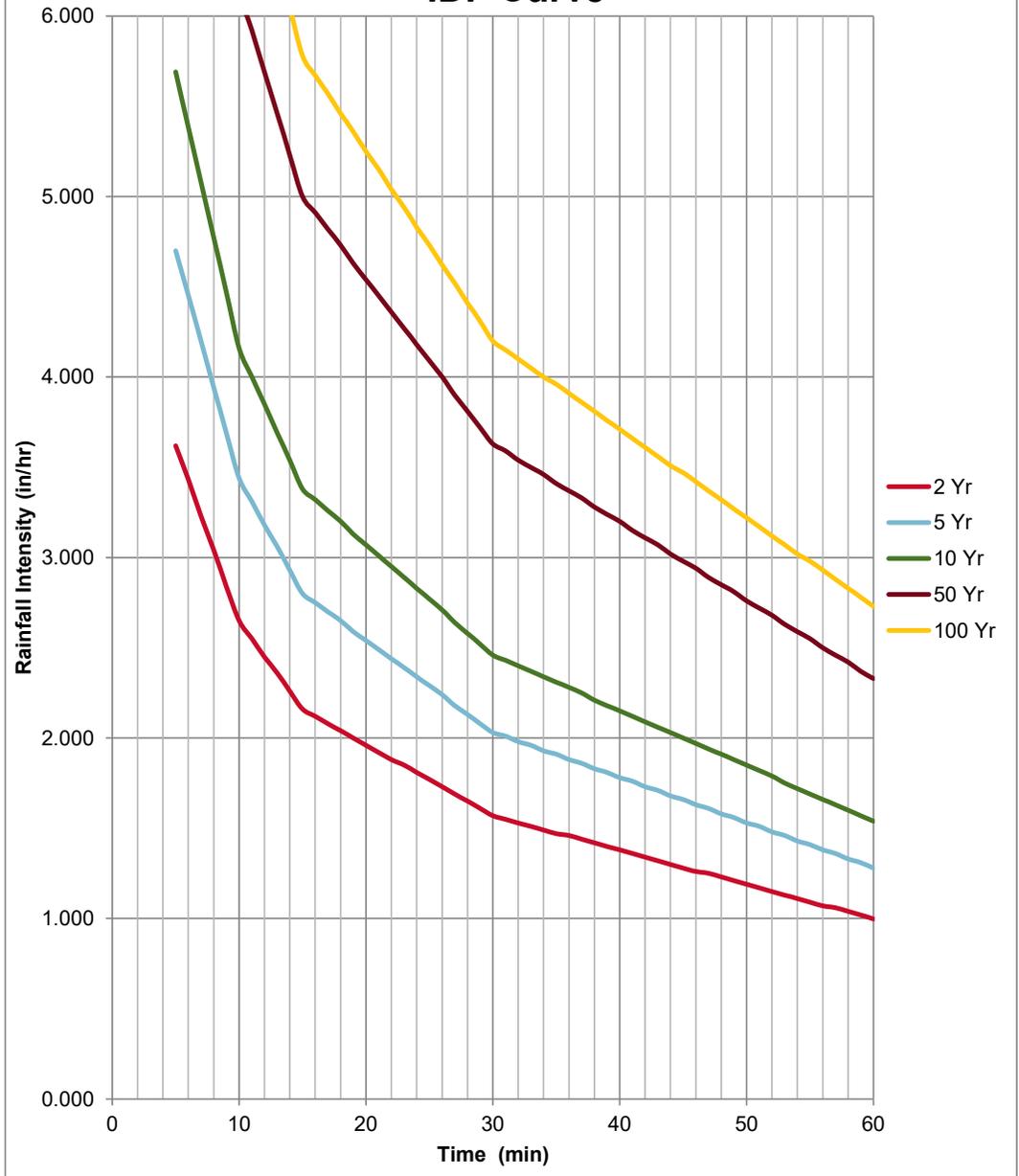


Appendix C: Precipitation Information

Colorado SpringsIDF Computed: **CB** Date: **10/30/2024**
 Checked: _____ Date: _____

Time (min)	(in/hr)				
	2 Yr	5 Yr	10 Yr	50 Yr	100 Yr
5	3.620	4.700	5.690	8.400	9.720
6	3.430	4.450	5.380	7.950	9.200
7	3.230	4.200	5.080	7.500	8.680
8	3.040	3.940	4.770	7.050	8.160
9	2.840	3.690	4.470	6.600	7.640
10	2.650	3.440	4.160	6.150	7.120
11	2.550	3.310	4.000	5.920	6.850
12	2.450	3.180	3.850	5.690	6.580
13	2.360	3.060	3.690	5.460	6.320
14	2.260	2.930	3.540	5.230	6.050
15	2.160	2.800	3.380	5.000	5.780
16	2.120	2.750	3.320	4.910	5.670
17	2.080	2.700	3.260	4.820	5.570
18	2.040	2.650	3.200	4.730	5.460
19	2.000	2.590	3.130	4.630	5.360
20	1.960	2.540	3.070	4.540	5.250
21	1.920	2.490	3.010	4.450	5.150
22	1.880	2.440	2.950	4.360	5.040
23	1.850	2.390	2.890	4.270	4.940
24	1.810	2.340	2.830	4.180	4.830
25	1.770	2.290	2.770	4.090	4.730
26	1.730	2.240	2.710	4.000	4.620
27	1.690	2.180	2.640	3.900	4.520
28	1.650	2.130	2.580	3.810	4.410
29	1.610	2.080	2.520	3.720	4.310
30	1.570	2.030	2.460	3.630	4.200
31	1.550	2.010	2.430	3.590	4.150
32	1.530	1.980	2.400	3.540	4.100
33	1.510	1.960	2.370	3.500	4.050
34	1.490	1.930	2.340	3.460	4.000
35	1.470	1.910	2.310	3.410	3.960
36	1.460	1.880	2.280	3.370	3.910
37	1.440	1.860	2.250	3.330	3.860
38	1.420	1.830	2.210	3.280	3.810
39	1.400	1.810	2.180	3.240	3.760
40	1.380	1.780	2.150	3.200	3.710
41	1.360	1.760	2.120	3.150	3.660
42	1.340	1.730	2.090	3.110	3.610
43	1.320	1.710	2.060	3.070	3.560
44	1.300	1.680	2.030	3.020	3.510
45	1.280	1.660	2.000	2.980	3.470
46	1.260	1.630	1.970	2.940	3.420
47	1.250	1.610	1.940	2.890	3.370
48	1.230	1.580	1.910	2.850	3.320
49	1.210	1.560	1.880	2.810	3.270
50	1.190	1.530	1.850	2.760	3.220
51	1.170	1.510	1.820	2.720	3.170
52	1.150	1.480	1.790	2.680	3.120
53	1.130	1.460	1.750	2.630	3.070
54	1.110	1.430	1.720	2.590	3.020
55	1.090	1.410	1.690	2.550	2.980
56	1.070	1.380	1.660	2.500	2.930
57	1.060	1.360	1.630	2.460	2.880
58	1.040	1.330	1.600	2.420	2.830
59	1.020	1.310	1.570	2.370	2.780
60	0.998	1.280	1.540	2.330	2.730

Colorado Springs IDF Curve





NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.7345°, Longitude: -104.6996°
Elevation: 5843 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael Si, Laurent, Carl Trypa, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps_&_aerials](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	3.01 (2.48-3.72)	3.62 (2.98-4.46)	4.70 (3.85-5.82)	5.69 (4.63-7.07)	7.16 (5.66-9.38)	8.40 (6.44-11.1)	9.72 (7.16-13.2)	11.1 (7.84-15.6)	13.2 (8.86-19.0)	14.8 (9.62-21.5)
10-min	2.21 (1.82-2.72)	2.65 (2.18-3.27)	3.44 (2.83-4.26)	4.16 (3.39-5.18)	5.24 (4.15-6.87)	6.15 (4.72-8.15)	7.12 (5.24-9.68)	8.16 (5.74-11.4)	9.64 (6.48-13.9)	10.8 (7.04-15.8)
15-min	1.80 (1.48-2.21)	2.16 (1.78-2.66)	2.80 (2.30-3.46)	3.38 (2.76-4.21)	4.26 (3.37-5.58)	5.00 (3.84-6.62)	5.78 (4.26-7.87)	6.63 (4.66-9.29)	7.84 (5.27-11.3)	8.81 (5.73-12.8)
30-min	1.31 (1.08-1.61)	1.57 (1.29-1.94)	2.03 (1.67-2.52)	2.46 (2.00-3.06)	3.09 (2.45-4.05)	3.63 (2.78-4.81)	4.20 (3.10-5.72)	4.82 (3.39-6.75)	5.70 (3.83-8.22)	6.40 (4.16-9.32)
60-min	0.851 (0.701-1.05)	0.998 (0.821-1.23)	1.28 (1.05-1.58)	1.54 (1.26-1.92)	1.96 (1.56-2.60)	2.33 (1.80-3.11)	2.73 (2.02-3.74)	3.18 (2.24-4.48)	3.83 (2.58-5.54)	4.36 (2.84-6.35)
2-hr	0.524 (0.434-0.641)	0.605 (0.501-0.742)	0.767 (0.633-0.943)	0.928 (0.761-1.15)	1.19 (0.958-1.57)	1.42 (1.11-1.89)	1.68 (1.26-2.30)	1.97 (1.41-2.77)	2.40 (1.64-3.47)	2.76 (1.81-3.99)
3-hr	0.383 (0.319-0.467)	0.436 (0.362-0.532)	0.547 (0.452-0.669)	0.662 (0.545-0.815)	0.855 (0.695-1.13)	1.03 (0.809-1.38)	1.23 (0.927-1.68)	1.46 (1.05-2.05)	1.80 (1.23-2.59)	2.08 (1.37-3.00)
6-hr	0.219 (0.184-0.266)	0.247 (0.206-0.299)	0.308 (0.256-0.374)	0.373 (0.309-0.456)	0.484 (0.397-0.640)	0.587 (0.464-0.780)	0.705 (0.536-0.960)	0.841 (0.609-1.18)	1.04 (0.722-1.50)	1.21 (0.807-1.74)
12-hr	0.121 (0.102-0.146)	0.139 (0.117-0.167)	0.174 (0.146-0.210)	0.211 (0.176-0.256)	0.272 (0.223-0.355)	0.327 (0.260-0.430)	0.389 (0.297-0.524)	0.460 (0.335-0.637)	0.565 (0.394-0.803)	0.653 (0.438-0.929)
24-hr	0.068 (0.057-0.081)	0.079 (0.067-0.095)	0.101 (0.085-0.121)	0.121 (0.102-0.147)	0.154 (0.127-0.199)	0.183 (0.146-0.238)	0.215 (0.165-0.286)	0.251 (0.183-0.343)	0.302 (0.212-0.425)	0.345 (0.233-0.487)
2-day	0.038 (0.032-0.045)	0.045 (0.038-0.054)	0.058 (0.049-0.069)	0.069 (0.059-0.083)	0.087 (0.072-0.110)	0.102 (0.082-0.131)	0.119 (0.091-0.156)	0.136 (0.100-0.185)	0.162 (0.114-0.225)	0.182 (0.124-0.256)
3-day	0.027 (0.023-0.032)	0.032 (0.028-0.038)	0.041 (0.035-0.049)	0.049 (0.042-0.059)	0.062 (0.051-0.078)	0.072 (0.058-0.092)	0.083 (0.064-0.109)	0.095 (0.070-0.129)	0.113 (0.080-0.157)	0.127 (0.087-0.178)
4-day	0.022 (0.019-0.026)	0.026 (0.022-0.030)	0.032 (0.028-0.038)	0.039 (0.033-0.046)	0.048 (0.040-0.061)	0.056 (0.045-0.071)	0.065 (0.050-0.085)	0.074 (0.055-0.100)	0.088 (0.062-0.121)	0.099 (0.068-0.138)
7-day	0.015 (0.013-0.017)	0.017 (0.015-0.020)	0.021 (0.018-0.025)	0.025 (0.021-0.030)	0.031 (0.025-0.038)	0.035 (0.029-0.045)	0.041 (0.032-0.053)	0.046 (0.035-0.062)	0.054 (0.039-0.075)	0.061 (0.042-0.085)
10-day	0.012 (0.010-0.014)	0.013 (0.012-0.016)	0.016 (0.014-0.019)	0.019 (0.017-0.023)	0.024 (0.020-0.029)	0.027 (0.022-0.034)	0.031 (0.024-0.040)	0.035 (0.026-0.047)	0.041 (0.029-0.056)	0.046 (0.032-0.063)
20-day	0.007 (0.006-0.009)	0.009 (0.008-0.010)	0.011 (0.009-0.013)	0.012 (0.011-0.015)	0.015 (0.012-0.018)	0.017 (0.014-0.021)	0.019 (0.015-0.024)	0.021 (0.016-0.028)	0.024 (0.017-0.033)	0.027 (0.019-0.037)
30-day	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.010)	0.010 (0.008-0.012)	0.012 (0.010-0.014)	0.013 (0.011-0.016)	0.015 (0.011-0.019)	0.016 (0.012-0.021)	0.018 (0.013-0.025)	0.020 (0.014-0.027)
45-day	0.005 (0.004-0.005)	0.005 (0.005-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.011)	0.010 (0.008-0.013)	0.011 (0.009-0.014)	0.012 (0.009-0.016)	0.014 (0.010-0.019)	0.015 (0.010-0.020)
60-day	0.004 (0.003-0.005)	0.005 (0.004-0.005)	0.006 (0.005-0.007)	0.007 (0.006-0.008)	0.008 (0.006-0.009)	0.009 (0.007-0.011)	0.009 (0.007-0.012)	0.010 (0.008-0.013)	0.011 (0.008-0.015)	0.012 (0.009-0.017)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.



Appendix D: Rational Method Calculations

El Paso County Intersection Improvements
Priority Intersections

Computed: CMB Date: 11/22/2024
Checked: LVS Date: 11/22/2024

Basin ID	Description	Hydr Soils Group	Total Area (ac)	Composite C		Streets (paved)			Industrial (Light areas)			Business (Neighborhood Area)			Undeveloped Areas or Parks			1/4 acre		
				C ₁₀	C ₁₀₀	C ₁₀	C ₁₀₀	Area (ac)	C ₁₀	C ₁₀₀	Area (ac)	C ₁₀	C ₁₀₀	Area (ac)	C ₁₀	C ₁₀₀	Area (ac)	C ₁₀	C ₁₀₀	Area (ac)
5a	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) NW corner, SB	B	1.93	0.90	0.95	0.90	0.95	1.93	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
5b	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) NE corner, NB	B	6.17	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	6.17
5c	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) East Median, WB	A	8.38	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	8.38
5d	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) East Median, EB	A	0.16	0.90	0.95	0.90	0.95	0.16	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
5e	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) SW corner, SB	A	0.04	0.90	0.95	0.90	0.95	0.04	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
5f	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) W median, WB	B	0.06	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.06
6a	Peterson Road mid-block crossing near Sequoyah Way SE corner, SWB	A	2.20	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	2.20
6b	Peterson Road mid-block crossing near Sequoyah Way NE corner, NWB	A	4.31	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	4.31
6c	Peterson Road mid-block crossing near Sequoyah Way N median, SEB	A	6.92	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	6.92
11a	Constitution Ave at Piros Dr NW corner, WB	A	0.45	0.90	0.95	0.90	0.95	0.45	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
11c	Constitution Ave at Piros Dr SE corner, WB	A	0.33	0.90	0.95	0.90	0.95	0.33	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
11e	Constitution Ave at Piros Dr W median - WB	A	0.08	0.90	0.95	0.90	0.95	0.08	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
18d	Palmer Park Blvd at Peterson Rd W median - EB	A	0.06	0.90	0.95	0.90	0.95	0.06	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
18g	Palmer Park Blvd at Peterson Rd S median - SB	A	0.08	0.90	0.95	0.90	0.95	0.08	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
18h	Palmer Park Blvd at Peterson Rd S median - NB	A	0.07	0.90	0.95	0.90	0.95	0.07	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
20a	Galley Road at Hathaway Drive NE corner, WB	A	1.60	0.63	0.72	0.90	0.95	0.80	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.80
20b	Galley Road at Hathaway Drive SW corner, WB	A	0.37	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.37
20c	Galley Road at Hathaway Drive SE corner, WB	A	3.76	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	3.76
20d	Galley Road at Hathaway Drive NW corner, WB	A	0.06	0.90	0.95	0.90	0.95	0.06	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	0.00
22a	Security Blvd at Grand Blvd SE corner, NWB	B	2.45	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	2.45
22b	Security Blvd at Grand Blvd N corner Grand	B	43.80	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	43.80
22c	Security Blvd at Grand Blvd N corner Security	B	44.27	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	44.27
22d	Security Blvd at Grand Blvd SE corner, NB	B	1.30	0.36	0.50	0.90	0.95	0.00	0.70	0.80	0.00	0.75	0.80	0.00	0.30	0.55	0.00	0.36	0.50	1.30

Basin ID	Description	C ₁₀	Area (ac)	INITIAL/OVERLAND FLOW (t)				TRAVEL TIME (t)						Total t _c = t _i + t _t (min)	Tc CHECK (Urbanized basins)			FINAL Tc (min)					
				Length (ft)	Start Elevation (ft)	End Elevation (ft)	Slope (%)	t (min)	Length (ft)	Start Elevation (ft)	End Elevation (ft)	S _w (ft/ft)	Type of Land Surface			Urban (Yes/No)	Total Length		Regional T _c max (min)	T _c max > t _c			
													Code		Description						Convey Coef (C _v)	Velocity (ft/s)	Travel Time (min)
5a	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) NW corner, SB	0.90	1.93	46	5736.2	5735.0	2.687	1.83	1225	5735.0	5702.5	0.026	6	Paved areas and swales	20.00	3.26	6.27	8.10	Yes	1271	17.06	Check	8.10
5b	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) NE corner, NB	0.36	6.17	240	5766.0	5735.9	12.558	9.30	1230	5735.9	5703.0	0.027	6	Paved areas and swales	20.00	3.27	6.27	15.57	Yes	1470	18.17	Check	15.57
5c	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) East Median, WB	0.36	8.38	130	5764.8	5741.7	17.772	6.10	1255	5741.7	5703.0	0.031	6	Paved areas and swales	20.00	3.51	5.95	12.06	Yes	1385	17.69	Check	12.06
5d	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) East Median, EB	0.90	0.16	75	5710.0	5708.0	2.673	2.34	275	5708.0	5701.0	0.025	6	Paved areas and swales	20.00	3.19	1.44	3.78	Yes	350	11.94	Check	5.00
5e	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) SW corner, SB	0.90	0.04	40	5704.1	5703.4	1.792	1.95	33	5703.4	5700.8	0.079	6	Paved areas and swales	20.00	5.61	0.10	2.05	Yes	73	10.41	Check	5.00
5f	Fontaine Boulevard at Dartmouth Street (Watson Jr. High) W median, WB	0.36	0.06	90	5703.9	5703.0	0.967	13.27	60	5703.0	5702.4	0.011	6	Paved areas and swales	20.00	2.95	0.49	13.76	Yes	150	10.83	Regional Tc	10.83
6a	Peterson Road mid-block crossing near Sequoyah Way SE corner, SWB	0.36	2.20	115	6434.4	6429.0	4.713	8.90	520	6429.0	6410.4	0.036	6	Paved areas and swales	20.00	3.78	2.29	11.19	Yes	635	13.53	Check	11.19
6b	Peterson Road mid-block crossing near Sequoyah Way NE corner, NWB	0.36	4.31	60	6450.7	6449.9	1.305	9.82	965	6449.9	6410.5	0.041	6	Paved areas and swales	20.00	4.04	3.98	13.79	Yes	1025	15.69	Check	13.79
6c	Peterson Road mid-block crossing near Sequoyah Way N median, SEB	0.36	6.92	55	6450.6	6449.9	1.232	9.58	995	6449.9	6410.3	0.040	6	Paved areas and swales	20.00	3.99	4.16	13.74	Yes	1050	15.83	Check	13.74
11a	Constitution Ave at Piros Dr NW corner, WB	0.90	0.45	200	6510.0	6500.5	4.770	3.16	325	6500.5	6483.9	0.051	6	Paved areas and swales	20.00	4.52	1.20	4.36	Yes	525	12.92	Check	5.00
11c	Constitution Ave at Piros Dr SE corner, WB	0.90	0.33	235	6520.0	6508.0	5.119	3.34	385	6508.0	6494.0	0.036	6	Paved areas and swales	20.00	3.81	1.68	5.03	Yes	620	13.44	Check	5.03
11e	Constitution Ave at Piros Dr W median - WB	0.90	0.08	100	6494.0	6488.5	5.486	2.13	70	6488.5	6485.5	0.044	6	Paved areas and swales	20.00	4.18	0.28	2.41	Yes	170	10.94	Check	5.00
18d	Palmer Park Blvd at Peterson Rd W median - EB	0.90	0.06	22	6454.8	6450.4	20.041	0.65	49	6450.4	6450.2	0.004	6	Paved areas and swales	20.00	1.21	0.68	1.33	Yes	71	10.39	Check	5.00
18g	Palmer Park Blvd at Peterson Rd S median - SB	0.90	0.08	34	6451.3	6450.4	2.659	1.58	80	6450.4	6450.3	0.001	6	Paved areas and swales	20.00	0.63	2.10	3.68	Yes	114	10.63	Check	5.00
18h	Palmer Park Blvd at Peterson Rd S median - NB	0.90	0.07	25	6451.1	6451.0	0.384	2.57	120	6451.0	6450.0	0.008	6	Paved areas and swales	20.00	1.81	1.10	3.67	Yes	145	10.81	Check	5.00
20a	Galley Road at Hathaway Drive NE corner, WB	0.63	1.60	31	6356.0	6355.0	3.292	3.30	895	6355.0	6330.8	0.027	6	Paved areas and swales	20.00	3.29	4.54	7.84	Yes	926	15.14	Check	7.84
20b	Galley Road at Hathaway Drive SW corner, WB	0.36	0.37	205	6340.1	6331.0	4.446	12.11	225	6331.0	6321.0	0.044	6	Paved areas and swales	20.00	4.22	0.89	13.00	Yes	430	12.39	Regional Tc	12.39
20c	Galley Road at Hathaway Drive SE corner, WB	0.36	3.75	200	6354.3	6349.2	2.537	14.39	735	6349.2	6331.0	0.025	6	Paved areas and swales	20.00	3.15	3.89	18.28	Yes	935	15.19	Regional Tc	15.19
20d	Galley Road at Hathaway Drive NW corner, WB	0.90	0.06	55	6332.1	6330.0	3.911	1.77	85	6330.0	6328.7	0.015	6	Paved areas and swales	20.00	2.44	0.58	2.35	Yes	140	10.78	Check	5.00
22a	Security Blvd at Grand Blvd SE corner, NWB	0.36	2.45	55	5740.5	5739.2	2.335	7.76	1525	5739.2	5715.7	0.015	6	Paved areas and swales	20.00	2.48	10.23	17.99	Yes	1580	18.78	Check	17.99
22b	Security Blvd at Grand Blvd N corner Grand	0.36	43.80	295	5772.4	5766.5	2.005	18.89	2270	5766.5	5715.8	0.022	6	Paved areas and swales	20.00	2.99	12.66	31.55	Yes	2565	24.25	Regional Tc	24.25
22c	Security Blvd at Grand Blvd N corner Security	0.36	44.27	250	5843.0	5825.5	6.968	11.53	6700	5825.5	5715.8	0.016	6	Paved areas and swales	20.00	2.56	43.63	55.16	Yes	6950	48.61	Regional Tc	48.61
22d	Security Blvd at Grand Blvd SE corner, NB	0.36	1.30	20	5716.4	5715.9	2.493	4.58	145	5715.9	5715.4	0.003	6	Paved areas and swales	20.00	1.08	2.23	6.81	Yes	165	10.92	Check	6.81

Design Storm: 10-yr

Basin Description	DIRECT RUNOFF							REMARKS
	AREA DESIGN (name)	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C.A. (AC)	I IN / HR	Q (CFS)	
(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) NW corner, SB	5a	1.929	0.900	8.10	1.74	4.74	8.23	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) NE corner, NB	5b	6.167	0.360	15.57	2.22	3.35	7.43	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) East Median, WB	5c	8.380	0.360	12.06	3.02	3.84	11.59	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) East Median, EB	5d	0.164	0.900	5.00	0.15	5.69	0.84	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) SW corner, SB	5e	0.041	0.900	5.00	0.04	5.69	0.21	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) W median, WB	5f	0.059	0.360	10.83	0.02	4.03	0.09	Basin 5f = 5f+5a+5b+5c = 27.33 cfs
Peterson Road mid-block crossing near Sequoyah Way SE corner, SWB	6a	2.203	0.360	11.19	0.79	3.97	3.15	
Peterson Road mid-block crossing near Sequoyah Way NE corner, NWB	6b	4.306	0.360	13.79	1.55	3.57	5.54	Basin 6b = 6b+18h = 5.92 cfs
Peterson Road mid-block crossing near Sequoyah Way N median, SEB	6c	6.919	0.360	13.74	2.49	3.58	8.92	Basin 6c = 6c+18g+18d = 9.65 cfs
Constitution Ave at Piros Dr NW corner, WB	11a	0.455	0.900	5.00	0.41	5.69	2.33	
Constitution Ave at Piros Dr SE corner, WB	11c	0.332	0.900	5.03	0.30	5.68	1.70	
Constitution Ave at Piros Dr W median - WB	11e	0.078	0.900	5.00	0.07	5.69	0.40	
Palmer Park Blvd at Peterson Rd W median - EB	18d	0.064	0.900	5.00	0.06	5.69	0.33	
Palmer Park Blvd at Peterson Rd S median - SB	18g	0.079	0.900	5.00	0.07	5.69	0.40	Basin 18g = 18g+18d = 0.73147 cfs
Palmer Park Blvd at Peterson Rd S median - NB	18h	0.074	0.900	5.00	0.07	5.69	0.38	
Galley Road at Hathaway Drive NE corner, WB	20a	1.601	0.630	7.84	1.01	4.82	4.86	
Galley Road at Hathaway Drive SW corner, WB	20b	0.369	0.360	12.39	0.13	3.79	0.50	Basin 20b = 20b+20c = 5.06251 cfs
Galley Road at Hathaway Drive SE corner, WB	20c	3.760	0.360	15.19	1.35	3.37	4.56	
Galley Road at Hathaway Drive NW corner, WB	20d	0.056	0.900	5.00	0.05	5.69	0.29	Basin 20d = 20d+20a = 5.14477 cfs
Security Blvd at Grand Blvd SE corner, NWB	22a	2.452	0.360	17.99	0.88	3.20	2.83	
Security Blvd at Grand Blvd N corner Grand	22b	43.803	0.360	24.25	15.77	2.82	44.39	
Security Blvd at Grand Blvd N corner Security	22c	44.266	0.360	48.61	15.94	1.89	30.15	
Security Blvd at Grand Blvd SE corner, NB	22d	1.304	0.360	6.81	0.47	5.14	2.41	

- (1) Basin Description linked to C-Value Sheet
- (2) Basin Design Point (not designated)
- (3) Enter the Basin Name from C Value Sheet
- (4) Basin Area linked to C-Value Sheet
- (5) Composite C linked to C-Value Sheet
- (6) Time of Concentration linked to C-Value Sheet

- (7) =Column 4 x Column 5
- (8) = $28.5 \cdot P / (10 + \text{Column } 6)^{0.786}$
- (9) =Column 7 x Column 8
- (10) =Column 6 + Column 21
- (11) Add the Basin Areas (7) to get the combined basin AC
- (12) = $28.5 \cdot P / (10 + \text{Column } 10)^{0.786}$

Design Storm: 100-yr

Basin Description	DIRECT RUNOFF							REMARKS
	Basin ID	AREA (AC)	RUNOFF COEFF	t _c (MIN)	C-A. (AC)	I IN / HR	Q (CFS)	
(1)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) NW corner, SB	5a	1.929	0.950	8.10	1.83	8.11	14.85	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) NE corner, NB	5b	6.167	0.500	15.57	3.08	5.72	17.63	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) East Median, WB	5c	8.380	0.500	12.06	4.19	6.56	27.51	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) East Median, EB	5d	0.164	0.950	5.00	0.16	9.72	1.52	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) SW corner, SB	5e	0.041	0.950	5.00	0.04	9.72	0.38	
Fontaine Boulevard at Dartmouth Street (Watson Jr. High) W median, WB	5f	0.059	0.500	10.83	0.03	6.90	0.20	Basin 5f = 5f+5a+5b+5c = 60.19 cfs
Peterson Road mid-block crossing near Sequoyah Way SE corner, SWB	6a	2.203	0.500	11.19	1.10	6.80	7.49	
Peterson Road mid-block crossing near Sequoyah Way NE corner, NWB	6b	4.306	0.500	13.79	2.15	6.11	13.15	Basin 6b = 6b+18h = 13.83 cfs
Peterson Road mid-block crossing near Sequoyah Way N median, SEB	6c	6.919	0.500	13.74	3.46	6.12	21.18	Basin 6c = 6c+18g+18d = 22.50 cfs
Constitution Ave at Piros Dr NW corner, WB	11a	0.455	0.950	5.00	0.43	9.72	4.20	
Constitution Ave at Piros Dr SE corner, WB	11c	0.332	0.950	5.03	0.32	9.71	3.06	
Constitution Ave at Piros Dr W median - WB	11e	0.078	0.950	5.00	0.07	9.72	0.72	
Palmer Park Blvd at Peterson Rd W median - EB	18d	0.064	0.950	5.00	0.06	9.72	0.59	
Palmer Park Blvd at Peterson Rd S median - SB	18g	0.079	0.950	5.00	0.07	9.72	0.73	Basin 18g = 18g+18d = 1.31897 cfs
Palmer Park Blvd at Peterson Rd S median - NB	18h	0.074	0.950	5.00	0.07	9.72	0.68	
Galley Road at Hathaway Drive NE corner, WB	20a	1.601	0.725	7.84	1.16	8.24	9.56	
Galley Road at Hathaway Drive SW corner, WB	20b	0.369	0.500	12.39	0.18	6.48	1.20	Basin 20b = 20b+20c = 12.0215 cfs
Galley Road at Hathaway Drive SE corner, WB	20c	3.760	0.500	15.19	1.88	5.76	10.83	
Galley Road at Hathaway Drive NW corner, WB	20d	0.056	0.950	5.00	0.05	9.72	0.52	Basin 20d = 20d+20a = 10.0789 cfs
Security Blvd at Grand Blvd SE corner, NWB	22a	2.452	0.500	17.99	1.23	5.46	6.70	
Security Blvd at Grand Blvd N corner Grand	22b	43.803	0.500	24.25	21.90	4.81	105.24	
Security Blvd at Grand Blvd N corner Security	22c	44.266	0.500	48.61	22.13	3.29	72.81	
Security Blvd at Grand Blvd SE corner, NB	22d	1.304	0.500	6.81	0.65	8.78	5.73	

- (1) Basin Description linked to C-Value Sheet
- (2) Basin Design Point (not designated)
- (3) Enter the Basin Name from C Value Sheet
- (4) Basin Area linked to C-Value Sheet
- (5) Composite C linked to C-Value Sheet
- (6) Time of Concentration linked to C-Value Sheet

- (7) =Column 4 x Column 5
- (8) =28.5*P/(10+Column 6)^0.786
- (9) =Column 7 x Column 8
- (10) =Column 6 + Column 21
- (11) Add the Basin Areas (7) to get the combined basin AC
- (12) =28.5*P/(10+Column 10)^0.786



Appendix E: Hydraulic Results

Project: El Paso County Intersections
 Calculations by: Will Simmons
 Date: 11/20/2024
 Flow Master Results - Proposed Minor Storm, EPC Intersections
 Design Event: Minor, 10-year storm
 Solve For: Spread
 Manning Coefficient: 0.016

Design assumptions:
 Gutter Width: 1.2 feet
 Gutter Cross Slope: 0.083 ft/ft
 Curb Height: 6 inches

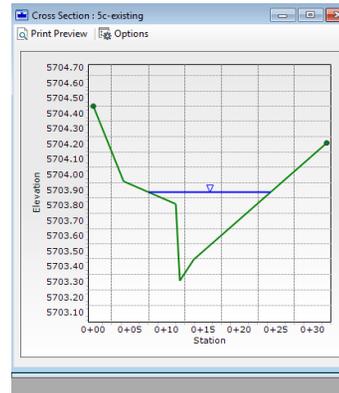
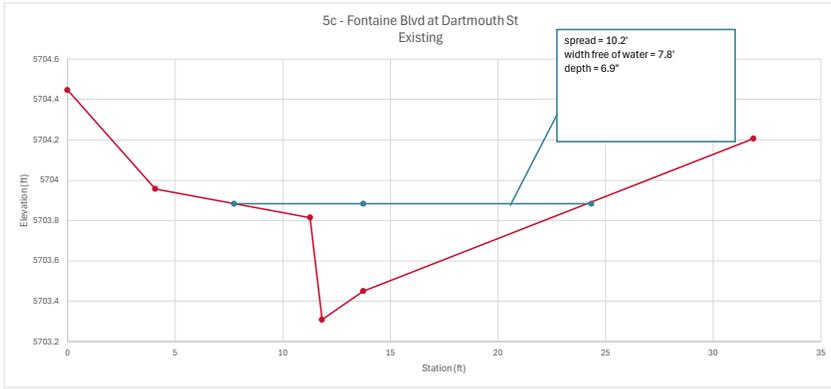
Basin ID	Description	Road Long. Slope	Discharge (cfs)	Road Cross Slope (ft/ft)	Depth Above Curb (in)	Depth (in)	Spread (ft)	Total Lane Width (ft)	Lane Free of Water Width (ft)	Street Type	Meets Criteria per Street Type
6c	Peterson Road mid-block crossing near Sequoyah Way	0.04	9.7	0.03	-1.5	4.5	10.5	28	17.5	Collector or Minor Arterial	YES
6b	Peterson Road mid-block crossing near Sequoyah Way	0.04	5.9	0.03	-2.3	3.7	8.2	27	18.8	Collector or Minor Arterial	YES
6a	Peterson Road mid-block crossing near Sequoyah Way	0.03	3.2	0.04	-3.0	3.0	6.3	14	7.7	Residential/Local	YES
5a	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.03	8.2	0.03	-1.7	4.3	9.8	14	4.2	Residential/Local	YES
5b	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.01	7.4	0.02	-1.5	4.5	15.1	13	-2.1	Residential/Local	YES
5c	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.01	11.6	0.04	0.2	6.2	11.6	24	12.4	Collector or Minor Arterial	FAIL
5d	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.01	0.8	0.02	-3.6	2.4	6.2	13	6.8	Collector or Minor Arterial	YES
5e	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.02	0.2	0.01	-4.6	1.4	3.1	14	10.9	Residential/Local	YES
5f	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.01	27.3	0.05	2.9	8.9	14.0	14	0	Collector or Minor Arterial	FAIL
22a	Security Blvd at Grand Blvd	0.02	2.8	0.02	-2.9	3.1	8.9	18	9.1	Residential/Local	YES
22b	Security Blvd at Grand Blvd	0.02	44.4	0.02	1.2	7.2	26.1	16	-10.1	Residential/Local	FAIL
22c	Security Blvd at Grand Blvd	0.005	30.2	0.02	1.9	7.9	29.3	14	-15.3	Collector or Minor Arterial	FAIL
22d	Security Blvd at Grand Blvd	0.005	2.4	0.02	-2.5	3.5	10.2	24	13.79	Collector or Minor Arterial	YES
20a	Galley Road at Hathaway Drive	0.01	4.9	0.04	-1.4	4.6	8.3	20	11.7	Collector or Minor Arterial	YES
20b	Galley Road at Hathaway Drive	0.07	5.1	0.02	-3.0	3.0	8.8	30	21.2	Collector or Minor Arterial	YES
20c	Galley Road at Hathaway Drive	0.01	4.6	0.04	-1.5	4.5	8.1	14	5.9	Collector or Minor Arterial	YES
20d	Galley Road at Hathaway Drive	0.02	5.1	0.04	-1.8	4.2	7.4	14	6.6	Collector or Minor Arterial	YES
11a	Constitution Ave at Piros Dr	0.05	2.3	0.04	-3.2	2.8	4.5	30	25.5	Arterial	YES
11c	Constitution Ave at Piros Dr	0.04	1.7	0.01	-3.8	2.2	9.5	30	20.5	Arterial	YES
11e	Constitution Ave at Piros Dr	0.05	0.4	0.04	-4.5	1.5	1.9	55	53.1	Arterial	YES

Project: El Paso County Intersections
 Calculations by: Will Simmons
 Date: 11/20/2024
 Flow Master Results - Proposed Major Storm, EPC Intersections
 Design Event: Major, 100-year storm
 Solve For: Spread
 Manning Coefficient: 0.016

Design assumptions:
 Gutter Width: 1.2 feet
 Gutter Cross Slope: 0.083 ft/ft
 Curb Height: 6 inches

Checked: EVS 11/25/2024

Basin ID	Description	Road Long. Slope (ft/ft)	Discharge (cfs)	Road Cross Slope (ft/ft)	Depth Above Curb (in)	Depth (in)	Spread (ft)	Total Lane Width (ft)	Lane Free of Water Width (ft)	Street Type	Meets Criteria per Street Type
6c	Peterson Road mid-block crossing near Sequoyah Way	0.04	22.5	0.03	0.0	6.0	14.5	28	13.5	Collector or Minor Arterial	YES
6b	Peterson Road mid-block crossing near Sequoyah Way	0.04	13.8	0.03	-1.1	4.9	11.4	27	15.6	Collector or Minor Arterial	YES
6a	Peterson Road mid-block crossing near Sequoyah Way	0.03	7.5	0.04	-2.0	4.0	9	14	5	Residential/Local	YES
5f	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.01	60.2	0.05	5.8	11.8	18.9	14	-4.9	Collector or Minor Arterial	YES
5e	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.02	0.4	0.01	-4.3	1.7	5.1	14	8.9	Residential/Local	YES
5d	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.01	1.5	0.02	-3.2	2.8	8	13	5	Collector or Minor Arterial	YES
5c	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.01	27.5	0.04	2.4	8.4	16.1	24	7.9	Collector or Minor Arterial	YES
5b	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.01	17.6	0.02	-0.1	5.9	21	13	-8	Residential/Local	YES
5a	Fontaine Boulevard at Dartmouth Street (Watson Jr. High)	0.03	14.9	0.03	-0.8	5.2	12.4	14	1.6	Residential/Local	YES
22d	Security Blvd at Grand Blvd	0.005	5.7	0.02	-1.4	4.6	15.5	24	8.5	Collector or Minor Arterial	YES
22c	Security Blvd at Grand Blvd	0.005	72.8	0.02	4.7	10.7	40.9	14	-26.9	Collector or Minor Arterial	YES
22b	Security Blvd at Grand Blvd	0.02	105.2	0.02	3.6	9.6	36.2	16	-20.2	Residential/Local	YES
22a	Security Blvd at Grand Blvd	0.02	6.7	0.02	-2.1	3.9	12.6	18	5.4	Residential/Local	YES
20d	Galley Road at Hathaway Drive	0.02	10.1	0.04	-0.8	5.2	9.6	14	4.4	Collector or Minor Arterial	YES
20c	Galley Road at Hathaway Drive	0.01	10.8	0.04	0.1	6.1	11.3	14	2.7	Collector or Minor Arterial	YES
20b	Galley Road at Hathaway Drive	0.07	12.0	0.02	-2.1	3.9	12.4	30	17.6	Collector or Minor Arterial	YES
20a	Galley Road at Hathaway Drive	0.01	9.6	0.04	-0.2	5.8	10.8	20	9.2	Collector or Minor Arterial	YES
11e	Constitution Ave at Piros Dr	0.05	0.7	0.04	-4.1	1.9	2.6	55	52.4	Arterial	YES
11c	Constitution Ave at Piros Dr	0.04	3.1	0.01	-3.5	2.5	12.3	30	17.7	Arterial	YES
11a	Constitution Ave at Piros Dr	0.05	4.2	0.04	-2.6	3.4	5.7	30	24.3	Arterial	YES



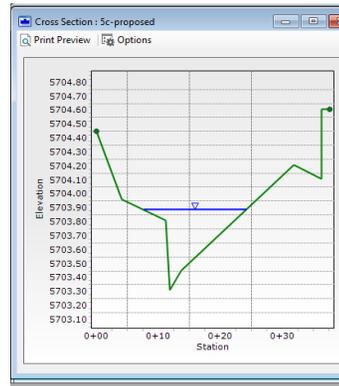
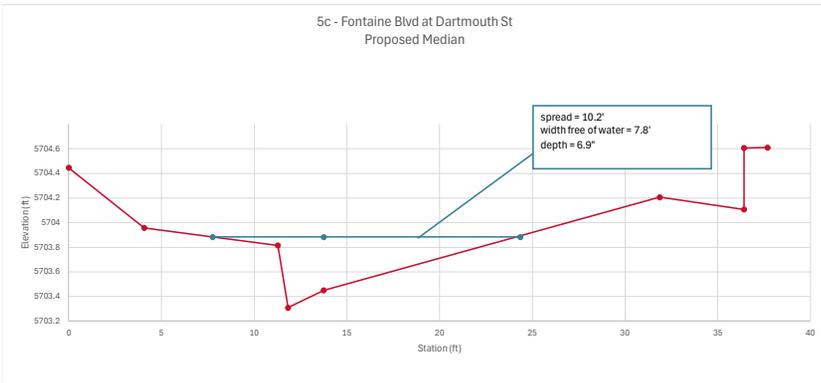
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Uniform Flow | Gradually Varied Flow | Messages

Solve For: Normal Depth | Friction Method: Manning Formula

Roughness Coefficient:	0.016	Flow Area:	3.6	ft ²
Channel Slope:	0.010	Wetted Perimeter:	16.81	ft
Elevation:	5,703.89	Hydraulic Radius:	2.6	in
Elevation Range:	5,703.31 to 5,704.45	Top Width:	16.60	ft
Discharge:	11.59	Normal Depth:	6.9	in
		Critical Depth:	7.5	in
		Critical Slope:	0.006	ft/ft
		Velocity:	3.24	ft/s
		Velocity Head:	0.16	ft
		Specific Energy:	0.74	ft
		Froude Number:	1.233	
		Flow Type:	Supercritical	

Calculation Successful.



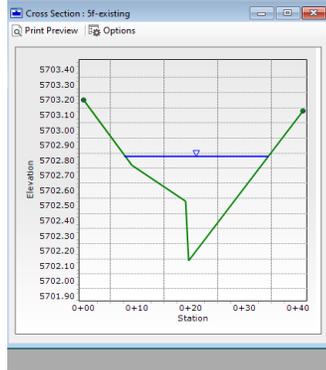
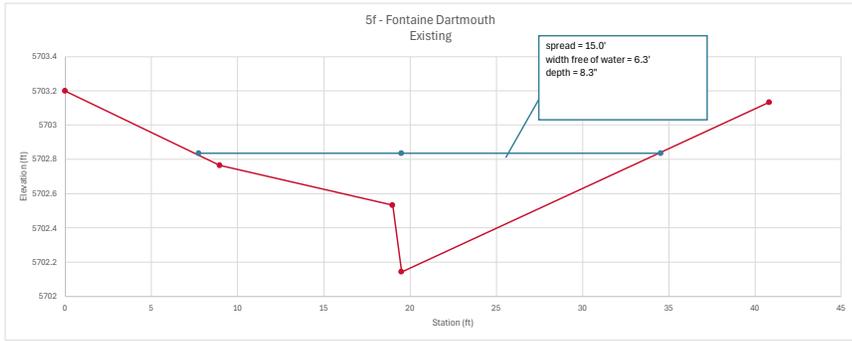
Worksheet : 5c-proposed

Uniform Flow | Gradually Varied Flow | Messages

Solve For: Normal Depth | Friction Method: Manning Formula

Roughness Coefficient:	0.016	Flow Area:	3.6	ft ²
Channel Slope:	0.010	Wetted Perimeter:	16.81	ft
Elevation:	5,703.89	Hydraulic Radius:	2.6	in
Elevation Range:	5,703.31 to 5,704.61	Top Width:	16.60	ft
Discharge:	11.59	Normal Depth:	6.9	in
		Critical Depth:	7.5	in
		Critical Slope:	0.006	ft/ft
		Velocity:	3.24	ft/s
		Velocity Head:	0.16	ft
		Specific Energy:	0.74	ft
		Froude Number:	1.233	
		Flow Type:	Supercritical	

Calculation Successful.



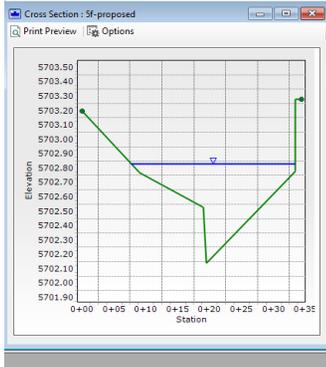
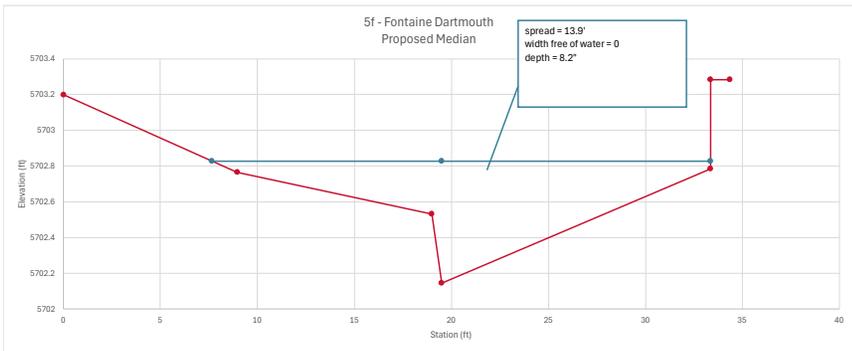
Worksheet : 5f-existing

Uniform Flow Gradually Varied Flow Messages

Solve For: Normal Depth Friction Method: Manning Formula

Roughness Coefficient	0.016	Flow Area:	7.3 ft ²
Channel Slope:	0.009 ft/ft	Wetted Perimeter:	26.95 ft
Elevation:	5,702.83 ft	Hydraulic Radius:	3.2 in
Elevation Range:	5,702.14 to 5,703.20 ft	Top Width:	26.80 ft
Discharge:	27.33 cfs	Normal Depth:	8.3 in
		Critical Depth:	8.9 in
		Critical Slope:	0.006 ft/ft
		Velocity:	3.76 ft/s
		Velocity Head:	0.22 ft
		Specific Energy:	0.91 ft
		Froude Number:	1.272
		Flow Type:	Supercritical

Calculation Successful.



Worksheet : 5f-proposed

Uniform Flow Gradually Varied Flow Messages

Solve For: Normal Depth Friction Method: Manning Formula

Roughness Coefficient	0.016	Flow Area:	7.2 ft ²
Channel Slope:	0.009 ft/ft	Wetted Perimeter:	25.90 ft
Elevation:	5,702.83 ft	Hydraulic Radius:	3.3 in
Elevation Range:	5,702.14 to 5,703.28 ft	Top Width:	25.71 ft
Discharge:	27.33 cfs	Normal Depth:	8.2 in
		Critical Depth:	8.8 in
		Critical Slope:	0.006 ft/ft
		Velocity:	3.82 ft/s
		Velocity Head:	0.23 ft
		Specific Energy:	0.91 ft
		Froude Number:	1.276
		Flow Type:	Supercritical

Calculation Successful.

