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PRELIMINARY

DRAINAGE DESIGN REPORT

for

PAINTED DESERT REGIONAL FOOD HUB

Coconino County, Arizona

March 2019

Prepared for:

Dr. Mark Sorensen. Pres.
Painted Desert Demonstration Projects
145 Leupp Road
Flagstaff, Arizona 86004

Project No. 18-11

Expires 06/30/2019

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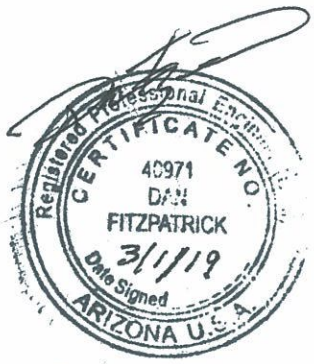


Expires 06/30/2019

1. INTRODUCTION

1.1. Purpose

This Preliminary Drainage Design Report has been prepared for an existing 16.0 acre commercial development located at 19722 Leupp Road in Coconino County, Arizona (see Figure 1 for Project Vicinity Map and Figure 2 for Location Map). The analyses contained herein was prepared through a contract to provide engineering services for development of the southern portion of the property into the PAINTED DESERT REGIONAL FOOD HUB hereafter known as Food Hub. Preliminary Plans calls for the addition of commercial buildings, parking, guess quarters, a public garden, greenhouse, and other entities for food distribution to local families. The purpose of this report is to provide a narrative and a summary of the final hydrologic and hydraulic analysis and final drainage structures.

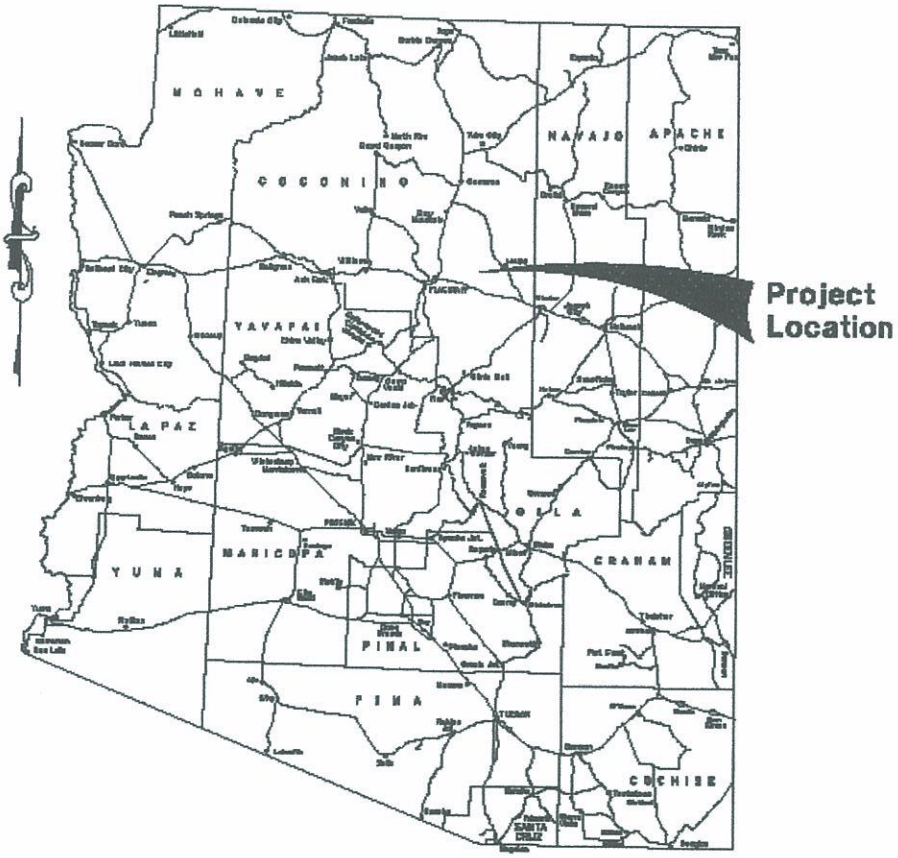


FIGURE-1: Project Vicinity Map

1.2. Background

The proposed Food Hub project is located in the southwest quarter of Section 11, Township 22 North, Range 10 East of the Gila & Salt River Meridian, Town of Payson, Arizona. This development is privately owned. The property south of project is owned by the Sate of Arizona. See Figure 2 for the Project Location Map.

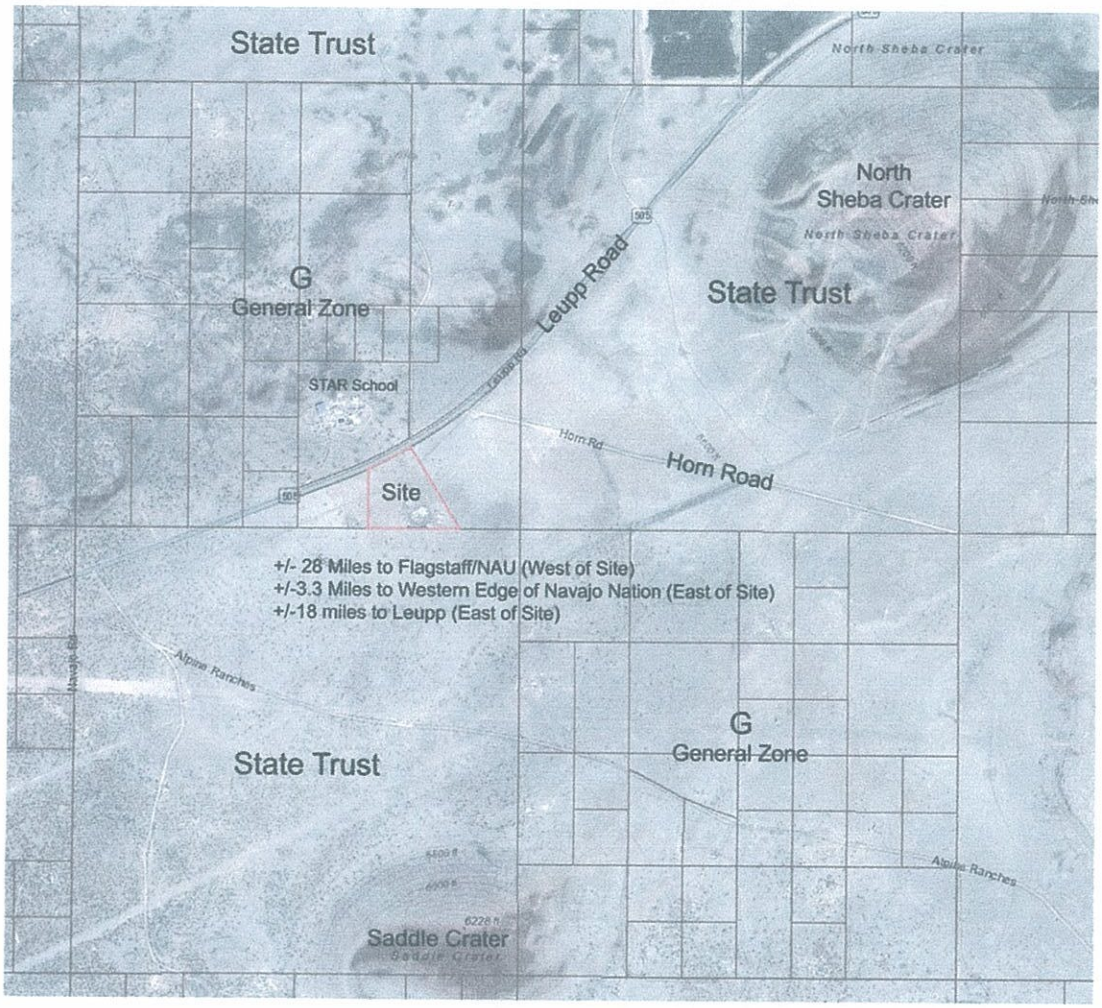


FIGURE 2: Project Location Map

1.3. Objective

The overall objective of this report is to provide an engineering analysis to support proposed drainage improvements for the Food Hub in accordance with the *Coconino County Drainage Design Criteria*[1]. Improvements will ensure that post development peak discharges do not exceed the pre-development peak discharges for the 2-, 10-, and 100-year peak rainfall events.

2. DRAINAGE BASIN CHARACTERISTICS

2.1. Mapping

The drainage basins were delineated using new Topographic Mapping information prepared by Aerial Mapping Company of Phoenix, 1"=100', 1' C.I., 2018.

2.2. Watershed Boundaries

The on-site watersheds consist of three drainage basins. The two northern basins were split according to the soil's classifications. These northern basins drain into the southern basin which is where the future Food Hub will be located. (see Exhibit A – Existing Conditions Drainage Map). Outfall of the southern basin is at the southern boundary onto State Land.

2.3. Basin Characteristics

A. Overland Slopes

Average overland slopes across the site are less than 1.0%.

B. Vegetation

Vegetative cover is sparse and consists mainly of brush and cactus.

C. Soils

According to the *USDA National Soil Survey*[2], the Food Hub project site is made up of two soils classifications, 69-Wupatki-Waukoki, very cindery loams

and 24-LOMAKI-Nalaki, very cindery loams. Refer to Appendix "A" for excerpts from the survey that defines the soil texture of the Food Hub project site as cindery loam and in Hydrologic Soil Group (HSG) B, C, and D.

D. Development

The current southern drainage basin consists of commercial buildings, a residential structure, and various other impervious areas. Future development of this project, will consist of additional buildings. The parking and walkways will not be paved and will not add to the existing rainfall runoff.

3. HYDROLOGIC ANALYSIS

3.1 Methodology

Because the drainage area does not exceed 160 acres, the Rational Method was used to determine the 2-, 10-, and 100-year peak flows. The methods used to determine modeling parameters are in accordance with the *Arizona Department of Transportation Highway Drainage Manual*[3] guidelines (herein referred to as the ADOT Manual).

The Rational Method equation is:

$$Q = CIA$$

Where: Q is the peak discharge in cfs
C is the Rational Method runoff coefficient
I is the rainfall intensity in in/hour
A is the drainage basin area in Acres

3.1.1 Rational Method Runoff Coefficient (C)

To determine the existing conditions "C" factors for each of the northern drainage basins, Figure 2-5 of the ADOT Manual was referenced. For Basin A1 with soils type 69 and HSG's of B & D with 10% vegetation, the "C" factors are C_2=0.20, C_{10}=0.34, and C_{100}=0.55. For Basin A2 with soil type 24,

10% vegetation and HSG's of C & B, the "C" values are C_2=0.20, C_{10}=0.34, and C_{100}=0.50. (see Figures 2-5 in Appendix "B").

Existing conditions "C" values for the southern drainage basin was determined by referencing Figure 2-3 of the ADOT Manual for developed watersheds. With closed polylines and added areas, the total impervious area (25,000 s.f.) in the southern basin was determined, divided by the total area (163,000 s.f.) of the southern basin and found to be 15% imperious. "C" factors from Figure 2-3 resulted in C2=0.28, C10=0.50, and C100=0.62. (see Figures 2-3 in Appendix "B").

Future Conditions of the site will add an impervious area (10,000 s.f.) to the existing impervious area (25,000 s.f.) totaling 35,000 s.f. divided by the total area (163,000 s.f.) resulting in an impervious area of 21%. Referencing Figure 2-3, the future conditions "C" coefficients are C_2 = 0.34, C_{10} = 0.55, and C_{100} = 0.67. Refer to Appendix "B" that included the ADOT Manual Figures 2-5 and 2-3. The parking lot and walkways will not be paved and will not contribute to the impervious area.

3.1.2 Rainfall Intensity (I)

The rainfall intensity (I) used in the Rational Method is dependent on the Time of Concentration (Tc) and interpolation with the IDF (Intensity-Duration-Frequency) Curve for the Food Hub area. The IDF curves for the 2, 10, and 100-year storm events was determined by first referencing the NOAA Altas 14 Volume 1, Version 5 and finding the rainfall for the site in inches. These values were then multiplied by 60 seconds and when divided by the storm duration to find the value in in/hr. resulting in Figure 3.1, IDF Curve for the Food Hub, Leupp, AZ (see Appendix B). The Tc for the three Food Hub drainage basins was determined using the Rational Method Tc Calculator. Copies of the Calculator for each of the basins are included in Appendix "B"

and show rainfall intensities (I) for the Rational Method 2-, 10-, and 100-year rainfall events.

3.1.3 Drainage Basin Area (A)

Areas for the Food Hub drainage basins are shown on Exhibit "A" and Exhibit "B".

3.2 Hydrologic Analysis Results

The results of the existing and future conditions Rational Method calculations (see Appendix "C") are summarized in Tables 3.1.

Table 3.1: Foof Hub
Rational Method Peak Discharge from Rainfall Events

Basin ID	Area (Ac)	2-Year Discharge (cfs)	10-Year Discharge (cfs)	100-Year Discharge (cfs)
Existing Conditions				
Basin A1	6.98	1.95	7.62	22.26
Basin A2	5.38	1.24	4.02	13.72
Basin A3	3.74	1.47	5.24	13.45
Total	-	**4.66**	**16.88**	**49.43**
Futured Conditions				
Basin B1	6.98	1.95	7.62	22.26
Basin B2	5.38	1.24	4.02	13.72
Basin B3	3.74	1.78	5.76	14.54
Totsl	-	**4.97**	**17.41**	**50.52**
Increased Rainfall Runoff				
Basin AB1	6.98	0.00	0.00	0.00
Basin AB2	5.38	0.00	0.00	0.00
Basin AB3	3.74	**0.31**	**0.52**	**1.08**

4.0 CONCLUSION

Table 3.1 illustrates under future conditions, the increased discharges from the Food Hub development will be minimal and because there are no residential structures immediately south of the property at the drainage outfall, no flooding danger is present. **Therefore, we are asking for a variance to the retention/detention requirements for development of the Painted Desert Regional Food Hub.**

5.0 REFERENCES

1 *Coconino County Drainage Design Criteria*, Coconino County Public Works Department 5600 East Commerce Avenue, Flagstaff, AZ. January 2001.

2 *USDA National Resources Conservation Services*, Web Soil Survey, National Cooperative Soil Survey.

3 Arizona Department of Transportation, *Highway Drainage Manual – Hydrology*, March 1993.

APPENDIX "A"

Soils Data

Coconino County Area, Arizona, Central Part

69—Wupatki-Wukoki very cindery loams, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 1rv5
Elevation: 5,000 to 6,100 feet
Mean annual precipitation: 8 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 175 days
Farmland classification: Not prime farmland

Map Unit Composition

Wupatki and similar soils: 60 percent
Wukoki and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wupatki

Setting

Landform: Fan terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium and/or colluvium derived from pyroclastic rock

Typical profile

H1 - 0 to 6 inches: very gravelly loam
H2 - 6 to 16 inches: very gravelly loam
H3 - 16 to 20 inches: indurated
H4 - 20 to 60 inches: cinders

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 8 to 20 inches to duripan
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: Cinder Hills 10-14" p.z. (Provisional) (R035XA102AZ)
Hydric soil rating: No

Description of Wukoki

Setting

Landform: Fan terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium and/or colluvium derived from pyroclastic rock

Typical profile

H1 - 0 to 10 inches: very gravelly loam
H2 - 10 to 18 inches: very gravelly loam
H3 - 18 to 60 inches: cinders

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 2.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B
Ecological site: Cinder Hills 10-14" p.z. (Provisional) (R035XA102AZ)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Coconino County Area, Arizona, Central Part
Survey Area Data: Version 12, Sep 19, 2018

Coconino County Area, Arizona, Central Part

24—Lomaki-Nalaki very cindery loams, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 1rsl
Elevation: 4,800 to 5,900 feet
Mean annual precipitation: 8 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 175 days
Farmland classification: Not prime farmland

Map Unit Composition

Lomaki and similar soils: 60 percent
Nalaki and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lomaki

Setting

Landform: Fan terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium derived from pyroclastic rock

Typical profile

H1 - 0 to 3 inches: very gravelly loam
H2 - 3 to 24 inches: very gravelly loam
H3 - 24 to 60 inches: cinders

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: B

Ecological site: Cinder Hills 10-14" p.z. (Provisional) (R035XA102AZ)
Hydric soil rating: No

Description of Nalaki

Setting

Landform: Fan terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium derived from pyroclastic rock

Typical profile

H1 - 0 to 10 inches: very gravelly loam
H2 - 10 to 21 inches: extremely gravelly loam
H3 - 21 to 27 inches: indurated
H4 - 27 to 60 inches: cinders

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 20 to 40 inches to duripan
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very low (about 1.5 inches)

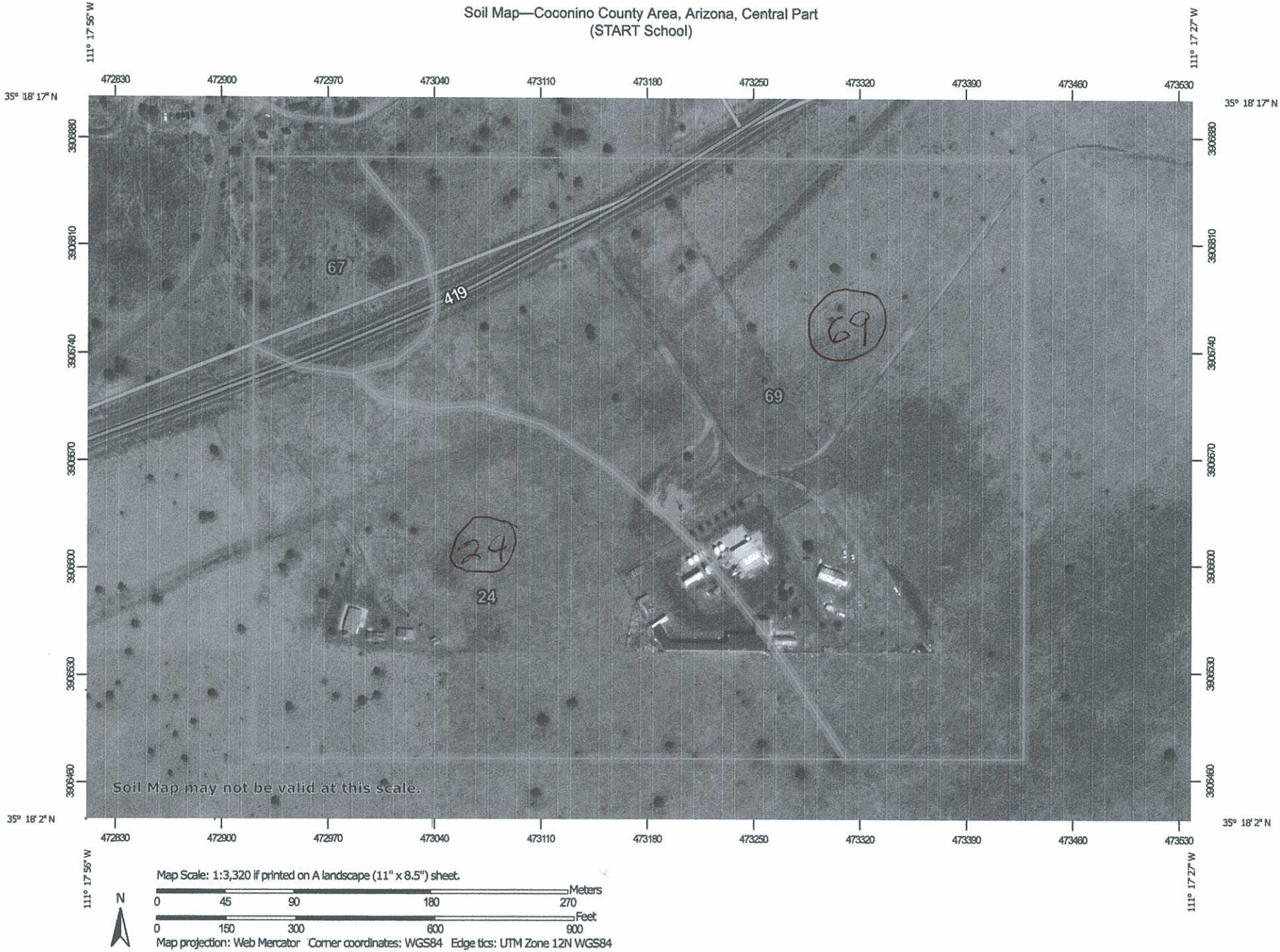
Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Ecological site: Cinder Hills 10-14" p.z. (Provisional) (R035XA102AZ)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Coconino County Area, Arizona, Central Part
Survey Area Data: Version 12, Sep 19, 2018

Soil Map—Coconino County Area, Arizona, Central Part
(START School)



Map Scale: 1:3,320 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N 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: Coconino County Area, Arizona, Central Part
Survey Area Data: Version 12, Sep 19, 2018

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

Date(s) aerial images were photographed: Dec 31, 2009—Oct 12, 2017

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
24	Lomaki-Nalaki very cindery loams, 0 to 8 percent slopes	17.6	35.7%
67	Wukoki-Rock outcrop complex, 5 to 25 percent slopes	3.5	7.1%
69	Wupatki-Wukoki very cindery loams, 0 to 15 percent slopes	28.2	57.2%
Totals for Area of Interest		**49.4**	**100.0%**

APPENDIX "B"

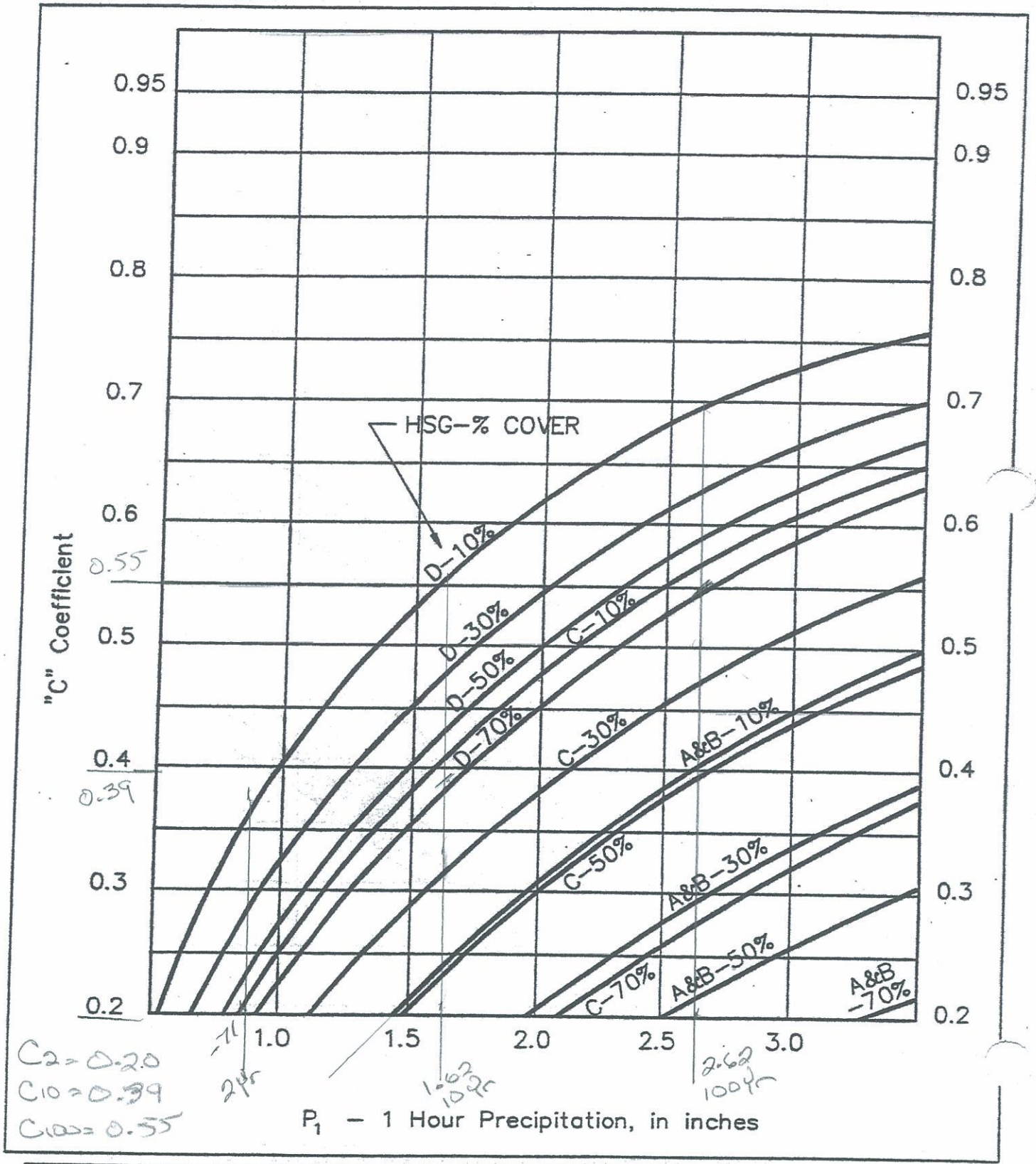
Hydrology Parameters

69- Wupatki-Wukoki Jery cindery loams, 0-15% slope

HSG D & B
10% Veg. Cover

FIGURE 2-5
RATIONAL "C" COEFFICIENT
UPLAND RANGELAND
(GRASS & BRUSH)

AS A FUNCTION OF RAINFALL DEPTH, HYDROLOGIC SOIL GROUP (HSG), AND % OF VEGETATION COVER



C2 = 0.20
C10 = 0.39
C100 = 0.55

24 - Lomaki - Naiaki Cindery Loam 0-8% slope

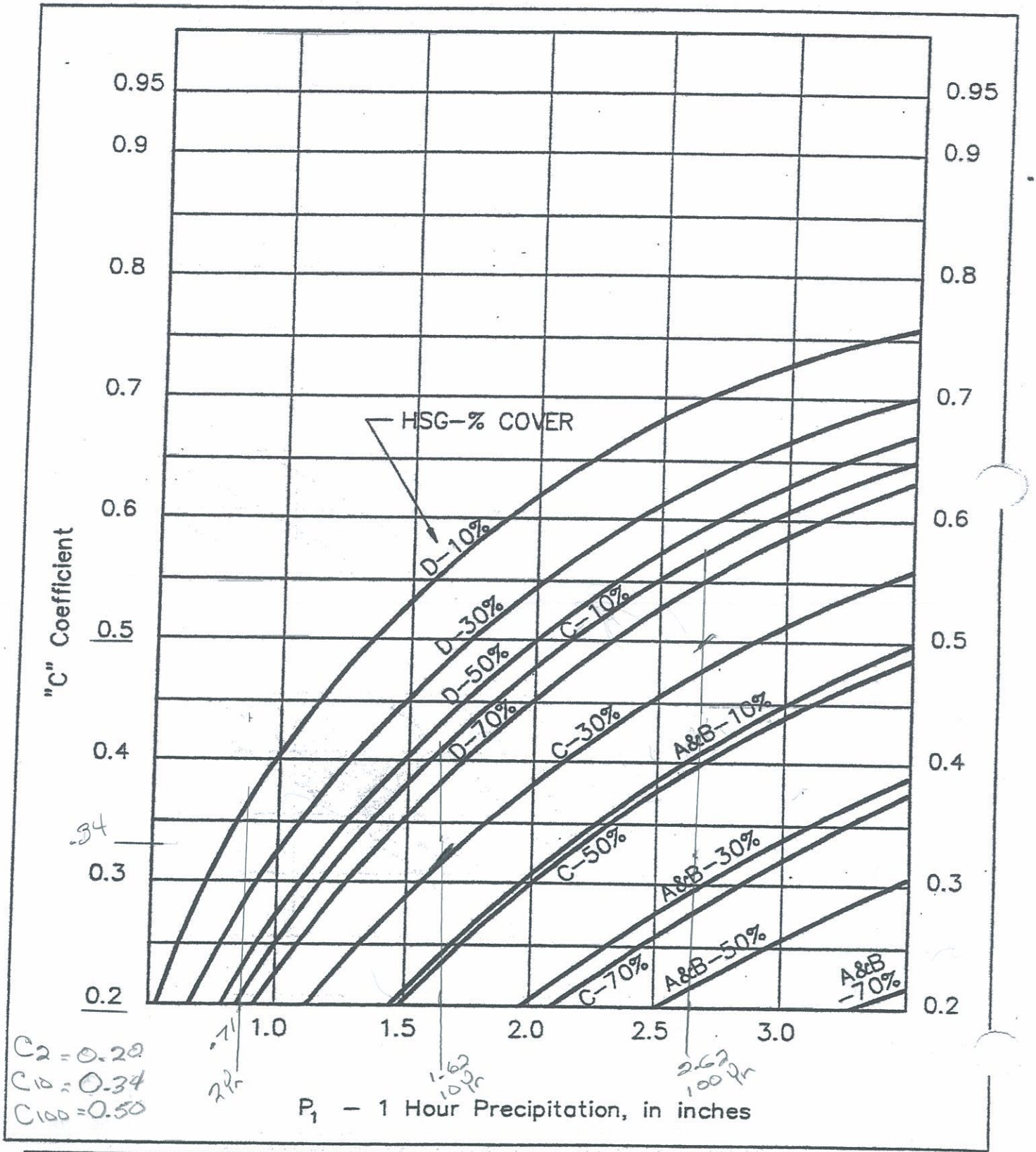
Very

HSG C & B

10% Veg Cover

FIGURE 2-5
RATIONAL "C" COEFFICIENT
UPLAND RANGELAND
(GRASS & BRUSH)

AS A FUNCTION OF RAINFALL DEPTH, HYDROLOGIC SOIL GROUP (HSG), AND % OF VEGETATION COVER

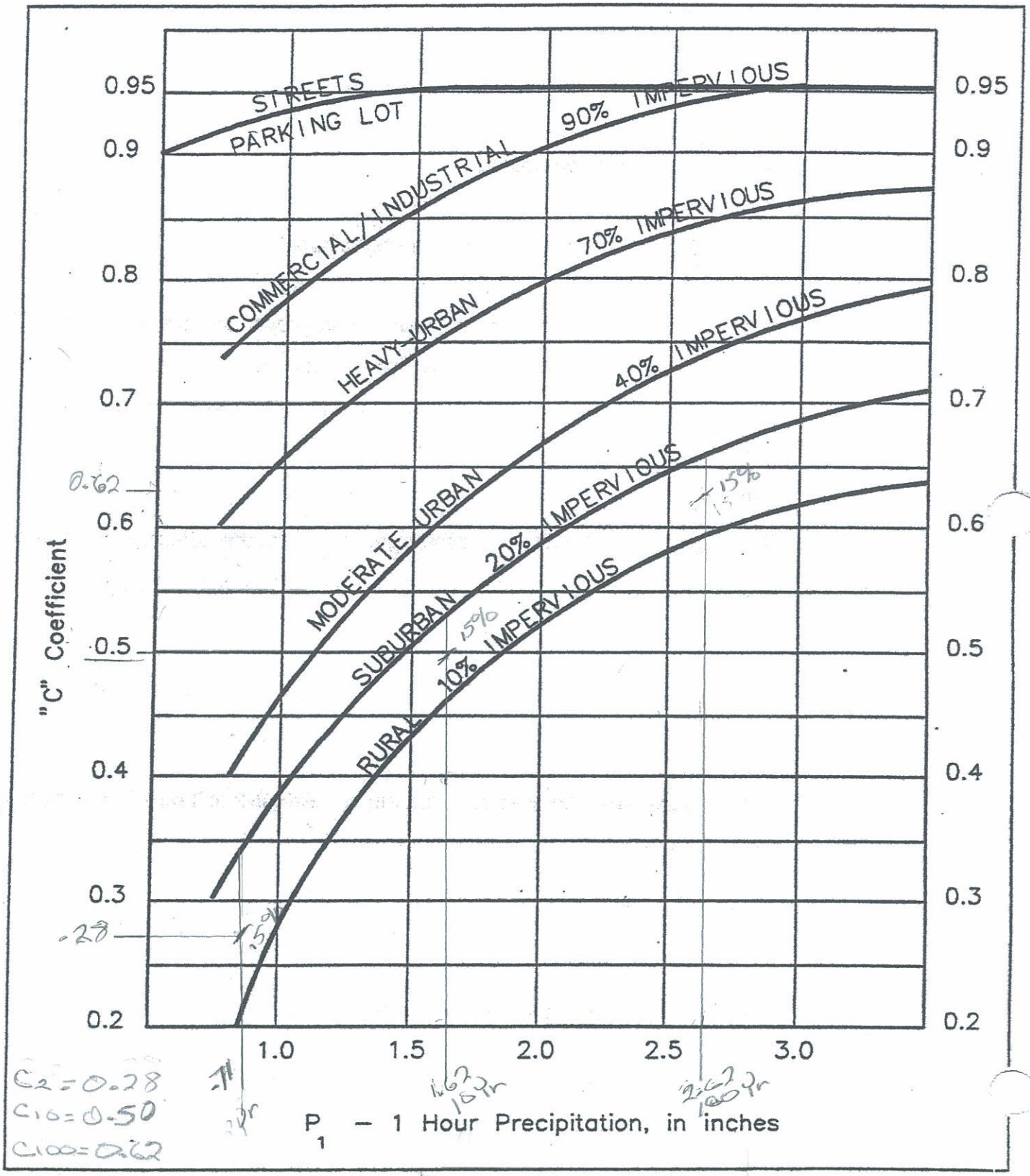


$C_2 = 0.29$
$C_{10} = 0.34$
$C_{100} = 0.50$

Existing Conditions

FIGURE 2-3
RATIONAL "C" COEFFICIENT
DEVELOPED WATERSHEDS

AS A FUNCTION OF RAINFALL DEPTH AND TYPE OF DEVELOPMENT

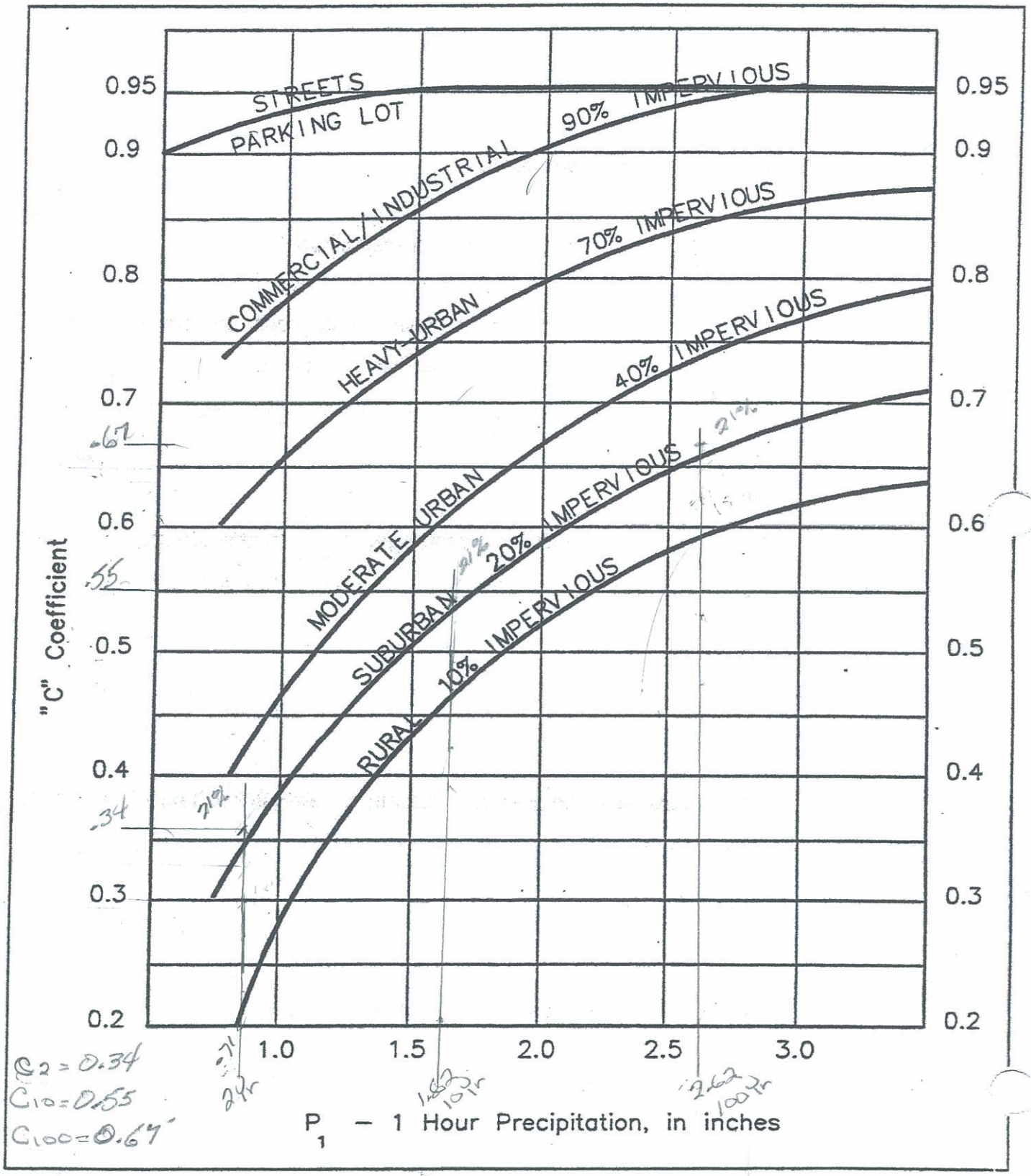


C2 = 0.28
C10 = 0.50
C100 = 0.62

Future Conditions

FIGURE 2-3
RATIONAL "C" COEFFICIENT
DEVELOPED WATERSHEDS

AS A FUNCTION OF RAINFALL DEPTH AND TYPE OF DEVELOPMENT



NOAA Atlas 14, Volume 1, Version 5
Location name: Flagstaff, Arizona, USA*
Latitude: 35.3028°, Longitude: -111.295°
Elevation: 5591.84 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

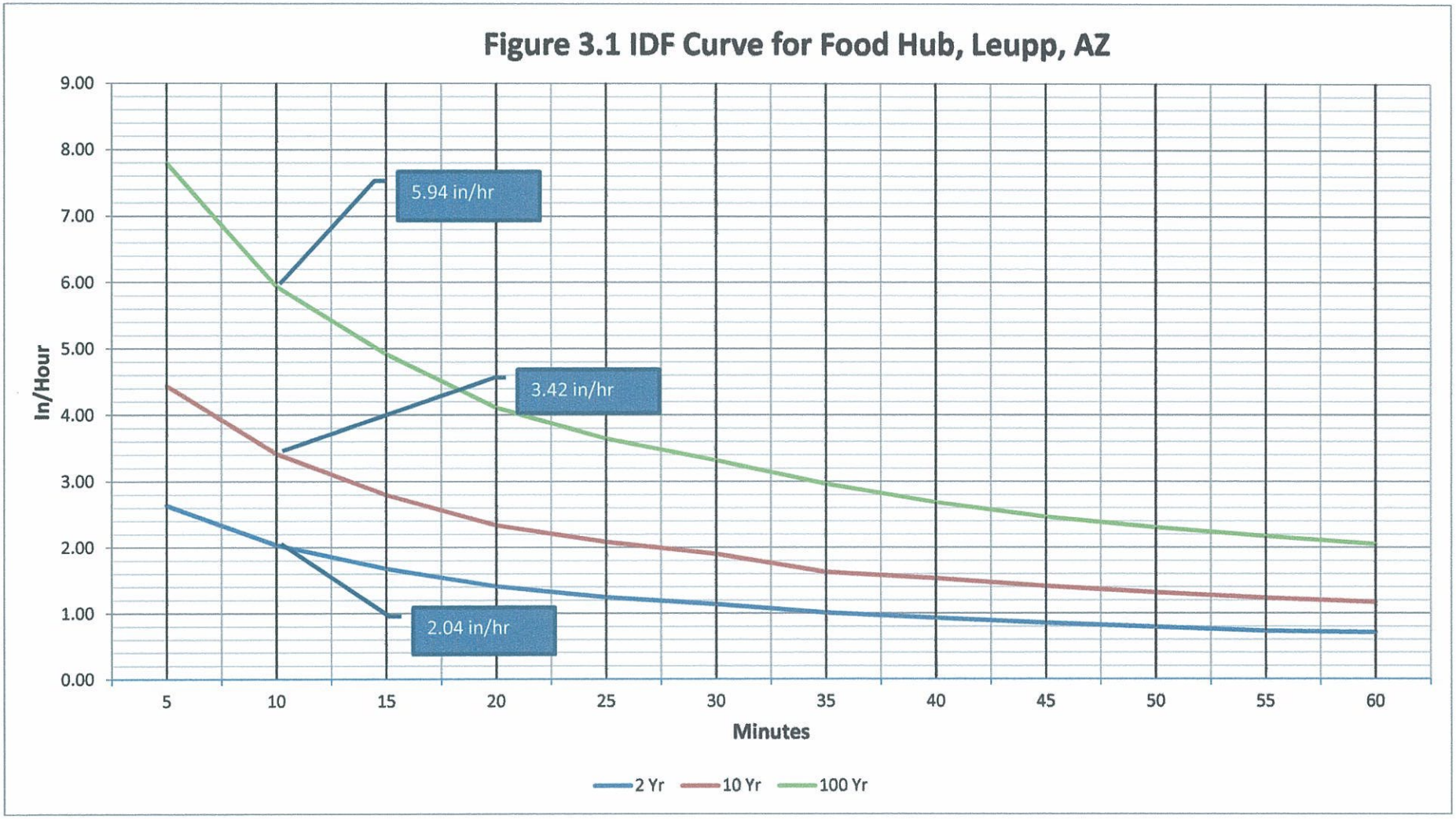
PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.173 (0.149-0.202)	0.224 (0.193-0.261)	0.304 (0.263-0.354)	0.373 (0.319-0.433)	0.473 (0.401-0.549)	0.558 (0.468-0.647)	0.653 (0.538-0.758)	0.756 (0.612-0.880)	0.908 (0.719-1.07)	1.03 (0.803-1.22)
10-min	0.264 (0.227-0.307)	0.341 (0.295-0.397)	0.463 (0.401-0.540)	0.568 (0.486-0.660)	0.721 (0.611-0.835)	0.850 (0.712-0.985)	0.994 (0.819-1.15)	1.15 (0.932-1.34)	1.38 (1.09-1.62)	1.58 (1.22-1.86)
15-min	0.327 (0.282-0.382)	0.423 (0.365-0.493)	0.574 (0.496-0.669)	0.704 (0.603-0.818)	0.893 (0.757-1.03)	1.05 (0.883-1.22)	1.23 (1.01-1.43)	1.43 (1.16-1.66)	1.71 (1.36-2.01)	1.95 (1.52-2.31)
30-min	0.441 (0.380-0.514)	0.569 (0.492-0.664)	0.773 (0.669-0.901)	0.947 (0.812-1.10)	1.20 (1.02-1.39)	1.42 (1.19-1.64)	1.66 (1.37-1.93)	1.92 (1.56-2.24)	2.31 (1.83-2.71)	2.63 (2.04-3.11)
60-min	0.545 (0.470-0.636)	0.705 (0.609-0.821)	0.957 (0.828-1.12)	1.17 (1.00-1.36)	1.49 (1.26-1.73)	1.76 (1.47-2.03)	2.05 (1.69-2.38)	2.38 (1.93-2.77)	2.86 (2.26-3.35)	3.26 (2.53-3.85)
2-hr	0.649 (0.572-0.748)	0.823 (0.722-0.948)	1.09 (0.957-1.26)	1.32 (1.15-1.51)	1.66 (1.43-1.90)	1.95 (1.65-2.23)	2.27 (1.90-2.60)	2.62 (2.15-3.01)	3.14 (2.51-3.63)	3.57 (2.80-4.16)
3-hr	0.696 (0.619-0.796)	0.880 (0.781-1.01)	1.14 (1.01-1.30)	1.36 (1.20-1.55)	1.69 (1.47-1.91)	1.96 (1.69-2.25)	2.27 (1.93-2.62)	2.64 (2.18-3.04)	3.17 (2.55-3.66)	3.61 (2.84-4.20)
6-hr	0.804 (0.723-0.900)	1.00 (0.900-1.12)	1.26 (1.13-1.41)	1.48 (1.32-1.65)	1.80 (1.59-2.01)	2.07 (1.81-2.31)	2.36 (2.04-2.64)	2.68 (2.28-3.07)	3.18 (2.64-3.70)	3.65 (2.93-4.24)
12-hr	0.950 (0.860-1.06)	1.18 (1.06-1.31)	1.45 (1.31-1.61)	1.67 (1.51-1.85)	1.98 (1.77-2.19)	2.21 (1.97-2.45)	2.46 (2.17-2.73)	2.73 (2.38-3.10)	3.21 (2.69-3.74)	3.68 (2.96-4.28)
24-hr	1.11 (1.01-1.23)	1.38 (1.25-1.53)	1.71 (1.55-1.89)	1.98 (1.79-2.18)	2.34 (2.11-2.58)	2.63 (2.36-2.89)	2.93 (2.61-3.22)	3.23 (2.87-3.56)	3.64 (3.20-4.02)	3.96 (3.46-4.38)
2-day	1.26 (1.15-1.39)	1.56 (1.43-1.72)	1.92 (1.75-2.12)	2.21 (2.02-2.43)	2.60 (2.36-2.85)	2.91 (2.64-3.19)	3.22 (2.91-3.53)	3.54 (3.17-3.89)	3.96 (3.52-4.36)	4.28 (3.79-4.73)
3-day	1.34 (1.23-1.48)	1.67 (1.52-1.83)	2.05 (1.88-2.25)	2.36 (2.16-2.59)	2.79 (2.54-3.06)	3.13 (2.84-3.43)	3.48 (3.15-3.81)	3.84 (3.45-4.21)	4.32 (3.85-4.76)	4.70 (4.15-5.19)
4-day	1.43 (1.31-1.57)	1.77 (1.62-1.94)	2.18 (2.00-2.39)	2.52 (2.30-2.75)	2.99 (2.72-3.26)	3.36 (3.05-3.66)	3.74 (3.39-4.09)	4.14 (3.72-4.54)	4.69 (4.17-5.15)	5.12 (4.51-5.64)
7-day	1.67 (1.54-1.82)	2.06 (1.90-2.24)	2.52 (2.33-2.73)	2.89 (2.67-3.13)	3.41 (3.14-3.68)	3.81 (3.49-4.12)	4.22 (3.86-4.57)	4.65 (4.22-5.04)	5.22 (4.71-5.68)	5.66 (5.07-6.18)
10-day	1.86 (1.71-2.02)	2.30 (2.11-2.50)	2.79 (2.57-3.03)	3.18 (2.92-3.44)	3.69 (3.39-3.99)	4.08 (3.74-4.41)	4.47 (4.09-4.84)	4.86 (4.42-5.26)	5.38 (4.87-5.83)	5.76 (5.19-6.26)
20-day	2.42 (2.23-2.63)	2.99 (2.76-3.25)	3.58 (3.31-3.89)	4.03 (3.72-4.37)	4.61 (4.25-4.99)	5.02 (4.62-5.43)	5.41 (4.98-5.86)	5.78 (5.31-6.26)	6.23 (5.71-6.75)	6.53 (5.98-7.10)
30-day	2.93 (2.70-3.18)	3.60 (3.32-3.92)	4.30 (3.96-4.66)	4.81 (4.44-5.21)	5.46 (5.03-5.90)	5.92 (5.45-6.39)	6.35 (5.84-6.87)	6.75 (6.19-7.31)	7.22 (6.61-7.83)	7.54 (6.89-8.19)
45-day	3.51 (3.23-3.83)	4.32 (3.97-4.72)	5.16 (4.75-5.62)	5.79 (5.33-6.30)	6.59 (6.07-7.15)	7.15 (6.58-7.75)	7.68 (7.06-8.32)	8.16 (7.49-8.84)	8.73 (8.01-9.45)	9.09 (8.35-9.85)
60-day	4.05 (3.73-4.42)	4.98 (4.58-5.43)	5.90 (5.44-6.42)	6.58 (6.06-7.15)	7.42 (6.83-8.05)	8.00 (7.37-8.67)	8.53 (7.85-9.24)	9.01 (8.29-9.75)	9.54 (8.79-10.3)	9.87 (9.11-10.7)

[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

Figure 3.1 IDF Curve for Food Hub, Leupp, AZ



Rational Method Tc Calculator
START SCHOOL
Project 18-11
Drainage Basin A1

USER INPUTS			
Recurrence	2	year	
1 hour depth	0.71	inches	
Tc	10	minutes	
L	0.154	mile	
Kb	0.1		(Refer to Table 2-1)
S	57	feet/mile	
I	2.04	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	1.40		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

OUTPUT			
Tc	20.4	minutes	*If less than 10 minutes use 10 minute intensity
$I_{2=}$	**1.40**	**inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

USER INPUTS			
Recurrence	10	year	
1 hour depth	1.62	inches	
Tc	10	minutes	
L	0.154	mile	
Kb	0.1		(Refer to Table 2-1)
S	57	feet/mile	
I	3.42	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	2.80		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

OUTPUT			
Tc	15.7	minutes	*If less than 10 minutes use 10 minute intensity
$I_{10=}$	**2.80**	**inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

USER INPUTS			
Recurrence	100	year	
1 hour depth	2.62	inches	
Tc	10	minutes	
L	0.154	mile	
Kb	0.1		(Refer to Table 2-1)
S	57	feet/mile	
I	5.94	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	5.80		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

OUTPUT			
Tc	11.9	minutes	*If less than 10 minutes use 10 minute intensity
$I_{100=}$	**5.80**	**inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

RAINFALL INTENSITY SUMMARY:

$I_{2=}$	**1.40**	**inches/hour**
$I_{10=}$	**2.80**	**inches/hour**
$I_{100=}$	**5.80**	**inches/hour**

Rational Method Tc Calculator
START SCHOOL
Project 18-11
Drainage Basin A2

USER INPUTS			
Recurrence	2	year	
1 hour depth	0.71	inches	
Tc	10	minutes	
L	0.151	mile	
Kb	0.1		(Refer to Table 2-1)
S	38	feet/mile	
I	2.04	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	1.15		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$$

OUTPUT		
Tc	24.6 minutes	*If less than 10 minutes use 10 minute intensity
$I_{2=}$	**1.15 inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

USER INPUTS			
Recurrence	10	year	
1 hour depth	1.62	inches	
Tc	10	minutes	
L	0.151	mile	
Kb	0.1		(Refer to Table 2-1)
S	38	feet/mile	
I	3.42	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	2.20		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$$

OUTPUT		
Tc	19.3 minutes	*If less than 10 minutes use 10 minute intensity
$I_{10=}$	**2.20 inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

USER INPUTS			
Recurrence	100	year	
1 hour depth	2.62	inches	
Tc	10	minutes	
L	0.151	mile	
Kb	0.1		(Refer to Table 2-1)
S	38	feet/mile	
I	5.94	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	5.10		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4L^{0.5}K_b^{0.52}S^{-0.31}i^{-0.38}$$

OUTPUT		
Tc	14.0 minutes	*If less than 10 minutes use 10 minute intensity
$I_{100=}$	**5.10 inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

RAINFALL INTENSITY SUMMARY:

$I_{2=}$	**1.15**	**inches/hour**
$I_{10=}$	**2.20**	**inches/hour**
$I_{100=}$	**5.10**	**inches/hour**

Rational Method Tc Calculator
START SCHOOL
Project 18-11
Drainage Basin A3

USER INPUTS			
Recurrence	2	year	
1 hour depth	0.71	inches	
Tc	10	minutes	
L	0.104	mile	
Kb	0.1		(Refer to Table 2-1)
S	31	feet/mile	
I	2.04	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	1.40		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

OUTPUT			
Tc	20.2	minutes	*If less than 10 minutes use 10 minute intensity
$I_{2=}$	**1.40**	**inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

USER INPUTS			
Recurrence	10	year	
1 hour depth	1.62	inches	
Tc	10	minutes	
L	0.104	mile	
Kb	0.1		(Refer to Table 2-1)
S	31	feet/mile	
I	3.42	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	2.80		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

OUTPUT			
Tc	15.5	minutes	*If less than 10 minutes use 10 minute intensity
$I_{10=}$	**2.80**	**inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

USER INPUTS			
Recurrence	100	year	
1 hour depth	2.62	inches	
Tc	10	minutes	
L	0.104	mile	
Kb	0.1		(Refer to Table 2-1)
S	31	feet/mile	
I	5.94	inches/hour	(Rainfall Intensity from Figure 3.1 for 10 Minutes)
I	5.80		(Rainfall Intensity from Figure 3.1, if greater than 10 Minutes)

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

OUTPUT			
Tc	11.8	minutes	*If less than 10 minutes use 10 minute intensity
$I_{100=}$	**5.80**	**inches/hour**	Per ADOT Draiange Criteria Figure 3.1*

RAINFALL INTENSITY SUMMARY:

$I_{2=}$	**1.40**	**inches/hour**
$I_{10=}$	**2.80**	**inches/hour**
$I_{100=}$	**5.80**	**inches/hour**

APPENDIX "C"

Rational Method Hydrology Data

for

Existing and Future Conditions

START SCHOOL
Project Number 18-11
Existing Conditions

Drainage Basin A1

Rational Method	**Q=CIA**		**Rational "C" Cofficient**	
Drainage Basin	303,946 s.f.		**2 year**	**10 year**	**100 year**
Native (Siol Type 69)			**0.20**	**0.39**	**0.55** (Figure 2.5)
	A =	6.98 Acres			
Rainfall Intensity (I)	I2 =	1.40 in/hr	Refer to Rational Method Tc Calculator		
	I10 =	2.80 in/hr			
	I100 =	5.80 in/hr			
Rainfall Runoff					
Q2 =	0.20 * 1.40 * 6.98 =	**1.95 cfs**			
Q10 =	0.39 * 2.80 * 6.98 =	**7.62 cfs**			
Q100 =	055 * 5.80 * 6.98 =	**22.26 cfs**			

Drainage Basin A2

Rational Method	**Q=CIA**		**Rational "C" Cofficient**	
Drainage Basin	234,342 s.f.		**2 year**	**10 year**	**100 year**
Native (Soil Type 24)			**0.20**	**0.34**	**0.50** (Figure 2.5)
	A =	5.38 Acres			
Rainfall Intensity (I)	I2 =	1.15 in/hr	Refer to Rational Method Tc Calculator		
	I10 =	2.20 in/hr			
	I100 =	5.10 in/hr			
Rainfall Runoff					
Q2 =	0.20 * 1.15 * 5.38 =	**1.24 cfs**			
Q10 =	0.34 * 2.20 * 5.38 =	**4.02 cfs**			
Q100 =	0.50 * 5.10 * 5.38 =	**13.72 cfs**			

Drainage Basin A3

Rational Method	**Q=CIA**		**Rational "C" Cofficient**	
Drainage Basin	162,965 s.f.		**2 year**	**10 year**	**100 year**
Developed (15% Impervious)			**0.28**	**0.50**	**0.62** (Figure 2.3)
	A =	3.74 Acres			
Rainfall Intensity (I)	I2 =	1.40 in/hr	Refer to Rational Method Tc Calculator		
	I10 =	2.80 in/hr			
	I100 =	5.80 in/hr			
Rainfall Runoff					
Q2 =	0.28 * 1.40 * 3.74 =	**1.47 cfs**			
Q10 =	0.50 * 2.80 * 3.74 =	**5.24 cfs**			
Q100 =	0.62 * 5.80 * 3.74 =	**13.45 cfs**			

START SCHOOL
Project Number 18-11
Post Developed Conditions

Drainage Basin B1

SAME AS EXISTING CONDITIONS

Q2 = 1.95 cfs
Q10 = 7.62 cfs
Q100 = 22.26 cfs

Drainage Basin B2

SAME AS EXISTING CONDITIONS

Q2 = 1.24 cfs
Q10 = 4.02 cfs
Q100 = 13.72 cfs

Drainage Basin B3

Rational Method **Q=CIA**
Drainage Basin 162,965 s.f.
Developed (21% Impervious)

Rational "C" Cofficient

2 year	**10 year**	**100 year**	
0.34	**0.55**	**0.67**	(Figure 2.3)

A = 3.74 Acres

Rainfall Intensity (I)

I2 = 1.40 in/hr Refer to Rational Method Tc Calculator
I10 = 2.80 in/hr
I100 = 5.80 in/hr

Rainfall Runoff

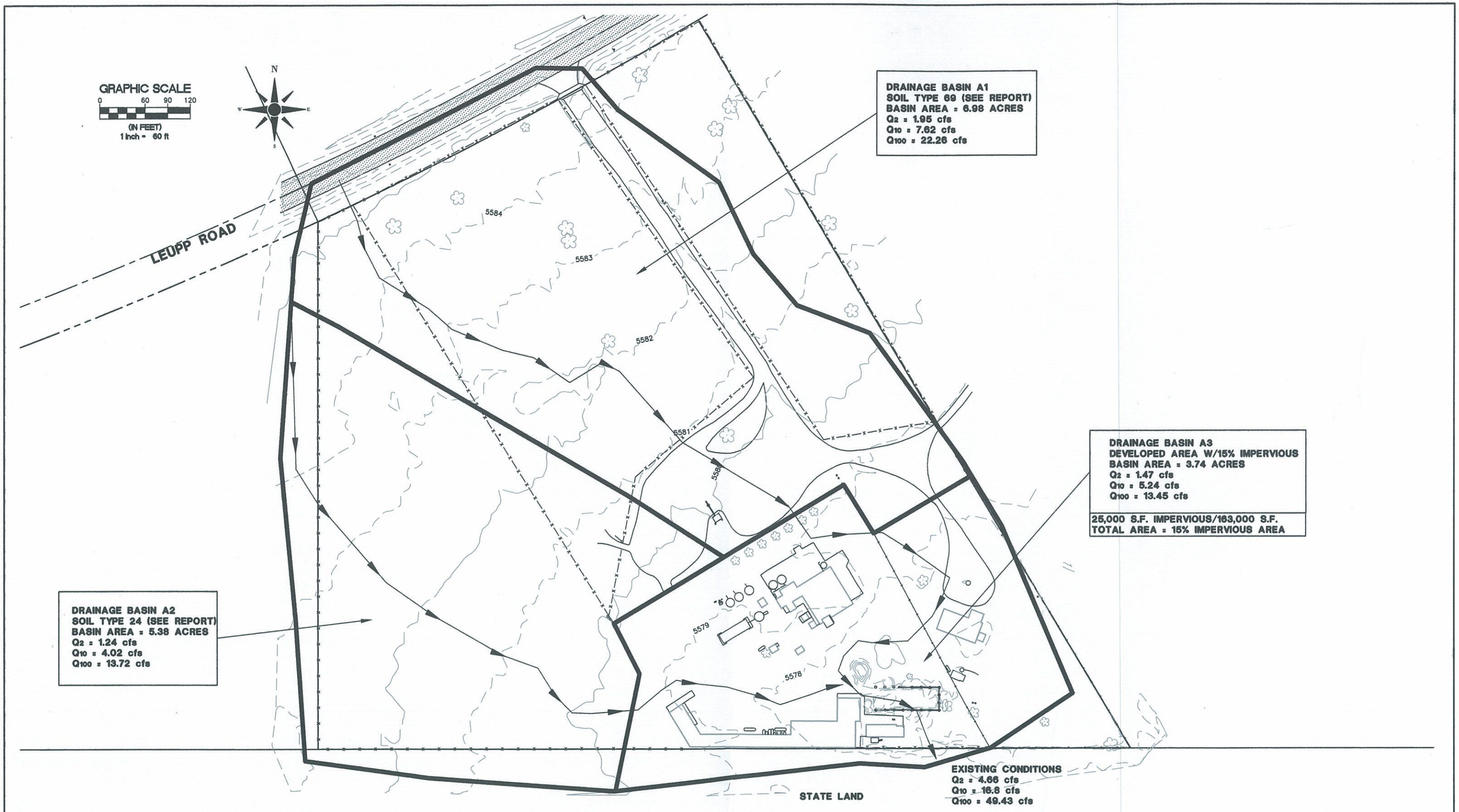
Q2 = 0.34 * 1.40 * 3.74 = 1.78 cfs
Q10 = 0.55 * 2.80 * 3.74 = 5.76 cfs
Q100 = 0.67 * 5.80 * 3.74 = 14.54 cfs

Increase in Rainfall Runoff

Q2 = 0.31 cfs
Q10 = 0.52 cfs
Q100 = 1.08 cfs

EXHIBITS

- A – Existing Conditions Drainage Map
- B - Developed Conditions Drainage Map



CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT
1-800-782-5348
Blue Stake Center
(OUTSIDE MARICOPA COUNTY)

NO.	REVISIONS	DATE	BY	CHK.

Exhibit A

Verde Engineering Group PLLC

1109 North McLane Road
Payson, Arizona 85541
Ralph Bossert P.E. R.L.S.
(928) 978-4345
Dan Fitzpatrick P.E.
(928) 595-2816

PAINTED DESERT REGIONAL FOOD HUB

COCONINO COUNTY, ARIZONA

JOB NO.	18-11
DESIGNED BY:	VE
DRAWN BY:	VE
CHECKED BY:	DCF
APPROVED BY:	DCF
DATE:	02/28/19

EXHIBIT "A"
EXISTING CONDITIONS DRAINAGE MAP

SCALE: HORIZ: 1"= 60'
CONT. INTERVAL = 1'
DRAWING NO. EXA
SHEET NO. 1 OF: 2

GRAPHIC SCALE
0 60 90 120
(IN FEET)
1 inch = 60 ft

LEUPP ROAD

DRAINAGE BASIN B1
SAME AS EXISTING CONITIONS
Q_2 = 1.95 cfs
Q_{10} = 7.62 cfs
Q_{100} = 22.26 cfs

ADDED IMPERVIOUS AREAS

DRAINAGE BASIN B3
DEVELOPED AREA W/21% IMPERVIOUS
BASIN AREA = 3.74 ACRES
Q_2 = 1.78 cfs
Q_{10} = 5.76 cfs
Q_{100} = 14.54 cfs

10,000 S.F. ADDED IMPERVIOUS
PLUS 25,000 S.F. EXISTING
IMPERVIOUS DIVIDED BY 163,000 S.F.
TOTAL AREA = 21% IMPERVIOUS.

INCREASED RAINFALL RUNOFF UNDER
DEVELOPED CONDITIONS
Q_2 = 0.31 cfs
Q_{10} = 0.52 cfs
Q_{100} = 1.08 cfs

DRAINAGE BASIN B2
SAME AS EXISTING CONDITIONS
Q_2 = 1.24 cfs
Q_{10} = 4.02 cfs
Q_{100} = 13.72 cfs

DEVELOPED CONDITIONS
Q_2 = 4.97 cfs
Q_{10} = 17.41 cfs
Q_{100} = 50.52 cfs

STATE LAND

CALL TWO WORKING DAYS BEFORE YOU DIG
1-800-STAKE-IT
1-800-782-5348
Blue Stake Center
(OUTSIDE MARICOPA COUNTY)

NO.	REVISIONS	DATE	BY	CHK.

Exhibit B

Verde Engineering Group PLLC
1109 North McLane Road
Payson, Arizona 85541
Ralph Bossert P.E. R.L.S.
(928) 978-4345
Dan Fitzpatrick P.E.
(928) 595-2816

PAINTED DESERT REGIONAL FOOD HUB
COCONINO COUNTY, ARIZONA

JOB NO.	18-11
DESIGNED BY:	VE
DRAWN BY:	VE
CHECKED BY:	DCF
APPROVED BY:	DCF
DATE:	02/28/19

EXHIBIT "B"
DEVELOPED CONDITIONS
DRAINAGE MAP

SCALE: HORIZ: 1"= 60'
CONT. INTERVAL = 1'
DRAWING NO. EXB
SHEET NO. 2 OF: 2