# LOT 5, BLOCK 1 PALMER PARK BUSINESS CENTER SUBDIVISION FILING NO. 3 "PHASES TRUCK AND AUTO REPAIR ADDITION" DRAINAGE LETTER

1670 PAONIA STREET
COLORADO SPRINGS, COLORADO
80915

PREPARED FOR: CASCO CONSTRUCTION CORP.
1775 JET STREAM DRIVE
SUITE 102
COLORADO SPRINGS, CO 80921
(719) 380-1140

**PCD FILING NO. PPR-21-021**

August 15, 2021

**Prepared by**
**Scott Marvel, P.E.**
Rocky Mountain Group
2910 Austin Bluffs Blvd. | Colorado Springs, CO 80918 | 719-434-5638

## SIGNATURE PAGE

## LOT 5, BLOCK 1 PALMER PARK BUSINESS CENTER SUBDIVISION FIL. NO. 3
## 1670 PAONIA STREET
## "PHASES TRUCK AND AUTO REPAIR" MINOR AMENDMENT BUILDING ADDITION

### ENGINEER'S STATEMENT

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

SIGNATURE (Affix Seal): ______________________________ 08-15-2021
Scott Marvel Colorado P.E. No.: 52138 Date:

SCOTT MARVEL
08-15-2021
52138

## DEVELOPER'S STATEMENT

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

Debby Miller
Name of Developer

Debby Miller 8/10/2021
Authorized Signature Date

Debby Miller
Printed Name

President
Title

1445 N Union Blvd
Address

## 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.

**APPROVED**
**Engineering Department**
*08/31/2021 4:07:47 PM*
*dsdnijkamp*
**EPC Planning & Community Development Department**

Jennifer Irvine, P.E.
County Engineer / ECM Administrator

Conditions:

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# I. PURPOSE

This report is a Drainage Letter for Lot 5 Palmer Park Business Center Subdivision Fil. No. 3, address 1670 Paonia Street, for the minor development plan amendment for the addition of a pre-engineered metal building PEMB) and wrap around asphalt drive access.

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

# II. GENERAL LOCATION AND DESCRIPTION

## A. LOCATION

The proposed development of a 9,030 square foot PEMB addition and an additional 12,628 square feet of paved asphalt, is located at the address of 1670 Paonia Street in the City of Colorado Springs, Colorado in El Paso County within the Palmer Park Business Center Subdivision with the land us of an I-2 CAD-0 development. The parcel Schedule Number is 5406304014 and the legal description is "Lot 5, Block 1 Palmer Park Business Center Sub. Fil. No. 3" and is 2.58 acres. The parcel is on the west side Paonia Street, between Palmer Park Boulevard and Omaha Boulevard. The parcel falls within Section 6, Township 14 South, Range 65 West of the 6th P.M. The names and descriptions of surrounding platted developments can be seen on plan sets and appendix documents and are listed below:

North of Lot 5, Block 1 Palmer Park Business Center (1670 Paonia Street):

1720 Paonia Street, Owner: East Meriwether Properties LLC, Schedule No 55406304013, Zoning: I-2 CAD-O, Plat No. 6746, Lot 6 Block 1 Palmer Park Business Center Sub. Fil. No. 3.

West of Lot 2 Walker (3565 E Uintah Street):

5885 Palmer Park Blvd, Owner: US Realty 87 Colorado Springs, Schedule No. 5406304002, Zoning: CC CAD-O, Plat No. 5958, Lot 1 Block 1 Waldorf Subdivision.

South of Lot 5, Block 1 Palmer Park Business Center (1670 Paonia Street) west to east:

5918-5883 Palmer Park Blvd, Owner: Corevet Investment Group LLC, Schedule No. 5406304050, Zoning: CR CAD-O, Plat No. 12703, Lot 1 Powers Centre Filing No. 3.

Palmer Park Blvd, Owner: Corevet Investment Group LLC, Schedule No. 5406304017, Zoning: I-2 CAD-O, Plat No. 6698, Tract A Powers Plaza.

1620 Paonia Street, Owner: Structured LLC, Schedule No. 5406304015, Zoning: I-2 CAD-O, Plat No. 6698, Lot 4 Powers Plaza.

East of Lot 5, Block 1 Palmer Park Business Center (1670 Paonia Street) from north to south:

1620 Paonia Street, Owner: T M Properties LLC, Schedule No. 5406305002, Zoning: I-2 CAD-O, Plat No. 6494, Lot 1 Block1 Palmer Park Business Center Sub. Fil. No. 2.

1625 Paonia Street, Owner: Lebrun Properties LLC, Schedule No. 5406305001, Zoning: I-2 CAD-O, Plat No. 6494, Lot 2 Block1 Palmer Park Business Center Sub. Fil. No. 2

## B. DESCRIPTION OF PROPERTY – EXISTING CONDITIONS

Lot 5 is approximately 112,385 square feet or 2.58 acres and is located on the west side of Paonia Street, south of Palmer Park Boulevard, and north of Omaha Boulevard. The parcel falls within Section 6, Township 14 South, Range 65 West of the 6th P.M., City of Colorado Springs, El Paso County, Colorado. The parcel is currently an auto repair shop that has an asphalt paved parking lot in the frontage and also wraps around the current 11,200 square foot building. There is landscaping between the parking lot at the frontage and Paonia Street surrounded by concrete curb and gutter. A 6-foot wood privacy fence blocks access to the rear of the building with a chain link fence meeting at the property line and following at or near the property line around the parcel until meeting another 6-foot wood privacy fence on the opposite side of the parcel. The rear of the parcel is gravel with a 6-foot wide concrete drainage channel that runs north to south into a detention pond southwesterly of the parcel. The existing impervious conditions are approximately 33.9 percent of the entire lot.

There are no known existing non-stormwater discharges on the lot. Due to curb and gutters, fencing and berms surrounding the site, no off-site flows discharge onto the site. This includes the easterly landscaping area along Paonia Street that only contributes on-site flows to the lot as shown via flow arrows in Appendix E.

The project site does not lie within a designated floodplain according to information published in the Federal Emergency Management Agency Floodplain Map No. 08041C0752G, dated December 7, 2018. The map is provided in the Appendix showing it lies within Zone X, a minimal flood hazard area.

The existing topography consists of grades between one and three percent with drainage patterns flowing west towards the rear of the lot into the concrete drainage channel that routes the flow south into an existing detention pond.

## C. EXISTING SOILS

The soils indicative to the site are classified as Blakeland Loamy Sand and Blendon Loamy Sand by the USDA Soil Conservation Service and are listed as Hydrologic Soil Group A and B respectively. A USDA Soil Map is provided in the Appendix.

A “Subsurface Exploration Report” by Earth Engineering Consultants, Inc., dated March, 1999, was approved by the Regional Building Department on October, 2000, states “Sand with Varying amounts of silt was encountered at the existing ground surface. The essentially granular soils were loose to medium dense and brown in color with a low to moderate moisture content. The essentially granular soils extended to the bottom of the borings at depths of approximately 15 feet.”

### D. EXISTING DRAINAGE

According to the "Drainage Report for Palmer Park Business Center Preliminary Plan and Palmer Park Business Center Subdivision Filing No. 1", prepared by K L H Engineering Consultants, Inc., dated July, 1982, runoff travels west towards the rear of the lot into a private 6-foot wide concrete trapezoidal drainage channel. From here the runoff is intercepted and conveyed south into an existing private 6.5 acre-foot detention pond. The pond outlets into a public 48" CMP Storm Drain that travels under Omaha Boulevard and ultimately outlets into the immediate receiving waters of Sand Creek East Fork.

There is a known private storm water concrete trapezoidal open drainage channel in the rear of the lot currently on site. There are exiting public water, wastewater, and gas main located in Paonia Street and a fire hydrant at the southeast property corner. An existing conditions map is located in the Appendix for reference.

### E. DESCRIPTION OF PROPERTY – PROPOSED CONDITIONS

The proposed development is for a 9,030 square foot additional Pre-Engineered Metal Building directly adjacent to the existing PEMB and an additional 18,350 square feet of paved asphalt and concrete sidewalk. A non-structural retaining wall will be constructed so an existing utility box will remain undisturbed. The existing approximately 100 square foot trash enclosure will be upsized and relocated. The building addition will extend west towards the rear of the lot with the additional asphalt pavement drive access wrapping around the building extension and reaching westward. Lot 5 requires an approximate limit of disturbance of 37,800 square feet (0.87 acres) which is 34% of the lot. The grading limits are kept within the setbacks wherever possible and the grading within the drainage easements are consistent with the historical drainage patterns of the subdivision. A sub-basin delineation sheet for the proposed conditions is provided. A geotechnical report by RMG-Rocky Mountain Group describes the existing conditions and provides proposed concrete slab sections and design criteria for the development.

## III. DRAINAGE BASINS AND SUB-BASINS

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

The parcel is delineated into sub-basins according to the existing and proposed grading for existing and developed conditions. The site is not part of larger development and well under an acre of disturbance, therefore, is exempt from WQCV and on-site detention. A drainage channel in the rear of the property outlets into "Tract A Powers Plaza", a dedicated pond for the site. The pond or "Tract A Powers Plaza", is owned and maintained by Corevet Investment Group LLC. The pond and existing drainage channel are to remain undisturbed. The site is located in the Sand Creek Drainage Basin as designated by the City of Colorado Springs Water Resources Engineering Department. A map of the existing and proposed drainage conditions can be found in Appendix E.

The Drainage Basin Planning Study (DBPS) titled "Sand Creek Drainage Basin Planning Study, Preliminary Design Report", by Kiowa Engineering Corporation and originally dated January 1993 is associated with the Sand Creek Drainage Basin where this site is located. The project location appears to be adjacent to Reach SC-3 of Sand Creek. The DBPS references a recommended plan for this reach in Table VI-7 showing a recommended channel treatment scheme called “100-year channelization concept” because of the potential for flooding damages which exists within the reach. Channelization would involve the lining of the Creek into a more confined flow area for the 100-year flood discharges.

**Basin E** is the entirety of the parcel representing existing conditions and consists of two on-site sub-basins. There are no off-site basins or sub-basins that contribute to Basin E as the property is surrounded by raised features such as landscape medians or fencing atop concrete curb head.

**Sub-basin E-1 (1.29 ac. ; $Q_5$ = 1.66 cfs, $Q_{100}$ = 4.32 cfs)** is the entire northern half area of the platted parcel which includes half of the pitched roof area that drains north by means of down spouts and is directed westward. The runoff flows from the east end of the lot westerly over the asphalt paved lot to a concrete drainage channel in the rear of the lot on the west side (EP1). The runoff is channelized and travels south towards an existing detention pond.

**Sub-basin E-2 (1.29 ac. ; $Q_5$ = 1.60 cfs, $Q_{100}$ = 4.36 cfs)** is the entire southern half area of the platted parcel which includes half of the pitched roof area that drains south by means of down spouts and is directed westward. The runoff flows from the east end of the lot westerly over the asphalt paved lot to a concrete drainage channel in the rear of the lot on the west side (EP1). The runoff is channelized and travels south towards an existing detention pond.

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

**Basin D** is the entirety of the platted parcel representing developed conditions and consists of two sub-basins.

**Sub-basin D-1 (1.29 ac. ; $Q_5$ = 2.88 cfs, $Q_{100}$ = 6.17 cfs)** is the entire northern half area of the platted parcel which includes half of the pitched roof area of the proposed building that drains north by means of down spouts and is directed westward. The runoff flows from the east end of the lot westerly over the asphalt paved lot to a concrete drainage channel in the rear of the lot on the west side (DP1). The runoff is channelized and travels south towards an existing detention pond.

**Sub-basin D-2 (1.29 ac.; $Q_5$ = 2.88 cfs, $Q_{100}$ = 6.35 cfs)** is the entire southern half area of the platted parcel which includes half of the pitched roof area of the proposed building that drains south by means of down spouts and is directed westward. The runoff flows from the east end of the lot westerly over the asphalt paved lot to a concrete drainage channel in the rear of the lot on the west side (DP1). The runoff is channelized and travels south towards an existing detention pond.

The difference between Basin E and Basin D results in an increase of the 100-year storm water volume overall due to impervious pavement and roof area. However, the 100-year storm volume still falls within the parameters of the master drainage plan as the development is consistent with the anticipated conditions laid out in the plan.

The total storm water flow for the 100-year event is for lot 5 is 8.68 cfs for existing conditions and 12.52 cfs for the developed conditions. This is an overall increase in storm water flow of

3.84 cfs. The subdivision's original drainage report "Drainage Report for Palmer Park Business Center Preliminary Plan and Palmer Park Business Center Subdivision Filing No. 1", prepared by K L H Engineering Consultants, Inc., dated July, 1982, predicted a commercial development with a runoff of 73.1 cubic feet per second (cfs) yielding the need for a 6.5 ac-ft detention pond for the sub-basin within Tract A Powers Plaza. Using current standards from the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, a runoff of 62.42 cfs was found for the entire proposed sub-basin including this development. This falls well under the original calculated runoff from the developed and approved drainage report for Lot 5. The existing regional detention pond for the sub-basin including Lot 5 is sufficiently sized for the proposed developed conditions.

The existing impervious conditions of Lot 5 is 33.9 percent while the proposed developed conditions yield 57.4 percent imperviousness. The developed site remains consistent with historical drainage patterns and volumes for the parcel. Existing drainage patterns have the majority of runoff draining towards concrete drainage channel that flows into the regional detention pond. The proposed conditions conform to this drainage pattern by sloping the pavement westerly towards the concrete drainage channel.

## IV. DRAINAGE DESIGN CRITERIA

### A. REGULATIONS

The hydrological and hydraulic calculations and design of the site conform to the City of Colorado Springs Drainage Criteria Manuals I and II (latest revision, May 2014) as well as the Mile High Flood District Drainage Criteria manuals revised August 2018.

### B. DEVELOPMENT CRITERIA REFERENCE AND CONSTRAINTS

The parcel falls within the Sand Creek major drainage basin designated by the City of Colorado Springs Water Resources Engineering Department with the ultimate receiving waters of Arkansas River. No storage facilities exist on the site, however, there is a public 6-foot open concrete drainage channel storm sewer systems that runs from north to south on the far west side of the parcel. The drainage on this parcel will have no effect on downstream infrastructure or facilities, streets, utilities, transit, or further development of adjacent lots. Relevant criteria for the calculations shown further include equations and design criteria for the rational method, volumes and runoff of carious storm events.

### C. HYDROLOGICAL CRITERIA

The rational method was used to calculate the peak runoff of the delineated basin and sub-basins using the manuals referenced prior with the C, I, and P1 values from the Design Criteria Manual Volume I, Chapter 6 as well as the Colorado Springs designated IDF curve values. Specific calculations and tables are provided further with inputs including design rainfall, sub-basin acreage and percent imperviousness, runoff coefficients, one-hour rainfall depths, rainfall intensities, time of concentration, and peak discharge of various storm events. The default rainfall intensities and volumes use runoff coefficients based on soil types. Weighted runoff coefficients were calculated for each basin and sub-basin due to the mix of impervious surfaces, shown in the Appendix exhibits. Due to site disturbance being less than one acre and not part of a larger common plan, water quality is not required.

## D. FOUR-STEP PROCESS

The selection of appropriate control measures is based on the characteristics of the site and potential pollutants. The Four-Step Process provides a method of going through the selection process. The following outlines the four-step process as it relates to the 1670 Paonia Minor Amendment project.

### Step 1: Employ Runoff Reduction Practices

The 1670 Paonia Minor Amendment project includes proposed permanent seeding areas within grading areas to encourage infiltration and evapotranspiration, without obstructing utilities or drainage ways. Within the site, the storm water runoff is kept within the site limits via strategic grading, utilizing existing berms, and following existing drainage patterns within the site in an effort to reduce runoff. Proposed pavement areas are kept to a minimum to limit impervious area.

### Step 2: Stabilize Drainage ways

The drainage within the site is stabilized by way of proposed pavement including a swale that will tie into the existing paved swale to guide flow via the site's existing drainage pattern to the existing drainage channel.

### Step 3: Provide Water Quality Capture Volume (WQCV)

The 1670 Paonia Minor Amendment project involves site disturbances less than one acre and is not part of a larger common plan; new water quality requirements are not required. This site will discharge to an existing stormwater detention basin "Tract A Powers Plaza" as previously described which will act as the permanent BMP and for water quality.

### Step 4: Consider Need for Industrial and Commercial BMPs

The 1670 Paonia Minor Amendment project will include a structure for light commercial use that may include vehicle maintenance to be limited to indoor activities. Sediment control practices such as revegetation, and grading to prevent steep side slopes are to be employed.

The following BMPs should be implemented to avoid pollutant transport to drainageways.

- Good Housekeeping:
    - Keep all work areas neat and well organized. Sweep or pick-up trash and debris daily or as needed at an approved disposal facility.
    - Recycle or dispose of all wastes properly and promptly. Do not let waster accumulate at or around the work place.
    - Do not handle, use, pour, dispose or transfer materials outdoors near storm drainage inlets, ditches, or other drainageways.
    - Do not try to handle a container alone if it is awkward or requires over-exertion. Get help or use powered equipment.
    - Use tarps or containers to contain any waste spills.

  - Do not wash down or hose down any outdoor work areas except where wash water will only enter the sanitary sewer (if approved).
  - Use only dry-clean methods to clean up spills.
  - Clean-up all spills or releases promptly
- Spill Prevention:
  - Ensure all work involving pollutants is conducted indoors, under a roof, or inside of containment.
  - Implement an adequate spill kit or locker near work areas where spills or leaks are possible.
  - Identify and stencil any storm drain inlets at or near the facility to notify employees and contractors not to dispose of any materials or wastes there.

Any spills that occur are to be addressed according to the requirements of Colorado Department Public Health and Environment, Hazardous Materials and Waste Management Division. No groundwater and/or stormwater dewatering activities are proposed or expected for the proposed construction activities. Any waste disposal during construction or during operation is to be done at a location approved by El Paso County. Waste disposal, spill prevention, and response procedures are to be according to CDPHE and El Paso County standards.

## V. DRAINAGE AND BRIDGE FEES

Lot 5 is contained within the Sand Creek drainage basin area and has a 2021 Drainage Fee of \$13,775/acre, bridge fee of \$819/acre, a pond/land fee of \$1,070\$/acre, a pond facility fee of \$3,957/acre and surcharge fee of \$1,435/acre. The total site platted acreage is 2.58 acre.

Drainage fees are assumed to have already been paid as a part of the “Palmer Park Business Center Subdivision Filing No. 1” Final Plat process for the original Site Development Plan for the existing commercial business development and therefore no drainage, bridge, or pond fees are to be paid. The County is to review and confirm based on their own non-public records.

## VI. CONCLUSIONS

### A. COMPLIANCE WITH STANDARDS

The criteria used to design the storm water runoff volumes are formulas and figures within the City of Colorado Springs Drainage Manuals as well as the Mile High Flood District Drainage Criteria manual. Grading practices for optimal drainage comply with the geotechnical investigative report and City standards. The development of Lot 5 is within compliance and standards for drainage design.

The subdivision’s original drainage report “Drainage Report for Palmer Park Business Center Preliminary Plan and Palmer Park Business Center Subdivision Filing No. 1”, prepared by K L H Engineering Consultants, Inc., dated July, 1982, predicted a commercial development with a runoff of 73.1 cubic feet per second (cfs) yielding the need for a 6.5 ac-ft detention pond for the sub-basin within Tract A Powers Plaza. Using current standards from the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, a runoff of 62.42 cfs was found for the entire proposed sub-basin including this development. This falls well under the original calculated runoff from the developed and approved drainage report for Lot 5. The existing regional detention pond for the sub-basin including Lot 5 is sufficiently sized for the proposed developed conditions. Therefore, the proposed grading and drainage is within substantial conformance for the master drainage plan for the Palmer Park Business Center Subdivision. There is no impact on major drainageway planning studies within the larger drainage basin. This development will not adversely affect downstream development.

## VII. REFERENCES

Colorado Springs Drainage Manual Volumes I & II (May 2014)

Colorado Urban Drainage and Flood Control District Drainage Criteria Manual, Volume I (August 2018)

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

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

FEMA Flood Map Service Center

United States Department of Agriculture National Resources Conservation Service

Previous Drainage Report (Walker Subdivision Filing No. 1 Prepared by Leigh Whitehead & Associates, Inc., Dated July, 2008)

El Paso County Engineering Criteria Manual, latest revision

El Paso County Drainage Criteria Manual, latest revision

Sand Creek Drainage Basin Planning Study (DBPS) Preliminary Design Report, by Kiowa Engineering Corporation, originally dated January 1993

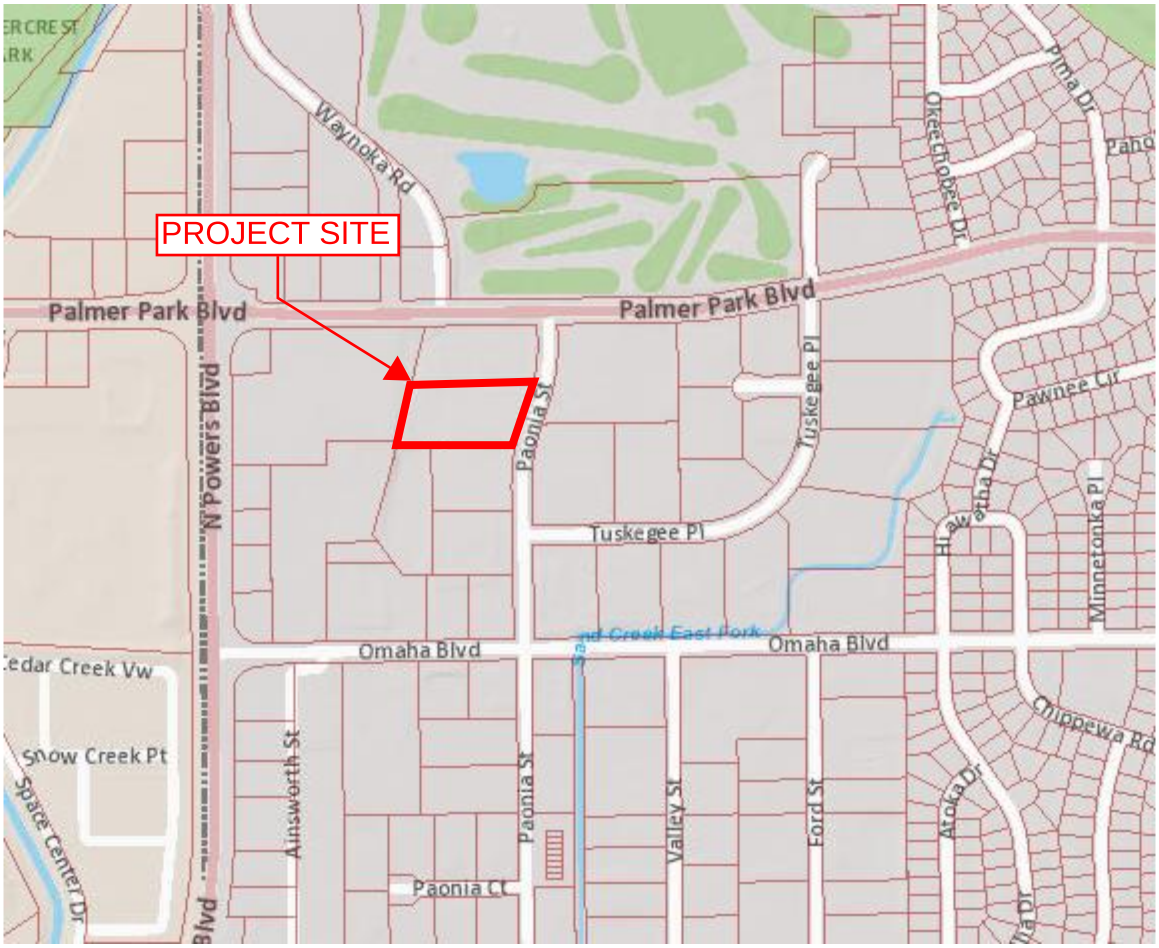
# VIII. Appendices

# APPENDIX A – VICINITY MAP

# VICINITY MAP

1670 PAONIA STREET

COLORADO SPRINGS, COLORADO 80915



# APPENDIX B – HYDROLOGIC COMPUTATIONS

**Project:** **1670 Paonia Street**
**Engineer:** **Richard Lyon**
**Date:** **1/4/2021**
**Address:** **1670 Paonia Street, Colorado Springs, CO**

| Sub-Basin: | **E-1** | **(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)** | | | |
|---|---|---|---|---|---|
| $t_t$ Duration: | **15.94** | | | | |
| $I_2$ | $I_5$ | $I_{10}$ | $I_{25}$ | $I_{50}$ | $I_{100}$ |
| 2.740122493 | 3.429793058 | 4.0015919 | 4.57339074 | 5.14518959 | 5.75761234 |

| Hydrologic Soil Type: | **A** |
|---|---|

### Coefficient (Table 6-6)

| Land Use or Surface Characteristic | Square Feet | Acreage | Coefficient $_2$ | Coefficient $_5$ | Coefficient $_{10}$ | Coefficient $_{25}$ | Coefficient $_{50}$ | Coefficient $_{100}$ | 2 Yr: $C_i * A_i$ | 5 Yr: $C_i * A_i$ | 10 Yr: $C_i * A_i$ | 25 Yr: $C_i * A_i$ | 50 Yr: $C_i * A_i$ | 100 Yr: $C_i * A_i$ | 2 Yr $C_c$ | 5 Yr $C_c$ | 10 Yr $C_c$ | 25 Yr $C_c$ | 50 Yr $C_c$ | 100 Yr $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 5527.00 | 0.127 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 | 0.090 | 0.093 | 0.095 | 0.099 | 0.102 | 0.103 | **0.418** | **0.455** | **0.501** | **0.564** | **0.596** | **0.626** |
| Pavement | 14621 | 0.336 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 | 0.299 | 0.302 | 0.309 | 0.316 | 0.319 | 0.322 | | | | | | |
| Lawn | 21359 | 0.490 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 | 0.010 | 0.039 | 0.074 | 0.123 | 0.147 | 0.172 | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| $A_t$: | 41507 | 0.953 | | | | | | | | | | | | | | | | | | |

### Q Peak Flow (cfs)

| 2 Year Q | 5 Year Q | 10 Year Q | 25 Year Q | 50 Year Q | 100 Year Q |
|---|---|---|---|---|---|
| **1.09** | **1.49** | **1.91** | **2.46** | **2.92** | **3.44** |

| Sub-Basin: | **E-2** | **(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)** | | | |
|---|---|---|---|---|---|
| $t_t$ Duration: | **10.10** | | | | |
| $I_2$ | $I_5$ | $I_{10}$ | $I_{25}$ | $I_{50}$ | $I_{100}$ |
| 3.283289007 | 4.114456731 | 4.80036619 | 5.48627564 | 6.1721851 | 6.90784731 |

| Hydrologic Soil Type: | **B** |
|---|---|

### Coefficient (Table 6-6)

| Land Use or Surface Characteristic | Square Feet | Acreage | Coefficient $_2$ | Coefficient $_5$ | Coefficient $_{10}$ | Coefficient $_{25}$ | Coefficient $_{50}$ | Coefficient $_{100}$ | 2 Yr: $C_i * A_i$ | 5 Yr: $C_i * A_i$ | 10 Yr: $C_i * A_i$ | 25 Yr: $C_i * A_i$ | 50 Yr: $C_i * A_i$ | 100 Yr: $C_i * A_i$ | 2 Yr $C_c$ | 5 Yr $C_c$ | 10 Yr $C_c$ | 25 Yr $C_c$ | 50 Yr $C_c$ | 100 Yr $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 0.00 | 0.000 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | **0.064** | **0.121** | **0.189** | **0.285** | **0.333** | **0.381** |
| Pavement | 731 | 0.017 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 | 0.015 | 0.015 | 0.015 | 0.016 | 0.016 | 0.016 | | | | | | |
| Lawn | 13869 | 0.318 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 | 0.006 | 0.025 | 0.048 | 0.080 | 0.096 | 0.111 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| $A_t$: | 14600 | 0.335 | | | | | | | | | | | | | | | | | | |

### Q Peak Flow (cfs)

| 2 Year Q | 5 Year Q | 10 Year Q | 25 Year Q | 50 Year Q | 100 Year Q |
|---|---|---|---|---|---|
| **0.07** | **0.17** | **0.30** | **0.52** | **0.69** | **0.88** |

| Sub-Basin: | **E-3** | **(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)** | | | |
|---|---|---|---|---|---|
| $t_t$ Duration: | **13.03** | | | | |
| $I_2$ | $I_5$ | $I_{10}$ | $I_{25}$ | $I_{50}$ | $I_{100}$ |
| 2.97954304 | 3.731583664 | 4.35368094 | 4.97577822 | 5.5978755 | 6.26462056 |

| Hydrologic Soil Type: | **A** |
|---|---|

### Coefficient (Table 6-6)

| Land Use or Surface Characteristic | Square Feet | Acreage | Coefficient $_2$ | Coefficient $_5$ | Coefficient $_{10}$ | Coefficient $_{25}$ | Coefficient $_{50}$ | Coefficient $_{100}$ | 2 Yr: $C_i * A_i$ | 5 Yr: $C_i * A_i$ | 10 Yr: $C_i * A_i$ | 25 Yr: $C_i * A_i$ | 50 Yr: $C_i * A_i$ | 100 Yr: $C_i * A_i$ | 2 Yr $C_c$ | 5 Yr $C_c$ | 10 Yr $C_c$ | 25 Yr $C_c$ | 50 Yr $C_c$ | 100 Yr $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 5683.00 | 0.130 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 | 0.093 | 0.095 | 0.098 | 0.102 | 0.104 | 0.106 | **0.367** | **0.407** | **0.455** | **0.523** | **0.557** | **0.590** |
| Pavement | 11886 | 0.273 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 | 0.243 | 0.246 | 0.251 | 0.256 | 0.259 | 0.262 | | | | | | |
| Lawn | 23577 | 0.541 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 | 0.011 | 0.043 | 0.081 | 0.135 | 0.162 | 0.189 | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | |
| $A_t$: | 41146 | 0.945 | | | | | | | | | | | | | | | | | | |

### Q Peak Flow (cfs)

| 2 Year Q | 5 Year Q | 10 Year Q | 25 Year Q | 50 Year Q | 100 Year Q |
|---|---|---|---|---|---|
| **1.03** | **1.43** | **1.87** | **2.46** | **2.94** | **3.49** |

| Sub-Basin: | **E-4** | **(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)** | | | |
|---|---|---|---|---|---|
| $t_t$ Duration: | **11.55** | | | | |
| $I_2$ | $I_5$ | $I_{10}$ | $I_{25}$ | $I_{50}$ | $I_{100}$ |
| 3.123648385 | 3.913229057 | 4.56560057 | 5.21797208 | 5.87034359 | 6.56978482 |

| Hydrologic Soil Type: | **B** |
|---|---|

### Coefficient (Table 6-6)

| Land Use or Surface Characteristic | Square Feet | Acreage | Coefficient $_2$ | Coefficient $_5$ | Coefficient $_{10}$ | Coefficient $_{25}$ | Coefficient $_{50}$ | Coefficient $_{100}$ | 2 Yr: $C_i * A_i$ | 5 Yr: $C_i * A_i$ | 10 Yr: $C_i * A_i$ | 25 Yr: $C_i * A_i$ | 50 Yr: $C_i * A_i$ | 100 Yr: $C_i * A_i$ | 2 Yr $C_c$ | 5 Yr $C_c$ | 10 Yr $C_c$ | 25 Yr $C_c$ | 50 Yr $C_c$ | 100 Yr $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 0.00 | 0.000 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | **0.062** | **0.120** | **0.187** | **0.283** | **0.332** | **0.380** |
| Pavement | 734 | 0.017 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 | 0.015 | 0.015 | 0.016 | 0.016 | 0.016 | 0.016 | | | | | | |
| Lawn | 14390 | 0.330 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 | 0.007 | 0.026 | 0.050 | 0.083 | 0.099 | 0.116 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| $A_t$: | 15124 | 0.347 | | | | | | | | | | | | | | | | | | |

### Q Peak Flow (cfs)

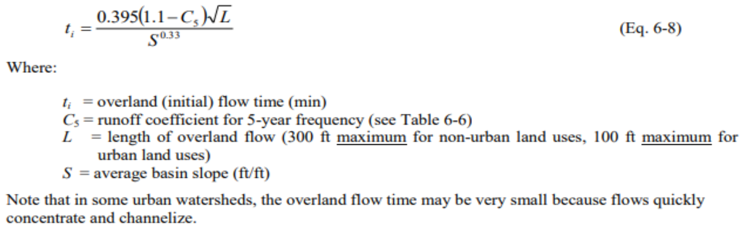
| 2 Year Q | 5 Year Q | 10 Year Q | 25 Year Q | 50 Year Q | 100 Year Q |
|---|---|---|---|---|---|
| **0.07** | **0.16** | **0.30** | **0.51** | **0.68** | **0.87** |

### Design Points

| Design Point | $Q_5$ | $Q_{10}$ | $Q_{100}$ |
|---|---|---|---|
| EX DP1 | 1.66 | 2.21 | 4.32 |
| EX DP2 | 1.60 | 2.17 | 4.36 |
| EX DP3 | 0.00 | 0.00 | 0.00 |
| **Total Site** | **3.25** | **4.38** | **8.67** |

## Time of Concentration $t_c = t_i + t_t$

### 3.2.1 - Overland (Initial) Flow Time



$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$ (Eq. 6-8)

Where:

$t_i$ = overland (initial) flow time (min)
$C_5$ = runoff coefficient for 5-year frequency (see Table 6-6)
$L$ = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
$S$ = average basin slope (ft/ft)

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

| **Sub-Basin or DP:** | **E-1** | |
|---|---|---|
| $C_5$: | **0.46** | [Table 6-6. Runoff Coefficients for Rational Method] |
| L: | **99** | ft |
| S: | **0.005** | ft/ft |

**Composite Runoff Coefficient Calculation:**

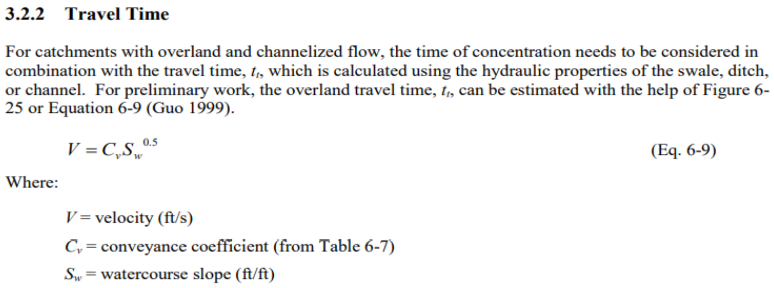
$C_c = (C_1 A_1 + C_2 A_2 + C_3 A_3 + .....C_i A_i) / A_t$

| **Land Use or Surface Characteristic** | **Square Feet** | **Acreage** | **$C_5$** |
|---|---|---|---|
| Roof | 5527.00 | 0.13 | 0.73 |
| Pavement | 14621.00 | 0.34 | 0.90 |
| Lawn | 21359.00 | 0.49 | 0.08 |
| $A_t$ : | 41507.00 | 0.95 | |

$C_c = (0.73*0.13 + 0.90*0.34 + 0.08*0.83) / 0.95 =$ **0.46**

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S\text{^}0.33)$

$t_i = (0.395*(1.1-0.36)*sqrt(99))/(0.005\text{^}0.33) =$ **14.56** mins



### 3.2.2 Travel Time

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

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

Where:

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

$V = C_v S_w^{0.5}$

$V = (20)(0.016)^{0.5} =$ **2.53** ft/s

Flow Distance: **210.00** ft

$t_t = L/V =$ 83.01 sec.

**1.38** min.

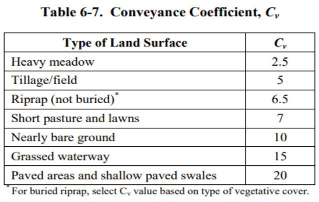
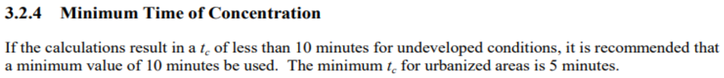


**Table 6-7. Conveyance Coefficient, $C_v$**

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

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

## $t_c = t_i + t_t =$ **15.94** min.



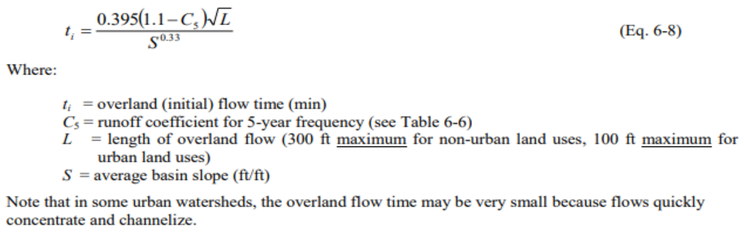
### 3.2.4 Minimum Time of Concentration

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

## Final $t_c$: **15.94** min.

## Time of Concentration $t_c = t_i + t_t$

### 3.2.1 - Overland (Initial) Flow Time



$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$ (Eq. 6-8)

Where:

$t_i$ = overland (initial) flow time (min)
$C_5$ = runoff coefficient for 5-year frequency (see Table 6-6)
$L$ = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
$S$ = average basin slope (ft/ft)

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

| **Sub-Basin or DP:** | **E-1** | |
|---|---|---|
| $C_5$: | **0.12** | [Table 6-6. Runoff Coefficients for Rational Method] |
| L: | **113** | ft |
| S: | **0.077** | ft/ft |

**Composite Runoff Coefficient Calculation:**

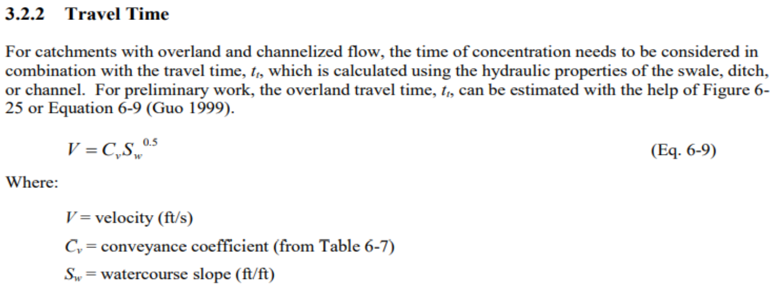
$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + .....C_iA_i) / A_t$

| **Land Use or Surface Characteristic** | **Square Feet** | **Acreage** | **$C_5$** |
|---|---|---|---|
| Roof | 0.00 | 0.00 | 0.73 |
| Pavement | 731.00 | 0.02 | 0.90 |
| Lawn | 13869.00 | 0.32 | 0.08 |
| $A_t$ : | 14600.00 | 0.34 | |

$C_c$ = (0.90*1.22 + 0.08*0.65) / 0.34 = **0.12**

$t_i$ = (0.395*(1.1-$C_5$)*sqrt(L))/(S^0.33)

$t_i$ = (0.395*(1.1-0.48)*sqrt(113))/(0.077^0.33) = **9.58** mins



### 3.2.2 Travel Time

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

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

Where:

$V$ = velocity (ft/s)

$C_v$ = conveyance coefficient (from Table 6-7)

$S_w$ = watercourse slope (ft/ft)

$V = C_v S_w^{0.5}$

$V = (20)(0.005)^{0.5}$ = **1.41** ft/s

Flow Distance: **44.00** ft

$t_t$ = L/V = 31.11 sec.
**0.52** min.

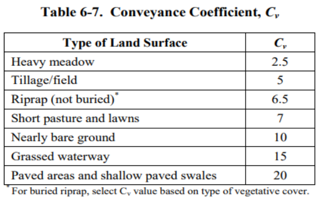
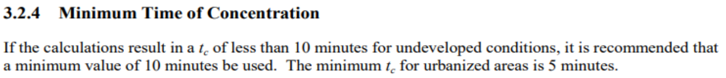


**Table 6-7. Conveyance Coefficient, $C_v$**

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

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

**$t_c = t_i + t_t$ =** **10.10** min.



### 3.2.4 Minimum Time of Concentration

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

**Final $t_c$:** **10.10** min.

## Time of Concentration $t_c = t_i + t_t$

### 3.2.1 - Overland (Initial) Flow Time

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$ (Eq. 6-8)

Where:

$t_i$ = overland (initial) flow time (min)
$C_5$ = runoff coefficient for 5-year frequency (see Table 6-6)
$L$ = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
$S$ = average basin slope (ft/ft)

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

| **Sub-Basin or DP:** | **E-2** | |
|---|---|---|
| $C_5$: | **0.41** | [Table 6-6. Runoff Coefficients for Rational Method] |
| L: | **89** | ft |
| S: | **0.01** | ft/ft |

**Composite Runoff Coefficient Calculation:**
*$C_c = (C_1 A_1 + C_2 A_2 + C_3 A_3 + \ldots C_i A_i) / A_t$*

| **Land Use or Surface Characteristic** | **Square Feet** | **Acreage** | **$C_5$** |
|---|---|---|---|
| Roof | 5683.00 | 0.13 | 0.73 |
| Pavement | 11886.00 | 0.27 | 0.90 |
| Lawn | 23577.00 | 0.54 | 0.08 |
| $A_t$ : | 41146.00 | 0.94 | |

*$C_c$ = (0.73*0.13 + 0.90*1.40 + 0.08*0.54) / 0.94 =* **0.41**

*$t_i$ = (0.395*(1.1-$C_5$)*sqrt(L))/(S^0.33)*
*$t_i$ = (0.395*(1.1-0.41)*sqrt(89))/(0.01^0.33) =* **11.81** mins

### 3.2.2 Travel Time

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

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

Where:

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

*$V = C_v S_w^{0.5}$*
*$V = (20)(0.026)^{0.5}$ =* **3.22** ft/s

Flow Distance: **237.00** ft

$t_t$ = L/V = 73.49 sec.
**1.22** min.

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

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

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

## $t_c = t_i + t_t$ = **13.03** min.

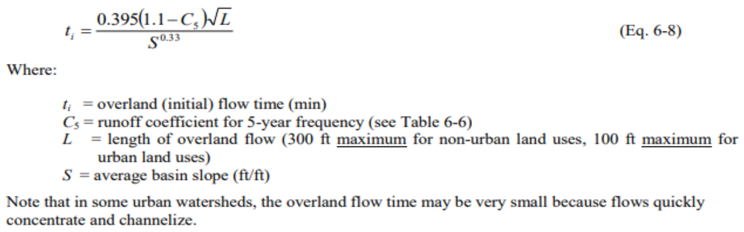
### 3.2.4 Minimum Time of Concentration

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

## Final $t_c$: **13.03** min.

## Time of Concentration $t_c = t_i + t_t$

### 3.2.1 - Overland (Initial) Flow Time



$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$ (Eq. 6-8)

Where:

$t_i$ = overland (initial) flow time (min)
$C_5$ = runoff coefficient for 5-year frequency (see Table 6-6)
$L$ = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
$S$ = average basin slope (ft/ft)

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

| **Sub-Basin or DP:** | **E-2** | |
|---|---|---|
| $C_5$: | **0.12** | [Table 6-6. Runoff Coefficients for Rational Method] |
| L: | **121** | ft |
| S: | **0.051** | ft/ft |

**Composite Runoff Coefficient Calculation:**

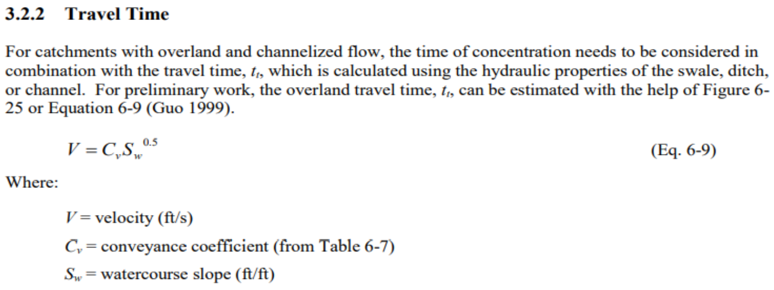
$C_c = (C_1 A_1 + C_2 A_2 + C_3 A_3 + .....C_i A_i) / A_t$

| **Land Use or Surface Characteristic** | **Square Feet** | **Acreage** | **$C_5$** |
|---|---|---|---|
| Roof | 0.00 | 0.00 | 0.73 |
| Pavement | 734.00 | 0.02 | 0.90 |
| Lawn | 14390.00 | 0.33 | 0.08 |
| $A_t$ : | 15124.00 | 0.35 | |

$C_c = (0.90*0.02 + 0.08*0.33) / 0.35 =$ **0.12**

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S^{\wedge}0.33)$

$t_i = (0.395*(1.1-0.12)*sqrt(121))/(0.051^{\wedge}0.33) =$ **11.37** mins



### 3.2.2 Travel Time

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

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

Where:

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

$V = C_v S_w^{0.5}$

$V = (20)(0.005)^{0.5} =$ **1.41** ft/s

Flow Distance: **15.00** ft

$t_t = L/V =$ 10.61 sec.
**0.18** min.

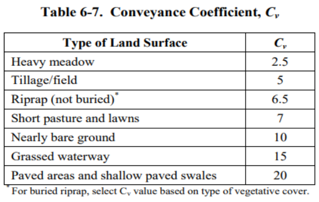
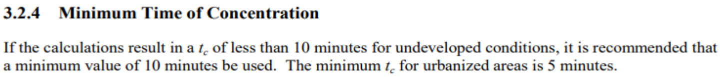


**Table 6-7. Conveyance Coefficient, $C_v$**

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

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

**$t_c = t_i + t_t$ =** **11.55** min.



### 3.2.4 Minimum Time of Concentration

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

**Final $t_c$:** **11.55** min.

**Project:** 1670 Paonia Street
**Engineer:** Richard Lyon
**Date:** 1/4/2021
**Address:** 1670 Paonia Street,  Colorado Springs, CO

| | | | | | |
|---|---|---|---|---|---|
| Sub-Basin: | **D-1** | **(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)** | | | |
| $t_t$ Duration: | **12.45** | | | | |
| $I_2$ | $I_5$ | $I_{10}$ | $I_{25}$ | $I_{50}$ | $I_{100}$ |
| 3.03383562 | 3.800019689 | 4.43352297 | 5.06702625 | 5.70052953 | 6.37959308 |

| | |
|---|---|
| Hydrologic Soil Type: | **A** |

### Coefficient (Table 6-6)

| Land Use or Surface Characteristic | Square Feet | Acreage | Coefficient $_{2}$ | Coefficient $_{5}$ | Coefficient $_{10}$ | Coefficient $_{25}$ | Coefficient $_{50}$ | Coefficient $_{100}$ | 2 Yr: $C_i * A_i$ | 5 Yr: $C_i * A_i$ | 10 Yr: $C_i * A_i$ | 25 Yr: $C_i * A_i$ | 50 Yr: $C_i * A_i$ | 100 Yr: $C_i * A_i$ | 2 Yr $C_c$ | 5 Yr $C_c$ | 10 Yr $C_c$ | 25 Yr $C_c$ | 50 Yr $C_c$ | 100 Yr $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 9027.00 | 0.207 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 | 0.147 | 0.151 | 0.155 | 0.162 | 0.166 | 0.168 | **0.583** | **0.611** | **0.646** | **0.693** | **0.717** | **0.740** |
| Pavement | 19702 | 0.452 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 | 0.403 | 0.407 | 0.416 | 0.425 | 0.430 | 0.434 | | | | | | |
| Lawn | 12778 | 0.293 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 | 0.006 | 0.023 | 0.044 | 0.073 | 0.088 | 0.103 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| $A_t$ : | 41507 | 0.953 | | | | | | | | | | | | | | | | | | |

### Q Peak Flow (cfs)

| 2 Year Q | 5 Year Q | 10 Year Q | 25 Year Q | 50 Year Q | 100 Year Q |
|---|---|---|---|---|---|
| **1.69** | **2.21** | **2.73** | **3.34** | **3.90** | **4.50** |

| | | | | | |
|---|---|---|---|---|---|
| Sub-Basin: | **D-2** | **(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)** | | | |
| $t_t$ Duration: | **5.00** | | | | |
| $I_2$ | $I_5$ | $I_{10}$ | $I_{25}$ | $I_{50}$ | $I_{100}$ |
| 4.119768884 | 5.168843131 | 6.03048365 | 6.89212418 | 7.7537647 | 8.67921646 |

| | |
|---|---|
| Hydrologic Soil Type: | **B** |

### Coefficient (Table 6-6)

| Land Use or Surface Characteristic | Square Feet | Acreage | Coefficient $_{2}$ | Coefficient $_{5}$ | Coefficient $_{10}$ | Coefficient $_{25}$ | Coefficient $_{50}$ | Coefficient $_{100}$ | 2 Yr: $C_i * A_i$ | 5 Yr: $C_i * A_i$ | 10 Yr: $C_i * A_i$ | 25 Yr: $C_i * A_i$ | 50 Yr: $C_i * A_i$ | 100 Yr: $C_i * A_i$ | 2 Yr $C_c$ | 5 Yr $C_c$ | 10 Yr $C_c$ | 25 Yr $C_c$ | 50 Yr $C_c$ | 100 Yr $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 1014.00 | 0.023 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 | 0.017 | 0.017 | 0.017 | 0.018 | 0.019 | 0.019 | **0.345** | **0.386** | **0.437** | **0.506** | **0.542** | **0.576** |
| Pavement | 4648 | 0.107 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 | 0.095 | 0.096 | 0.098 | 0.100 | 0.101 | 0.102 | | | | | | |
| Lawn | 8938 | 0.205 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 | 0.004 | 0.016 | 0.031 | 0.051 | 0.062 | 0.072 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| $A_t$ : | 14600 | 0.335 | | | | | | | | | | | | | | | | | | |

### Q Peak Flow (cfs)

| 2 Year Q | 5 Year Q | 10 Year Q | 25 Year Q | 50 Year Q | 100 Year Q |
|---|---|---|---|---|---|
| **0.48** | **0.67** | **0.88** | **1.17** | **1.41** | **1.68** |

| | | | | | |
|---|---|---|---|---|---|
| Sub-Basin: | **D-3** | **(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)** | | | |
| $t_t$ Duration: | **9.76** | | | | |
| $I_2$ | $I_5$ | $I_{10}$ | $I_{25}$ | $I_{50}$ | $I_{100}$ |
| 3.324398129 | 4.166274953 | 4.86082078 | 5.5553666 | 6.24991243 | 6.99490192 |

| | |
|---|---|
| Hydrologic Soil Type: | **A** |

### Coefficient (Table 6-6)

| Land Use or Surface Characteristic | Square Feet | Acreage | Coefficient $_{2}$ | Coefficient $_{5}$ | Coefficient $_{10}$ | Coefficient $_{25}$ | Coefficient $_{50}$ | Coefficient $_{100}$ | 2 Yr: $C_i * A_i$ | 5 Yr: $C_i * A_i$ | 10 Yr: $C_i * A_i$ | 25 Yr: $C_i * A_i$ | 50 Yr: $C_i * A_i$ | 100 Yr: $C_i * A_i$ | 2 Yr $C_c$ | 5 Yr $C_c$ | 10 Yr $C_c$ | 25 Yr $C_c$ | 50 Yr $C_c$ | 100 Yr $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 9535.00 | 0.219 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 | 0.155 | 0.160 | 0.164 | 0.171 | 0.175 | 0.177 | **0.571** | **0.600** | **0.636** | **0.683** | **0.708** | **0.731** |
| Pavement | 18518 | 0.425 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 | 0.378 | 0.383 | 0.391 | 0.400 | 0.404 | 0.408 | | | | | | |
| Lawn | 13093 | 0.301 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 | 0.006 | 0.024 | 0.045 | 0.075 | 0.090 | 0.105 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| $A_t$ : | 41146 | 0.945 | | | | | | | | | | | | | | | | | | |

### Q Peak Flow (cfs)

| 2 Year Q | 5 Year Q | 10 Year Q | 25 Year Q | 50 Year Q | 100 Year Q |
|---|---|---|---|---|---|
| **1.79** | **2.36** | **2.92** | **3.59** | **4.18** | **4.83** |

| | | | | | |
|---|---|---|---|---|---|
| Sub-Basin: | **D-4** | **(IDF Curve Equations from Figure 6-5 of the DCM Volume 1)** | | | |
| $t_t$ Duration: | **5.00** | | | | |
| $I_2$ | $I_5$ | $I_{10}$ | $I_{25}$ | $I_{50}$ | $I_{100}$ |
| 4.119768884 | 5.168843131 | 6.03048365 | 6.89212418 | 7.7537647 | 8.67921646 |

| | |
|---|---|
| Hydrologic Soil Type: | **B** |

### Coefficient (Table 6-6)

| Land Use or Surface Characteristic | Square Feet | Acreage | Coefficient $_{2}$ | Coefficient $_{5}$ | Coefficient $_{10}$ | Coefficient $_{25}$ | Coefficient $_{50}$ | Coefficient $_{100}$ | 2 Yr: $C_i * A_i$ | 5 Yr: $C_i * A_i$ | 10 Yr: $C_i * A_i$ | 25 Yr: $C_i * A_i$ | 50 Yr: $C_i * A_i$ | 100 Yr: $C_i * A_i$ | 2 Yr $C_c$ | 5 Yr $C_c$ | 10 Yr $C_c$ | 25 Yr $C_c$ | 50 Yr $C_c$ | 100 Yr $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Roof | 664.00 | 0.015 | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 | 0.011 | 0.011 | 0.011 | 0.012 | 0.012 | 0.012 | **0.243** | **0.291** | **0.347** | **0.426** | **0.466** | **0.506** |
| Pavement | 3358 | 0.077 | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 | 0.069 | 0.069 | 0.071 | 0.072 | 0.073 | 0.074 | | | | | | |
| Lawn | 11102 | 0.255 | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 | 0.005 | 0.020 | 0.038 | 0.064 | 0.076 | 0.089 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| $A_t$ : | 15124 | 0.347 | | | | | | | | | | | | | | | | | | |

### Q Peak Flow (cfs)

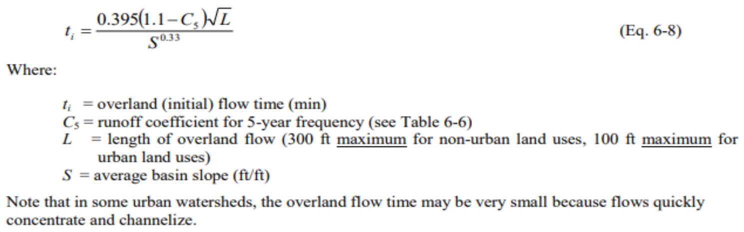
| 2 Year Q | 5 Year Q | 10 Year Q | 25 Year Q | 50 Year Q | 100 Year Q |
|---|---|---|---|---|---|
| **0.35** | **0.52** | **0.73** | **1.02** | **1.26** | **1.52** |

### Design Points

| Design Point | $Q_5$ | $Q_{10}$ | $Q_{100}$ |
|---|---|---|---|
| EX DP1 | 2.88 | 3.61 | 6.17 |
| EX DP2 | 2.88 | 3.65 | 6.35 |
| EX DP3 | 0.00 | 0.00 | 0.00 |
| **Total Site** | **5.76** | **7.26** | **12.53** |

## Time of Concentration $t_c = t_i + t_t$

### 3.2.1 - Overland (Initial) Flow Time



$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$ (Eq. 6-8)

Where:

$t_i$ = overland (initial) flow time (min)
$C_5$ = runoff coefficient for 5-year frequency (see Table 6-6)
$L$ = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
$S$ = average basin slope (ft/ft)

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

| **Sub-Basin or DP:** | **D-1** | |
|---|---|---|
| $C_5$: | **0.61** | [Table 6-6. Runoff Coefficients for Rational Method] |
| L: | **99** | ft |
| S: | **0.005** | ft/ft |

**Composite Runoff Coefficient Calculation:**

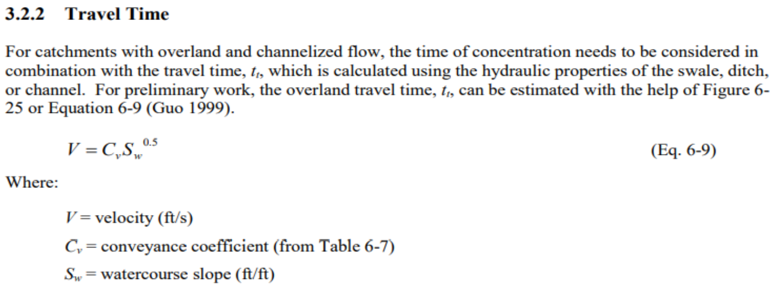
$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \ldots.. C_iA_i) / A_t$

| **Land Use or Surface Characteristic** | **Square Feet** | **Acreage** | **$C_5$** |
|---|---|---|---|
| Roof | 9027.00 | 0.21 | 0.73 |
| Pavement | 19702.00 | 0.45 | 0.90 |
| Lawn | 12778.00 | 0.29 | 0.08 |
| $A_t$ : | 41507.00 | 0.95 | |

$C_c = (0.73*0.21 + 0.90*0.45 + 0.08*0.29) / 0.95 =$ **0.61**

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S\text{^}0.33)$

$t_i = (0.395*(1.1-0.61)*sqrt(99))/(0.005\text{^}0.33) =$ **11.05** mins



### 3.2.2 Travel Time

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

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

Where:

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

$V = C_v S_w^{0.5}$

$V = (20)(0.015)^{0.5} =$ **2.45** ft/s

Flow Distance: **206.00** ft

$t_t = L/V =$ 84.10 sec.
**1.40** min.

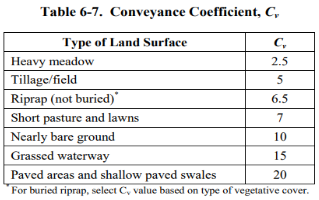
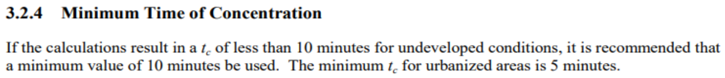


**Table 6-7. Conveyance Coefficient, $C_v$**

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

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

## $t_c = t_i + t_t =$ **12.45** min.



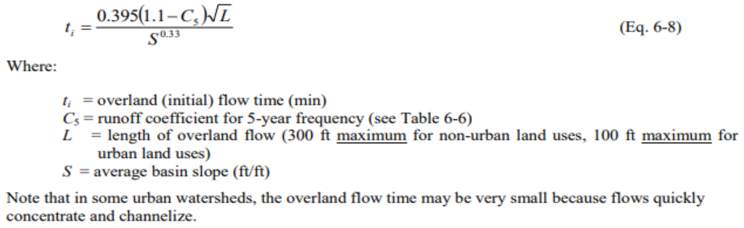
### 3.2.4 Minimum Time of Concentration

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

## Final $t_c$: **12.45** min.

## Time of Concentration $t_c = t_i + t_t$

### 3.2.1 - Overland (Initial) Flow Time



$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

$t_i$ = overland (initial) flow time (min)
$C_5$ = runoff coefficient for 5-year frequency (see Table 6-6)
$L$ = length of overland flow (300 ft <u>maximum</u> for non-urban land uses, 100 ft <u>maximum</u> for urban land uses)
$S$ = average basin slope (ft/ft)

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

| **Sub-Basin or DP:** | **D-1** | |
|---|---|---|
| $C_5$: | **0.39** | [Table 6-6. Runoff Coefficients for Rational Method] |
| L: | **1** | ft |
| S: | **0.015** | ft/ft |

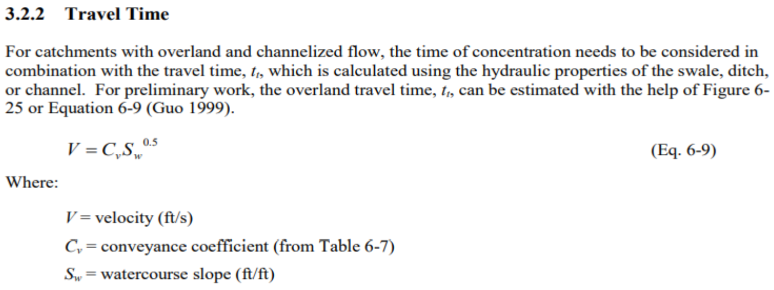
**Composite Runoff Coefficient Calculation:**

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

| Land Use or Surface Characteristic | Square Feet | Acreage | $C_5$ |
|---|---|---|---|
| Roof | 1014.00 | 0.02 | 0.73 |
| Pavement | 4648.00 | 0.11 | 0.90 |
| Lawn | 8938.00 | 0.21 | 0.08 |
| $A_t$ : | 14600.00 | 0.34 | |

$C_c$ = (0.73*.02 + 0.90*0.11 + 0.08*0.21) / 0.34 = **0.39**

$t_i$ = (0.395*(1.1-$C_5$)*sqrt(L))/(S^0.33)
$t_i$ = (0.395*(1.1-0.39)*sqrt(1))/(0.015^0.33) = **1.13** mins



### 3.2.2 Travel Time

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

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

Where:

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

$V = C_v S_w^{0.5}$
$V = (20)(0.033)^{0.5}$ = **3.63** ft/s

Flow Distance: **178.00** ft

$t_t$ = L/V = 48.99 sec.
**0.82** min.

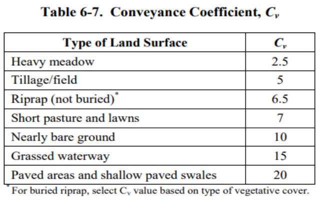
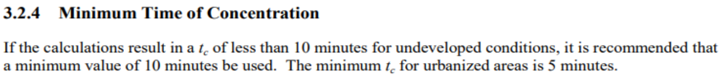


**Table 6-7. Conveyance Coefficient, $C_v$**

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

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

## $t_c = t_i + t_t$ = **1.94** min.



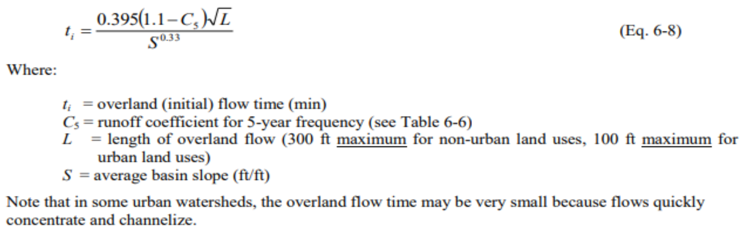
### 3.2.4 Minimum Time of Concentration

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

## Final $t_c$: **5.00** min.

## Time of Concentration $t_c = t_i + t_t$

### 3.2.1 - Overland (Initial) Flow Time



$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$ (Eq. 6-8)

Where:

$t_i$ = overland (initial) flow time (min)
$C_5$ = runoff coefficient for 5-year frequency (see Table 6-6)
$L$ = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
$S$ = average basin slope (ft/ft)

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

| Sub-Basin or DP: | D-2 | |
|---|---|---|
| $C_5$: | 0.60 | [Table 6-6. Runoff Coefficients for Rational Method] |
| L: | 89 | ft |
| S: | 0.01 | ft/ft |

**Composite Runoff Coefficient Calculation:**

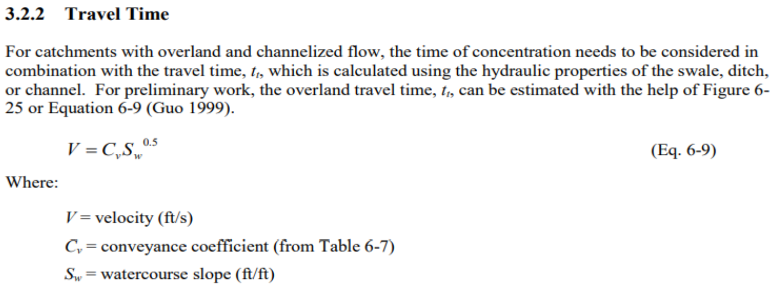
$C_c = (C_1A_1 + C_2A_2 + C_3A_3 + \ldots..C_iA_i) / A_t$

| Land Use or Surface Characteristic | Square Feet | Acreage | $C_5$ |
|---|---|---|---|
| Roof | 9535.00 | 0.22 | 0.73 |
| Pavement | 18518.00 | 0.43 | 0.90 |
| Lawn | 13093.00 | 0.30 | 0.08 |
| $A_t$ : | 41146.00 | 0.94 | |

$C_c = (0.73*0.22 + 0.90*0.43 + 0.08*0.30) / 0.94 =$ **0.60**

$t_i = (0.395*(1.1-C_5)*sqrt(L))/(S\text{^}0.33)$

$t_i = (0.395*(1.1-0.60)*sqrt(89))/(0.01\text{^}0.33) =$ **8.52** mins



### 3.2.2 Travel Time

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

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

Where:

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

$V = C_v S_w^{0.5}$

$V = (20)(0.025)^{0.5} =$ **3.16** ft/s

Flow Distance: **234.00** ft

$t_t = L/V =$ 74.00 sec.
**1.23** min.

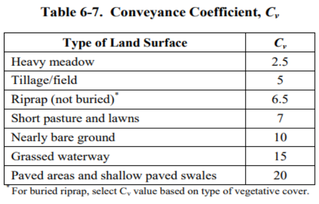
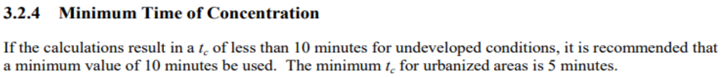


Table 6-7. Conveyance Coefficient, $C_v$

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

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

## $t_c = t_i + t_t$ = **9.76** min.



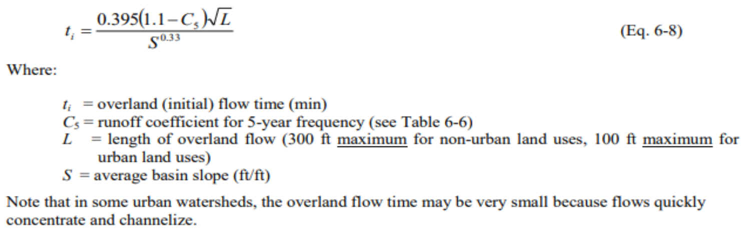
### 3.2.4 Minimum Time of Concentration

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

## Final $t_c$: **9.76** min.

## Time of Concentration $t_c = t_i + t_t$

### 3.2.1 - Overland (Initial) Flow Time



$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$ (Eq. 6-8)

Where:

$t_i$ = overland (initial) flow time (min)
$C_5$ = runoff coefficient for 5-year frequency (see Table 6-6)
$L$ = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
$S$ = average basin slope (ft/ft)

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

| Sub-Basin or DP: | D-2 | |
|---|---|---|
| $C_5$: | 0.29 | [Table 6-6. Runoff Coefficients for Rational Method] |
| L: | 1 | ft |
| S: | 0.025 | ft/ft |

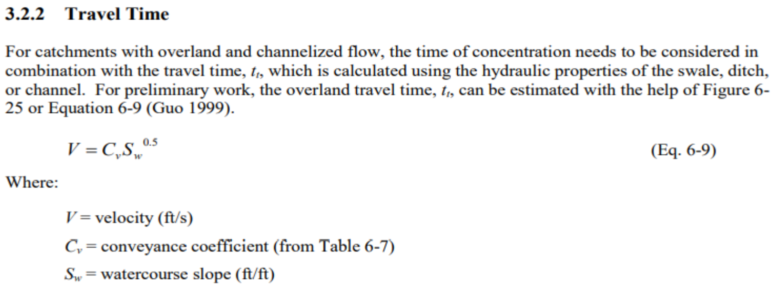
**Composite Runoff Coefficient Calculation:**

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

| Land Use or Surface Characteristic | Square Feet | Acreage | $C_5$ |
|---|---|---|---|
| Roof | 664.00 | 0.02 | 0.73 |
| Pavement | 3358.00 | 0.08 | 0.90 |
| Lawn | 11102.00 | 0.25 | 0.08 |
| $A_t$ : | 15124.00 | 0.35 | |

$C_c$ = (0.73*0.02 + 0.90*0.08 + 0.08*0.25) / 0.35 = **0.29**

$t_i$ = (0.395*(1.1-$C_5$)*sqrt(L))/(S^0.33)
$t_i$ = (0.395*(1.1-0.29)*sqrt(1))/(0.025^0.33) = **1.08** mins



### 3.2.2 Travel Time

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

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

Where:

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

$V = C_v S_w^{\,0.5}$
$V = (20)(0.065)^{0.5}$ = **5.10** ft/s

Flow Distance: **144.00** ft

$t_t$ = L/V = 28.24 sec.
**0.47** min.

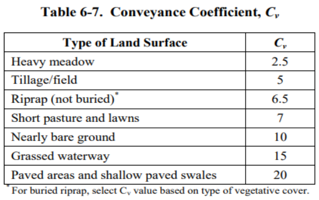
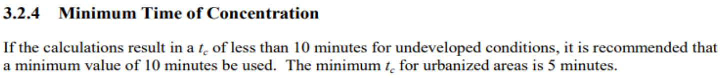


Table 6-7. Conveyance Coefficient, $C_v$

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

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

## $t_c = t_i + t_t$ = **1.55** min.



### 3.2.4 Minimum Time of Concentration

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

## Final $t_c$: **5.00** min.

# APPENDIX C – FEMA FLOODPLAIN MAP

# National Flood Hazard Layer FIRMette

104°43'20"W 38°51'36"N

1:6,000

104°42'42"W 38°51'8"N

## Legend

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

| | | |
|---|---|---|
| SPECIAL FLOOD HAZARD AREAS | 🟦 | Without Base Flood Elevation (BFE) *Zone A, V, A99* |
| | | With BFE or Depth *Zone AE, AO, AH, VE, AR* |
| | ▨ | Regulatory Floodway |
| OTHER AREAS OF FLOOD HAZARD | 🟧 | 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X* |
| | ▨ | Future Conditions 1% Annual Chance Flood Hazard *Zone X* |
| | ▨ | Area with Reduced Flood Risk due to Levee. See Notes. *Zone X* |
| | ▨ | Area with Flood Risk due to Levee *Zone D* |
| OTHER AREAS | NO SCREEN | Area of Minimal Flood Hazard *Zone X* |
| | ▭ | Effective LOMRs |
| | 🟧 | Area of Undetermined Flood Hazard *Zone D* |
| GENERAL STRUCTURES | – — – | Channel, Culvert, or Storm Sewer |
| | ǀǀǀǀǀǀǀ | Levee, Dike, or Floodwall |
| OTHER FEATURES | (B) 20.2 / 17.5 | Cross Sections with 1% Annual Chance Water Surface Elevation |
| | (8)– – – | Coastal Transect |
| | ~~~ 513 ~~~ | Base Flood Elevation Line (BFE) |
| | — | Limit of Study |
| | — | Jurisdiction Boundary |
| | --- --- | Coastal Transect Baseline |
| | - — | Profile Baseline |
| | — | Hydrographic Feature |
| MAP PANELS | ☐ | Digital Data Available |
| | ☐ | No Digital Data Available |
| | ☒ | Unmapped |

N

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

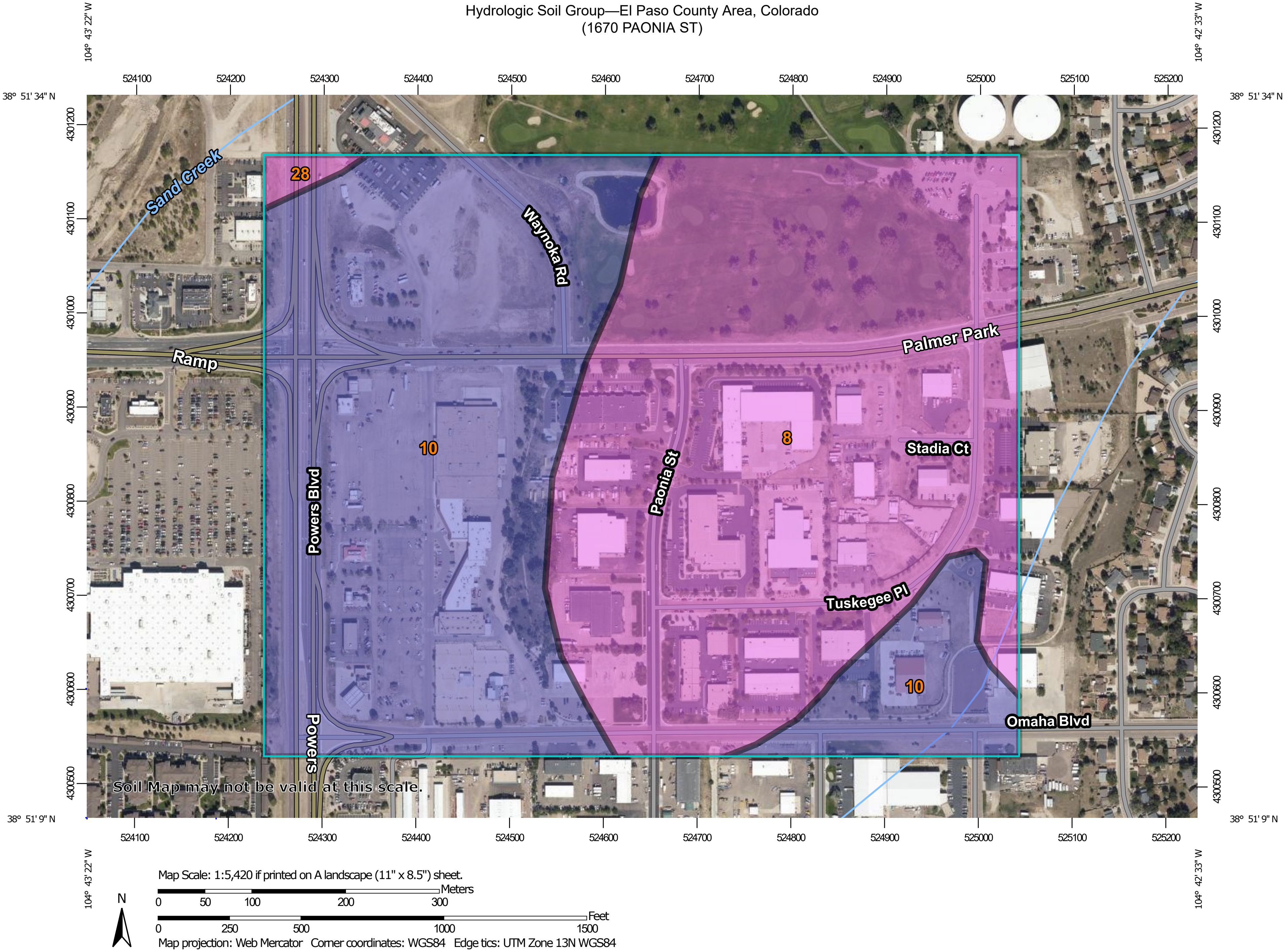
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/18/2020 at 10:15 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

# APPENDIX D – USGS SOILS SURVEY MAP

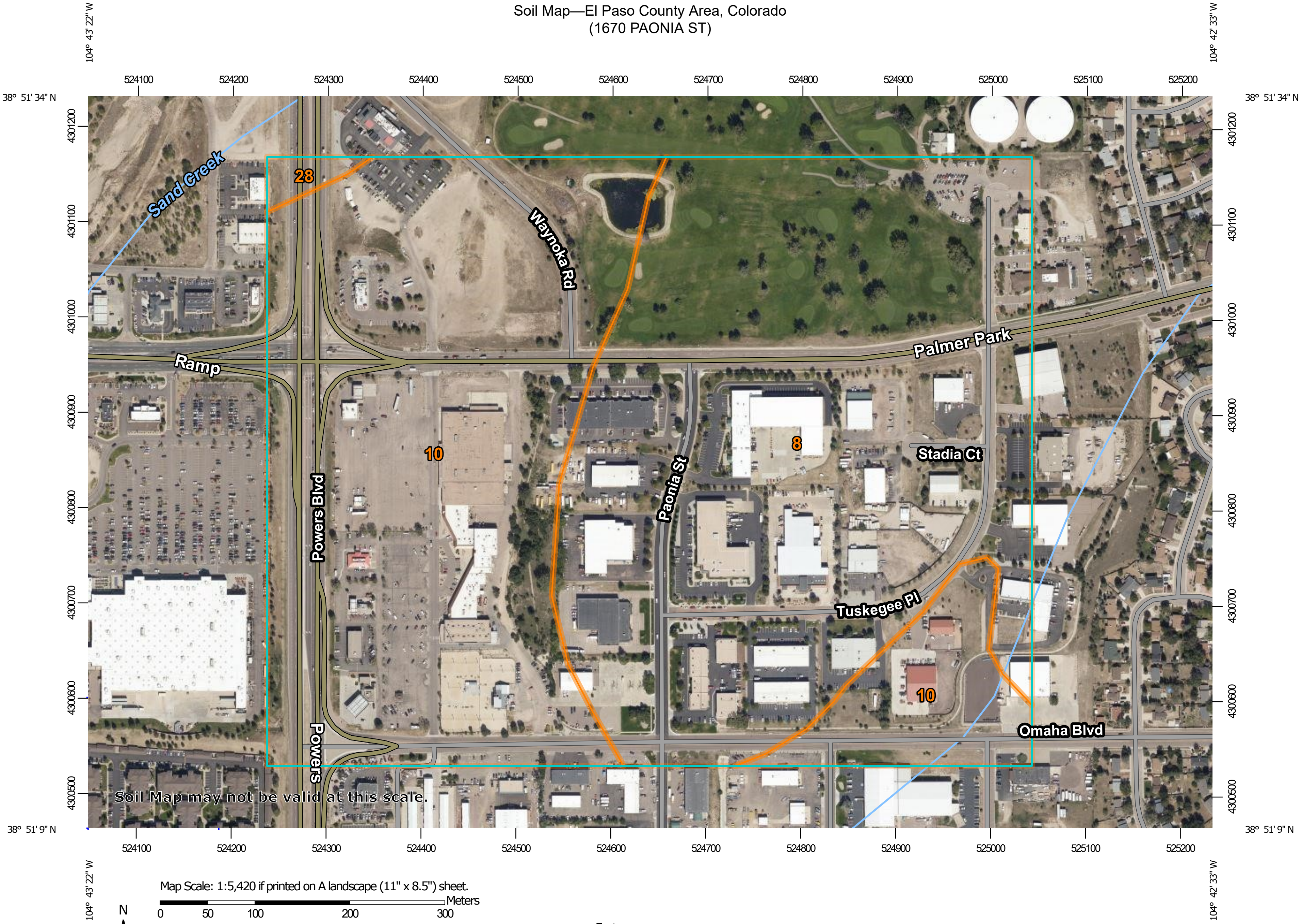
# Hydrologic Soil Group—El Paso County Area, Colorado
(1670 PAONIA ST)



Map Scale: 1:5,420 if printed on A landscape (11" x 8.5") sheet.

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

# Soil Map—El Paso County Area, Colorado
(1670 PAONIA ST)



Map Scale: 1:5,420 if printed on A landscape (11" x 8.5") sheet.

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

## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

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

**Water Features**
- Streams and Canals

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

**Background**
- Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 8 | Blakeland loamy sand, 1 to 9 percent slopes | 65.3 | 51.2% |
| 10 | Blendon sandy loam, 0 to 3 percent slopes | 61.5 | 48.2% |
| 28 | Ellicott loamy coarse sand, 0 to 5 percent slopes | 0.9 | 0.7% |
| **Totals for Area of Interest** | | **127.7** | **100.0%** |

## MAP LEGEND

**Area of Interest (AOI)**

- ☐ Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

- 🟪 A
- 🟩 A/D
- 🟦 B
- 🟫 B/D
- 🟦 C
- 🟨 C/D
- 🟥 D
- ⬜ Not rated or not available

**Soil Rating Lines**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Points**

- 🟪 A
- 🟩 A/D
- 🟦 B
- 🟫 B/D
- 🟦 C
- 🟨 C/D
- 🟥 D
- ⬜ Not rated or not available

**Water Features**

- Streams and Canals

**Transportation**

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

**Background**

- Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 8 | Blakeland loamy sand, 1 to 9 percent slopes | A | 65.3 | 51.2% |
| 10 | Blendon sandy loam, 0 to 3 percent slopes | B | 61.5 | 48.2% |
| 28 | Ellicott loamy coarse sand, 0 to 5 percent slopes | A | 0.9 | 0.7% |
| **Totals for Area of Interest** | | | **127.7** | **100.0%** |

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

# APPENDIX E – EXISTING & PROPOSED DRAINAGE MAPS

# LEGEND

| DESCRIPTION | SYMBOL | DESCRIPTION | SYMBOL |
|---|---|---|---|
| EX. STRUCTURE/BUILDING | ▨ | BASIN IDENTIFIER → | E–1 |
| EX. CONCRETE PAVEMENT | ░ | AREA IN ACRES → | X.XX AC |
| EX. ASPHALT PAVEMENT | ░ | | |
| EX. LANDSCAPE | ░ | DESIGN POINT ID | EP1 |
| EX. CONTOUR | ------- | FLOW ARROW | → |
| DRAINAGE SUB–BASIN BOUNDARY | ▬ ▬ ▬ | PROPERTY LINE | — — — — |

| DESIGN POINT | FLOW (CFS) |
|---|---|
| 1 | $Q_5$ = 1.66<br>$Q_{10}$ = 2.21<br>$Q_{100}$ = 4.32 |
| 2 | $Q_5$ = 1.60<br>$Q_{10}$ = 2.17<br>$Q_{100}$ = 4.36 |

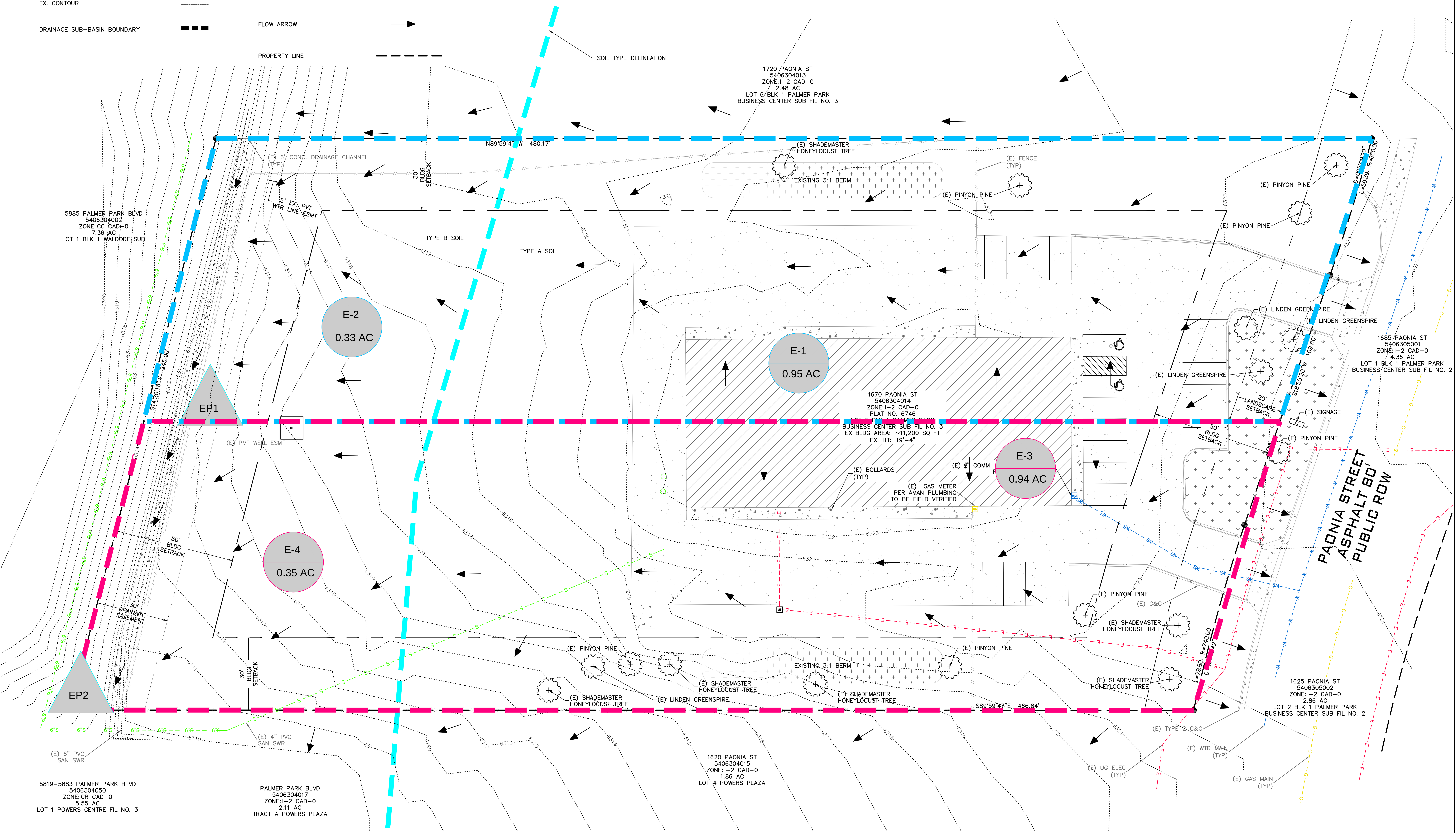
## BASIN SUMMARY

| BASIN | Q(5)-CFS | Q(100)-CFS | ACRES(AC) |
|---|---|---|---|
| E-1 | 1.49 | 3.44 | 0.95 |
| E-2 | 0.17 | 0.88 | 0.33 |
| E-3 | 1.43 | 3.49 | 0.94 |
| E-4 | 0.16 | 0.87 | 0.35 |

Graphic Scale

0 10 20 40

In Feet: 1" = 20'



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**ROCKY MOUNTAIN GROUP**
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Civil, Planning
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(719) 488-2145 ~ WWW.RMGENGINEERS.COM
SOUTHERN COLORADO, DENVER METRO, NORTHERN COLORADO

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FOR CIVIL ONLY

LOT 5, BLOCK 1 PALMER PARK BUSINESS CENTER
SUBDIVISION FILING NO. 3
1670 PAONIA STREET
COLORADO SPRINGS, COLORADO
CASCO CONSTRUCTION CORP.

SHEET NAME
EXISTING CONDITIONS

PROJECT STATUS
EXHIBIT

ENG: RDL
DRAWN: AMC
CHECKED: RDL

DATE
07/22/2021

| # | REVISION | DATE |
|---|---|---|
| | --- | --- |
| | --- | --- |
| | --- | --- |
| | --- | --- |
| | --- | --- |
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| | --- | --- |
| | --- | --- |

JOB NO.
179592

SHEET NO.
EX-01
of 2

# LEGEND

| DESCRIPTION | SYMBOL | DESCRIPTION | SYMBOL |
|---|---|---|---|
| EX. STRUCTURE/BUILDING | ▨ | BASIN IDENTIFIER | D–1 |
| EX. CONCRETE PAVEMENT | ░ | AREA IN ACRES | X.XX AC |
| EX. ASPHALT PAVEMENT | ░ | DESIGN POINT ID | DP1 |
| PROP. ASPHALT PAVEMENT | ▒ | FLOW ARROW | → |
| PROP. STRUCTURE/BUILDING | ▨ | PROPERTY LINE | – – – – |
| PROP. CONCRETE PAVEMENT | ▒ | | |
| EX. CONTOUR | ------ | | |
| PROP. CONTOUR | —— | | |
| DRAINAGE SUB–BASIN BOUNDARY | — — — | | |

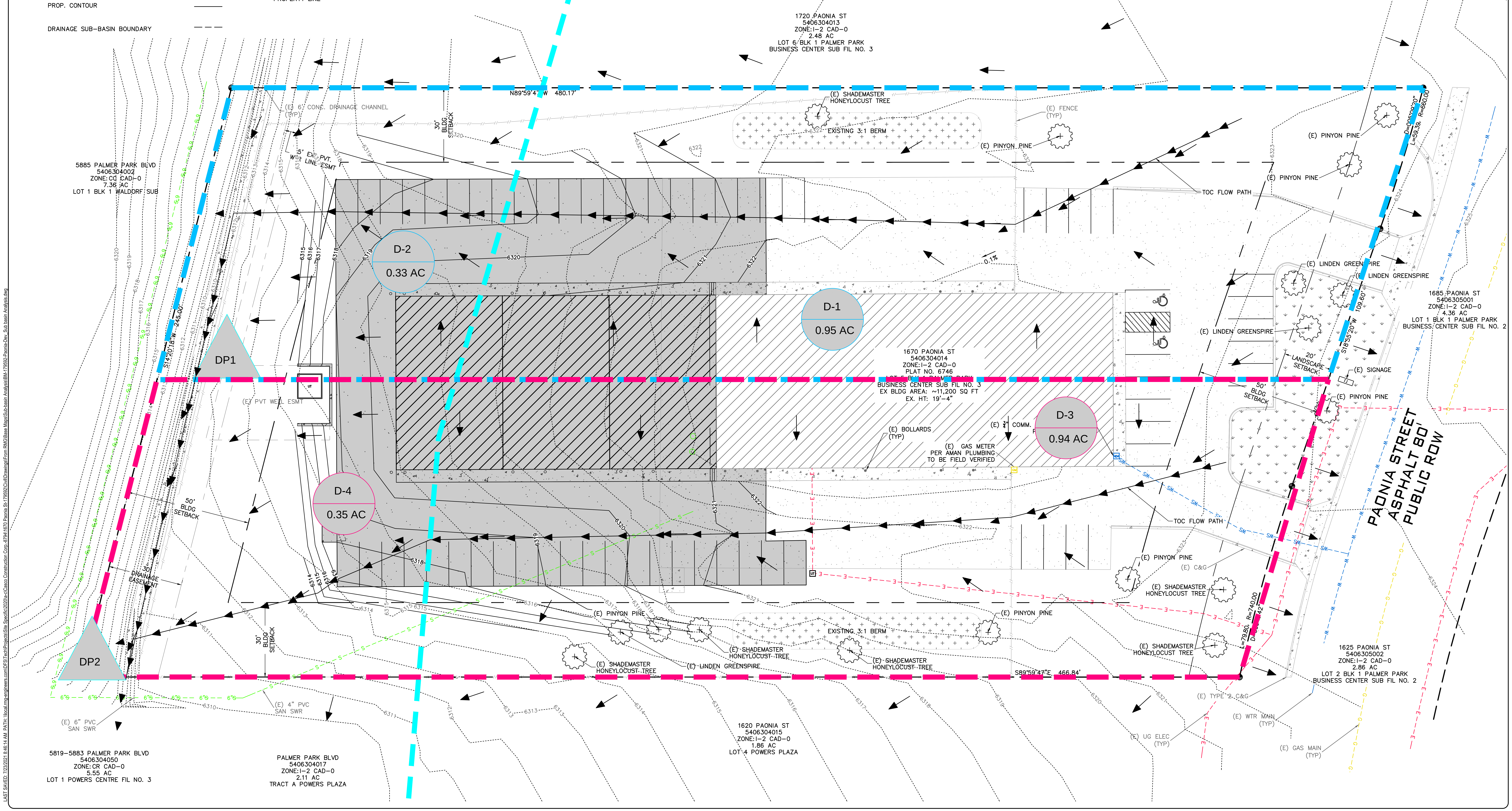
SOIL TYPE DELINEATION

| DESIGN POINT | FLOW (CFS) |
|---|---|
| 1 | $Q_5$ = 2.88<br>$Q_{10}$ = 3.61<br>$Q_{100}$ = 6.17 |
| 2 | $Q_5$ = 2.88<br>$Q_{10}$ = 3.65<br>$Q_{100}$ = 6.35 |

## BASIN SUMMARY

| BASIN | Q(5)-CFS | Q(100)-CFS | ACRES(AC) |
|---|---|---|---|
| D-1 | 2.21 | 4.50 | 0.95 |
| D-2 | 0.67 | 1.68 | 0.33 |
| D-3 | 2.36 | 4.83 | 0.94 |
| D-4 | 0.52 | 1.52 | 0.35 |

Graphic Scale
0 10 20 40
In Feet: 1" = 20'



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SHEET NAME
DEVELOPED CONDITIONS

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EXHIBIT

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DRAWN: AMC
CHECKED: RDL
DATE
07/22/2021

| # | REVISION | DATE |
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