HYDROLOGY STUDY

For

TERRA NOVA PLANNING
42635 MELANIE PLACE, STE 101
PALM DESERT, CA 92211

DAKOTA & GUSTINE WAREHOUSE

September 3, 2024

Prepared by:

Merrell-Johnson Companies

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Job No. 4171.001

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9/3/2024

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SECTION 1

DISCUSSION

INTRODUCTION

The purpose of this study was to determine the impact, if any, of the 100-year storm runoff flow tributary to the project site as delineated on the map contained in this study. The project site encompasses approximately 40 acres of vacant property located on the east side of Dakota Road between Gustine Street to the north and Fresno Road to the south. The site is located on the west side of the Apple Valley Airport within the North Apple Valley Industrial Specific Plan in the Town of Apple Valley, CA. Future development of the site will be construction of a warehouse facility.

METHODOLOGY

The method in determining these peak runoff flows was the rational method and the unit hydrograph method as specified in the 1986 San Bernardino County Hydrology Manual and the 2010 San Bernardino County Hydrology Manual Addendum for Arid Regions. The existing offsite flow was examined and delineated from U.S.G.S. Map: Apple Valley North and an examination of the project site.

Point rainfalls for the 100-year storm were obtained from the NOAA Atlas 14 per the 2010 Addendum to the County Hydrology Manual. The 100-year 1-hour point rainfall for the site is 1.06”. Per the afore-mentioned addendum, AMC II was used for the project site and the soil types were determined to be Soil Type A throughout the watershed with a small, localized area of Type C soils at Node 21 of the watershed per the Natural Resources Conservation Service’s “Web Soil Survey”. Rainfall and soils maps are included as exhibits in Section 3 of this report.

The watershed area tributary to the northern boundary of the proposed project, Gustine Street, is approximately 383 acres. The watershed area tributary to the eastern boundary of the project, the proposed extension of Ramona Road, is approximately 130 acres. The rational method was used to analyze the storm runoff from these watersheds. There are minor areas of existing scour within the site from past storm runoff flows and evidence of runoff in the form of sheet flows crossing the project.

The offsite tributary areas examined in this study are shown in Table A.

Table A

Sub-area	Elevation Difference (ft.)	Length (ft)	Area (Acres)	Avg. Slope (ft/ft)
Node 11 – Node 17	167	11,475	382.8	0.0146
Node 21 – Node 26	107	6,770	129.6	0.0158

EXISTING CONDITIONS

The site encompasses approximately 40 acres of vacant property located on the east side of Dakota Road between Gustine Street to the north and Fresno Road to the south. The watershed area tributary to the northern boundary of the proposed project, Gustine Street, is approximately 383 acres. The watershed area tributary to the eastern boundary of the project, the proposed extension of Ramona Road, is approximately 130 acres. There are minor areas of existing scour within the site from past storm runoff flows and evidence of runoff in the form of sheet flows crossing the project.

The results of the offsite and onsite flow analysis are summarized in Table B.

Table B

Sub-Area	Q_{100} (cfs)
Node 11 – Node 17	165.3
Node 21 – Node 26	71.5

CONCLUSIONS AND RECOMMENDATIONS

During our field investigation of the site, we observed the existing conditions as stated previously. Development of the project site is a warehouse facility being designed with engineered grading and drainage plans. Runoff from the north will be intercepted within the street improvements of Gustine Street and conveyed around the proposed warehouse with a storm drain system in the proposed street right-of-way. The storm drain system will convey runoff flows to their historical flow location along the southern project boundary on Fresno Road.

Storm runoff from the east will be intercepted within the street improvements of Ramona Road. These flows will also be conveyed around the warehouse facility within a storm drain system in the proposed street right-of-way to their historical flow location within Fresno Road. The two storm drains join together on the north side of Fresno Road and convey the storm runoff south of Fresno Road to an existing drainage swale along the south side of Fresno Road. The runoff will bubble out into the swale following its historical flow path.

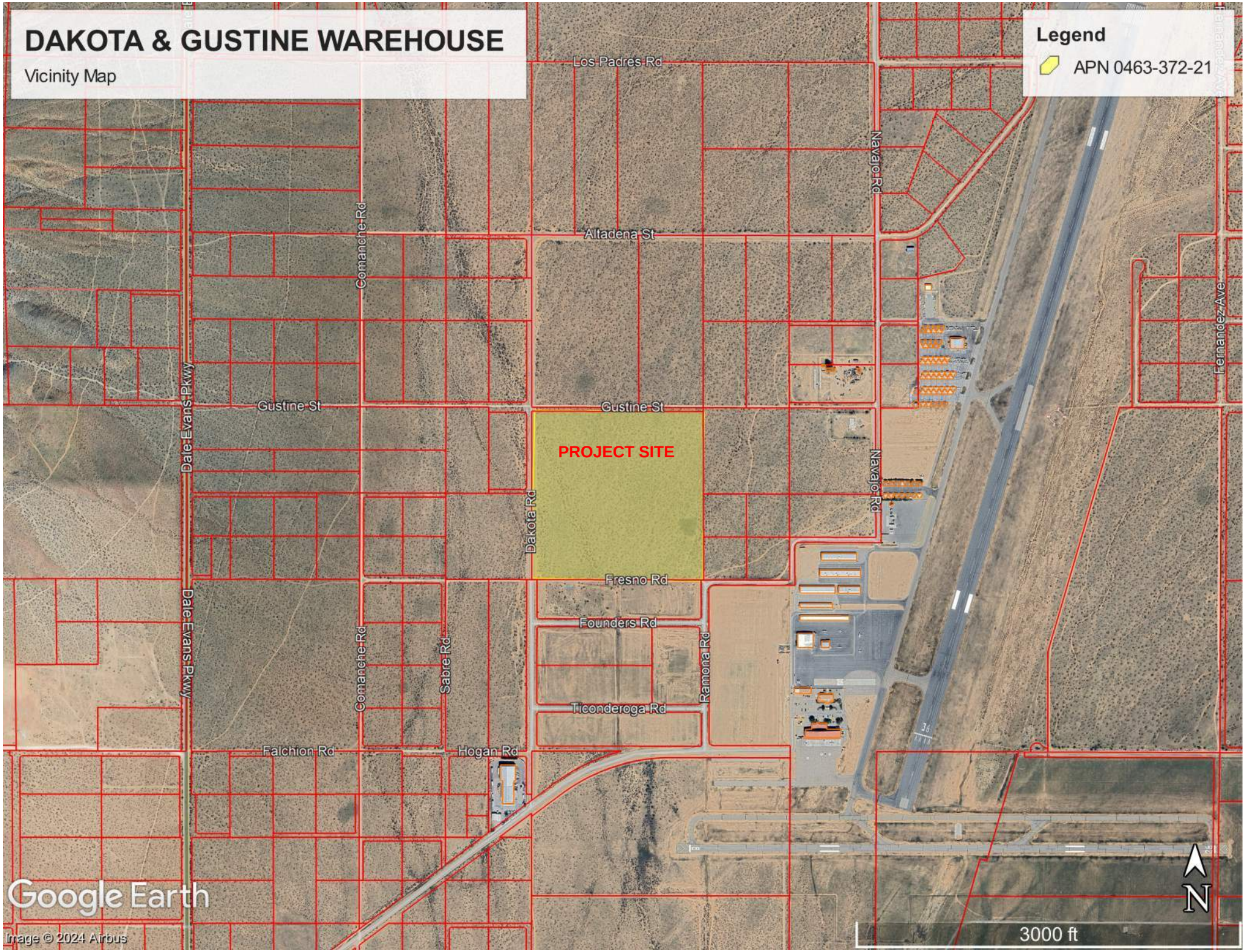
SECTION 2

EXHIBITS

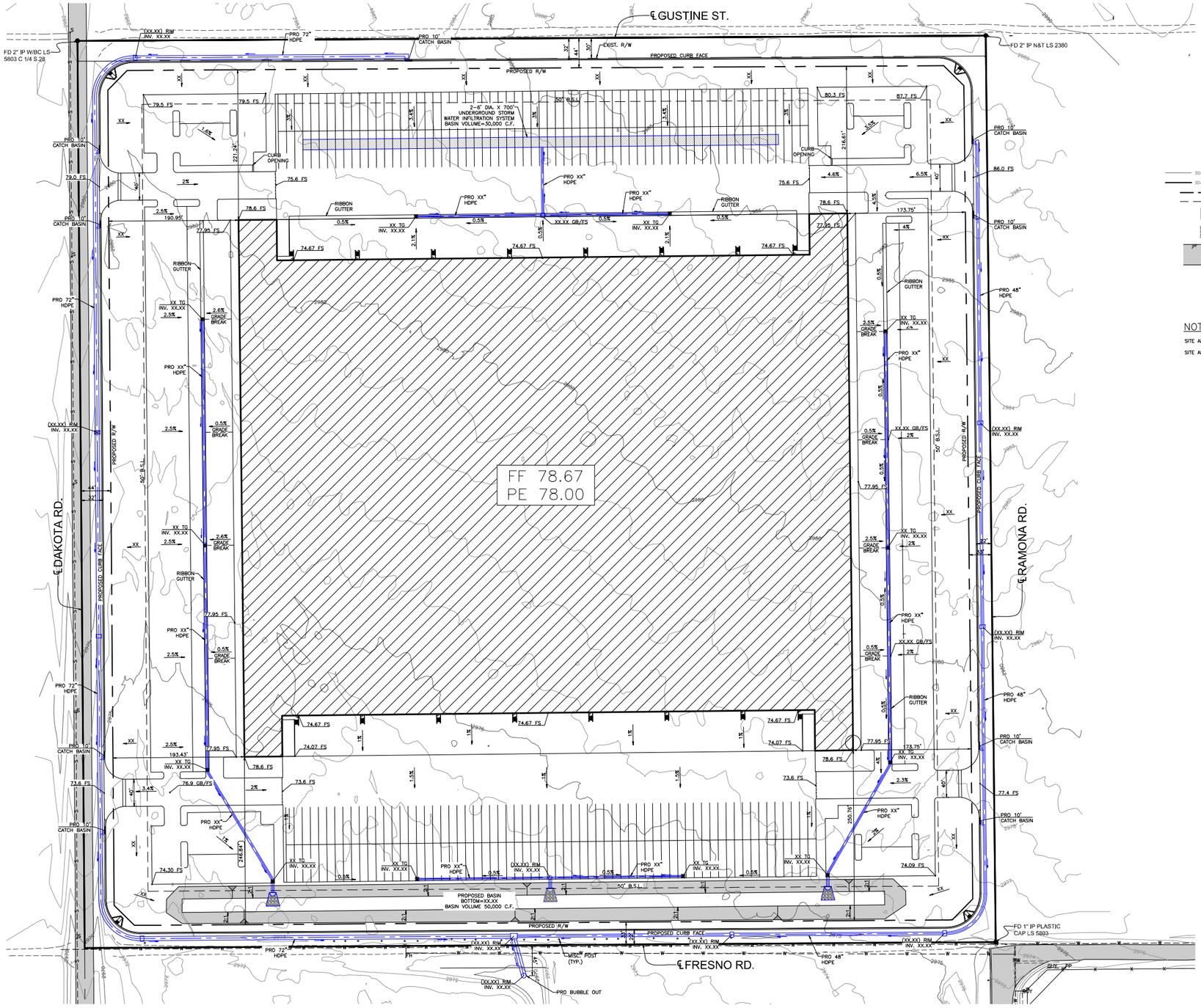
VICINITY MAP

DAKOTA & GUSTINE WAREHOUSE

Vicinity Map



PROPOSED DEVELOPMENT PLAN



LEGEND

- S• INDICATES SEWER MANHOLE
- FH• INDICATES FIRE HYDRANT
- W# INDICATES WATER METER
- W• INDICATES WATER VALVE
- 3040 INDICATES EXISTING CONTOUR
- 3040 INDICATES PROPOSED CONTOUR
- INDICATES PROPOSED PROPERTY LINE
- INDICATES BUILDING SETBACK LINE
- INDICATES PROPOSED BUILDING
- INDICATES PROPOSED RIP-RAP
- INDICATES EXISTING ASPHALT ROAD

NOTE:

SITE AREA BEFORE ROAD DEDICATION 1,787,209.56 S.F (41.03 AC.)

SITE AREA AFTER ROAD DEDICATION 1,585,477.13 S.F (36.40 AC.)

60' 30' 0' 60' 120'

SCALE: 1" = 60'

PROPOSED GRADING AND DRAINAGE PLAN

811 Know what's below. Call before you dig.

SURVEY MONUMENTATION:

ALL SURVEY MONUMENTS AND MARKERS SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO PROTECT IN PLACE UNTIL SURVEYOR HAS TIED OUT LOCATIONS FOR REPLACEMENT PURSUANT TO BUSINESS AND PROFESSIONS CODE SECTION 8700 TO 8805 (LAND SURVEYOR'S ACT).

UNDERGROUND UTILITIES:

THE LOCATIONS AND EXISTENCE OF UNDERGROUND UTILITIES ARE NOT GUARANTEED. THESE DRAWINGS WERE PREPARED BASED ON SURFACE DATA AND AVAILABLE RECORD INFORMATION AND IT IS POSSIBLE THAT ADDITIONAL UNDERGROUND UTILITIES COULD BE PRESENT THAT ARE NOT SHOWN. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFICATION OF THE LOCATION AND DEPTH OF EXISTING UNDERGROUND UTILITIES AND SHALL PERFORM POTHOLING AS NECESSARY AT ALL CROSSINGS PRIOR TO COMMENCING CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR TAKING ALL PRECAUTIONS NECESSARY TO PROTECT ALL EXISTING UTILITIES AND STRUCTURES FROM DAMAGE DURING THE COURSE OF THE WORK, AND SHALL BE RESPONSIBLE FOR REPAIRING OR REPLACING ANY UTILITIES OR STRUCTURES DAMAGED DURING THE COURSE OF THE WORK.

BENCHMARK

DESCRIPTION: CSM BENCHMARK 1-23

LOCATION:
1.0 MILES SOUTH ALONG CENTRAL ROAD FROM THE INTERSECTION OF CENTRAL ROAD AND QUARRY ROAD, 166 FEET EAST OF CENTERLINE CENTRAL ROAD, 33 FEET NORTH OF CENTERLINE JOHNSON ROAD, 16 FEET NORTH OF POWER POLE NO. 63127 CEPCO, 0.60 FEET ABOVE GROUND, 6.00 FEET SOUTH OF A WITNESS POST (11/01/70 ORIGINAL DESCRIPTION)

ELEVATION: 3156.94 DATUM:

BASIS OF BEARINGS

CALIFORNIA STATE PLANE COORDINATE SYSTEM ZONE V NAD83

DATE	DELTA	REVISION DESCRIPTION	APPROVAL DATE	APPROVAL BY

MERRELL JOHNSON

MERRELL JOHNSON ENGINEERING, INC.
22225 U.S. HIGHWAY 18, APPLE VALLEY, CA 92307
760.240.8000 | MERRELLJOHNSON.COM

CONCEPTUAL GRADING PLAN

DAKOTA & GUSTINE WAREHOUSE

DRAWN BY: EKJ
DATE: 07/15/24

JOB NO. 4171.001

SHEET 1 OF 1

Plotted: 20 August 2024 8:51:11 AM | Xrefs: None | P:\4171.001\Civil\Grading\4171001GR.dwg | Layout: 24x36 | User: ekjohnson

SECTION 3

HYDROLOGY CALCULATIONS

RATIONAL CALCULATIONS – Q_{100}

OFFSITE RATIONAL CALCULATIONS

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 09/03/24

TERRA NOVA PLANNING - DAKOTA & GUSTINE WAREHOUSE - JOB 4171.001
OFF-SITE TRIBUTARY STORM RUNOFF
NODE 11 - NODE 17
100-YEAR STORM EVENT - AMC II

MERRELL JOHNSON ENGINEERING
22221 HIGHWAY 18
APPLE VALLEY, CA 92307
(760) 240-8000

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.060 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

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Process from Point/Station 11.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 67.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
Initial subarea data:
Initial area flow distance = 937.000(Ft.)
Top (of initial area) elevation = 3149.000(Ft.)
Bottom (of initial area) elevation = 3136.000(Ft.)
Difference in elevation = 13.000(Ft.)
Slope = 0.01387 s(%)= 1.39
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 19.073 min.
Rainfall intensity = 2.364(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.680
Subarea runoff = 16.075(CFS)
Total initial stream area = 10.000(Ac.)
Pervious area fraction = 1.000

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Initial area Fm value =    0.578(In/Hr)

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Process from Point/Station       12.000 to Point/Station       13.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.630(Ft.), Average velocity =   3.128(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              5.00              0.00
        3             10.00              0.00
        4             15.00              1.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =     16.075(CFS)
  '     '        flow top width =     11.304(Ft.)
  '     '    velocity=    3.128(Ft/s)
  '     '        area =      5.139(Sq.Ft)
  '     '        Froude number =     0.818

Upstream point elevation =  3136.000(Ft.)
Downstream point elevation =  3125.000(Ft.)
Flow length =   698.000(Ft.)
Travel time  =    3.72 min.
Time of concentration =   22.79 min.
Depth of flow =   0.630(Ft.)
Average velocity =   3.128(Ft/s)
Total irregular channel flow =    16.075(CFS)
Irregular channel normal depth above invert elev. =   0.630(Ft.)
Average velocity of channel(s) =   3.128(Ft/s)

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Process from Point/Station       12.000 to Point/Station       13.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    22.79 min.
Rainfall intensity =      2.087(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.651
Subarea runoff =     27.246(CFS) for   21.900(Ac.)
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Total runoff =     43.320(CFS)
Effective area this stream =       31.90(Ac.)
Total Study Area (Main Stream No. 1) =       31.90(Ac.)
Area averaged Fm value =    0.578(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.801(Ft.), Average velocity =   3.861(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              2.00
        2             10.00              0.00
        3             20.00              0.00
        4             30.00              2.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =     43.321(CFS)
  '     '        flow top width =     18.011(Ft.)
  '     '    velocity=    3.861(Ft/s)
  '     '        area =     11.220(Sq.Ft)
  '     '        Froude number =     0.862

Upstream point elevation =  3125.000(Ft.)
Downstream point elevation =  3106.000(Ft.)
Flow length =  1208.000(Ft.)
Travel time  =    5.21 min.
Time of concentration =   28.01 min.
Depth of flow =   0.801(Ft.)
Average velocity =   3.861(Ft/s)
Total irregular channel flow =    43.320(CFS)
Irregular channel normal depth above invert elev. =   0.801(Ft.)
Average velocity of channel(s) =   3.861(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    28.01 min.
Rainfall intensity =      1.807(In/Hr) for a   100.0 year storm
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Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.612
Subarea runoff =     39.388(CFS) for   42.900(Ac.)
Total runoff =     82.708(CFS)
Effective area this stream =       74.80(Ac.)
Total Study Area (Main Stream No. 1) =       74.80(Ac.)
Area averaged Fm value =    0.578(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       15.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.972(Ft.), Average velocity =   4.284(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              2.00
        2             10.00              0.00
        3             25.00              0.00
        4             35.00              2.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =     82.708(CFS)
  '     '        flow top width =     24.720(Ft.)
  '     '    velocity=    4.284(Ft/s)
  '     '        area =     19.305(Sq.Ft)
  '     '        Froude number =     0.854

Upstream point elevation =  3106.000(Ft.)
Downstream point elevation =  3076.000(Ft.)
Flow length =  2097.000(Ft.)
Travel time  =    8.16 min.
Time of concentration =   36.16 min.
Depth of flow =   0.972(Ft.)
Average velocity =   4.284(Ft/s)
Total irregular channel flow =    82.708(CFS)
Irregular channel normal depth above invert elev. =   0.972(Ft.)
Average velocity of channel(s) =   4.284(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       15.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
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Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    36.16 min.
Rainfall intensity =      1.511(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.555
Subarea runoff =     50.903(CFS) for   84.400(Ac.)
Total runoff =    133.612(CFS)
Effective area this stream =      159.20(Ac.)
Total Study Area (Main Stream No. 1) =      159.20(Ac.)
Area averaged Fm value =    0.578(In/Hr)

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Process from Point/Station       15.000 to Point/Station       16.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   1.068(Ft.), Average velocity =   4.934(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              2.00
        2             10.00              0.00
        3             30.00              0.00
        4             40.00              2.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =    133.612(CFS)
  '     '        flow top width =     30.685(Ft.)
  '     '    velocity=    4.934(Ft/s)
  '     '        area =     27.078(Sq.Ft)
  '     '        Froude number =     0.926

Upstream point elevation =  3076.000(Ft.)
Downstream point elevation =  3033.000(Ft.)
Flow length =  2670.000(Ft.)
Travel time  =    9.02 min.
Time of concentration =   45.18 min.
Depth of flow =   1.068(Ft.)
Average velocity =   4.934(Ft/s)
Total irregular channel flow =   133.612(CFS)
Irregular channel normal depth above invert elev. =   1.068(Ft.)
Average velocity of channel(s) =   4.934(Ft/s)

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Process from Point/Station       15.000 to Point/Station       16.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
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Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    45.18 min.
Rainfall intensity =      1.293(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.497
Subarea runoff =     19.045(CFS) for   78.200(Ac.)
Total runoff =    152.657(CFS)
Effective area this stream =      237.40(Ac.)
Total Study Area (Main Stream No. 1) =      237.40(Ac.)
Area averaged Fm value =    0.578(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       17.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   1.132(Ft.), Average velocity =   4.305(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              2.00
        2             20.00              0.00
        3             40.00              0.00
        4             60.00              2.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =    152.657(CFS)
  '     '        flow top width =     42.642(Ft.)
  '     '    velocity=    4.305(Ft/s)
  '     '        area =     35.459(Sq.Ft)
  '     '        Froude number =     0.832

Upstream point elevation =  3033.000(Ft.)
Downstream point elevation =  2982.000(Ft.)
Flow length =  3865.000(Ft.)
Travel time  =   14.96 min.
Time of concentration =   60.14 min.
Depth of flow =   1.132(Ft.)
Average velocity =   4.305(Ft/s)
Total irregular channel flow =   152.657(CFS)
Irregular channel normal depth above invert elev. =   1.132(Ft.)
Average velocity of channel(s) =   4.305(Ft/s)

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Process from Point/Station       16.000 to Point/Station       17.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
```

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 67.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
Time of concentration = 60.14 min. T_C
Rainfall intensity = 1.058(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.408
Subarea runoff = 12.674(CFS) for 145.400(Ac.)
Total runoff = 165.331(CFS) Q_{100}
Effective area this stream = 382.80(Ac.)
Total Study Area (Main Stream No. 1) = 382.80(Ac.)
Area averaged Fm value = 0.578(In/Hr)
End of computations, Total Study Area = 382.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 67.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2019 Version 9.1
Rational Hydrology Study Date: 09/03/24

TERRA NOVA PLANNING - DAKOTA & GUSTINE WAREHOUSE - JOB 4171.001
OFF-SITE TRIBUTARY STORM RUNOFF
NODE 21 - NODE 26
100-YEAR STORM EVENT - AMC II

MERRELL JOHNSON ENGINEERING
22221 HIGHWAY 18
APPLE VALLEY, CA 92307
(760) 240-8000

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.060 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

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Process from Point/Station 21.000 to Point/Station 22.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.265(In/Hr)
Initial subarea data:
Initial area flow distance = 1000.000(Ft.)
Top (of initial area) elevation = 3084.000(Ft.)
Bottom (of initial area) elevation = 3074.000(Ft.)
Difference in elevation = 10.000(Ft.)
Slope = 0.01000 s(%)= 1.00
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 20.901 min.
Rainfall intensity = 2.218(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.792
Subarea runoff = 5.975(CFS)
Total initial stream area = 3.400(Ac.)
Pervious area fraction = 1.000

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Initial area Fm value =    0.265(In/Hr)

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Process from Point/Station       22.000 to Point/Station       23.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.330(Ft.), Average velocity =   2.724(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2              5.00              0.00
        3             10.00              0.00
        4             15.00              1.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =      5.975(CFS)
  '     '        flow top width =      8.299(Ft.)
  '     '    velocity=    2.724(Ft/s)
  '     '        area =      2.193(Sq.Ft)
  '     '        Froude number =     0.934

Upstream point elevation =  3074.000(Ft.)
Downstream point elevation =  3052.000(Ft.)
Flow length =   897.000(Ft.)
Travel time  =    5.49 min.
Time of concentration =   26.39 min.
Depth of flow =   0.330(Ft.)
Average velocity =   2.724(Ft/s)
Total irregular channel flow =     5.975(CFS)
Irregular channel normal depth above invert elev. =   0.330(Ft.)
Average velocity of channel(s) =   2.724(Ft/s)

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Process from Point/Station       22.000 to Point/Station       23.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    26.39 min.
Rainfall intensity =      1.884(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.667
Subarea runoff =      8.730(CFS) for    8.300(Ac.)
```

```
Total runoff =     14.704(CFS)
Effective area this stream =       11.70(Ac.)
Total Study Area (Main Stream No. 1) =       11.70(Ac.)
Area averaged Fm value =    0.487(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station       24.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.407(Ft.), Average velocity =   2.998(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              2.00
        2             10.00              0.00
        3             20.00              0.00
        4             30.00              2.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =     14.705(CFS)
  '     '        flow top width =     14.074(Ft.)
  '     '    velocity=    2.998(Ft/s)
  '     '        area =      4.904(Sq.Ft)
  '     '        Froude number =     0.895

Upstream point elevation =  3052.000(Ft.)
Downstream point elevation =  3032.000(Ft.)
Flow length =   976.000(Ft.)
Travel time  =    5.43 min.
Time of concentration =   31.81 min.
Depth of flow =   0.407(Ft.)
Average velocity =   2.998(Ft/s)
Total irregular channel flow =    14.704(CFS)
Irregular channel normal depth above invert elev. =   0.407(Ft.)
Average velocity of channel(s) =   2.998(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station       24.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    31.81 min.
Rainfall intensity =      1.653(In/Hr) for a   100.0 year storm
```

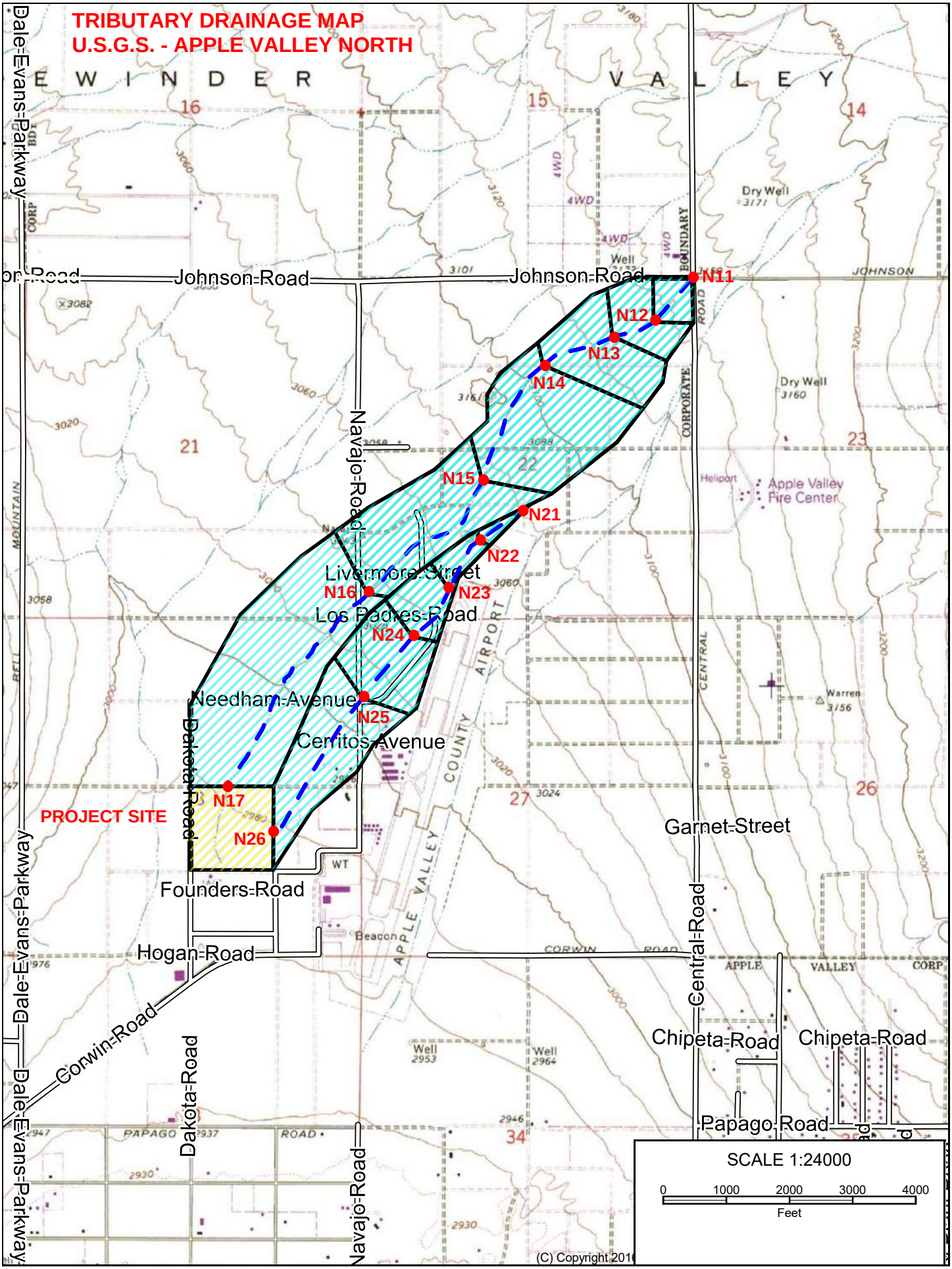
```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.605
Subarea runoff =     14.970(CFS) for   18.000(Ac.)
Total runoff =     29.675(CFS)
Effective area this stream =       29.70(Ac.)
Total Study Area (Main Stream No. 1) =       29.70(Ac.)
Area averaged Fm value =    0.542(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       25.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.508(Ft.), Average velocity =   3.334(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              2.00
        2             10.00              0.00
        3             25.00              0.00
        4             35.00              2.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =     29.675(CFS)
  '     '        flow top width =     20.076(Ft.)
  '     '    velocity=    3.334(Ft/s)
  '     '        area =      8.902(Sq.Ft)
  '     '        Froude number =     0.882

Upstream point elevation =  3032.000(Ft.)
Downstream point elevation =  3009.000(Ft.)
Flow length =  1253.000(Ft.)
Travel time  =    6.26 min.
Time of concentration =   38.08 min.
Depth of flow =   0.508(Ft.)
Average velocity =   3.334(Ft/s)
Total irregular channel flow =    29.675(CFS)
Irregular channel normal depth above invert elev. =   0.508(Ft.)
Average velocity of channel(s) =   3.334(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       25.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
```

```
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    38.08 min.
Rainfall intensity =      1.457(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.552
Subarea runoff =     25.232(CFS) for   38.500(Ac.)
Total runoff =     54.907(CFS)
Effective area this stream =       68.20(Ac.)
Total Study Area (Main Stream No. 1) =       68.20(Ac.)
Area averaged Fm value =    0.563(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       26.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.699(Ft.), Average velocity =   3.343(Ft/s)
        ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              2.00
        2             10.00              0.00
        3             30.00              0.00
        4             40.00              2.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =     54.907(CFS)
  '     '        flow top width =     26.991(Ft.)
  '     '    velocity=    3.343(Ft/s)
  '     '        area =     16.425(Sq.Ft)
  '     '        Froude number =     0.755

Upstream point elevation =  3009.000(Ft.)
Downstream point elevation =  2977.000(Ft.)
Flow length =  2644.000(Ft.)
Travel time  =   13.18 min.
Time of concentration =   51.26 min.
Depth of flow =   0.699(Ft.)
Average velocity =   3.343(Ft/s)
Total irregular channel flow =    54.907(CFS)
Irregular channel normal depth above invert elev. =   0.699(Ft.)
Average velocity of channel(s) =   3.343(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       26.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
```

Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 67.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
Time of concentration = 51.26 min. T_C
Rainfall intensity = 1.183(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.466
Subarea runoff = 16.637(CFS) for 61.400(Ac.)
Total runoff = 71.544(CFS) Q_{100}
Effective area this stream = 129.60(Ac.)
Total Study Area (Main Stream No. 1) = 129.60(Ac.)
Area averaged Fm value = 0.570(In/Hr)
End of computations, Total Study Area = 129.60 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 67.5

TRIBUTARY DRAINAGE MAP


TRIBUTARY DRAINAGE MAP
U.S.G.S. - APPLE VALLEY NORTH
E W I N D E R V A L L E Y
Dale Evans Parkway
Johnson Road
Navajo Road
Livermore Street
Los Padres Road
Needham Avenue
Cerritos Avenue
Dakota Road
Founders Road
Hogan Road
Corwin Road
Garnet Street
Central Road
Chipeta Road
Papago Road
N11
N12
N13
N14
N15
N16
N17
N21
N22
N23
N24
N25
N26
PROJECT SITE
Apple Valley Fire Center
Heliport
Dry Well
Warren
Beacon
APPLE VALLEY COUNTY AIRPORT
CORPORATE BOUNDARY
CENTRAL
CORWIN ROAD
APPLE VALLEY CORP
PAPAGO ROAD
SCALE 1:24000
0 1000 2000 3000 4000
Feet
(C) Copyright 201

2010 ANTECEDENT MOISTURE CONDITION (AMC) MAP

Figure ADD-1
Antecedent Moisture Condition (AMC)

5-day Rainfall - NOAA Atlas 14
(50% of Total Rainfall Prior to Peak)*

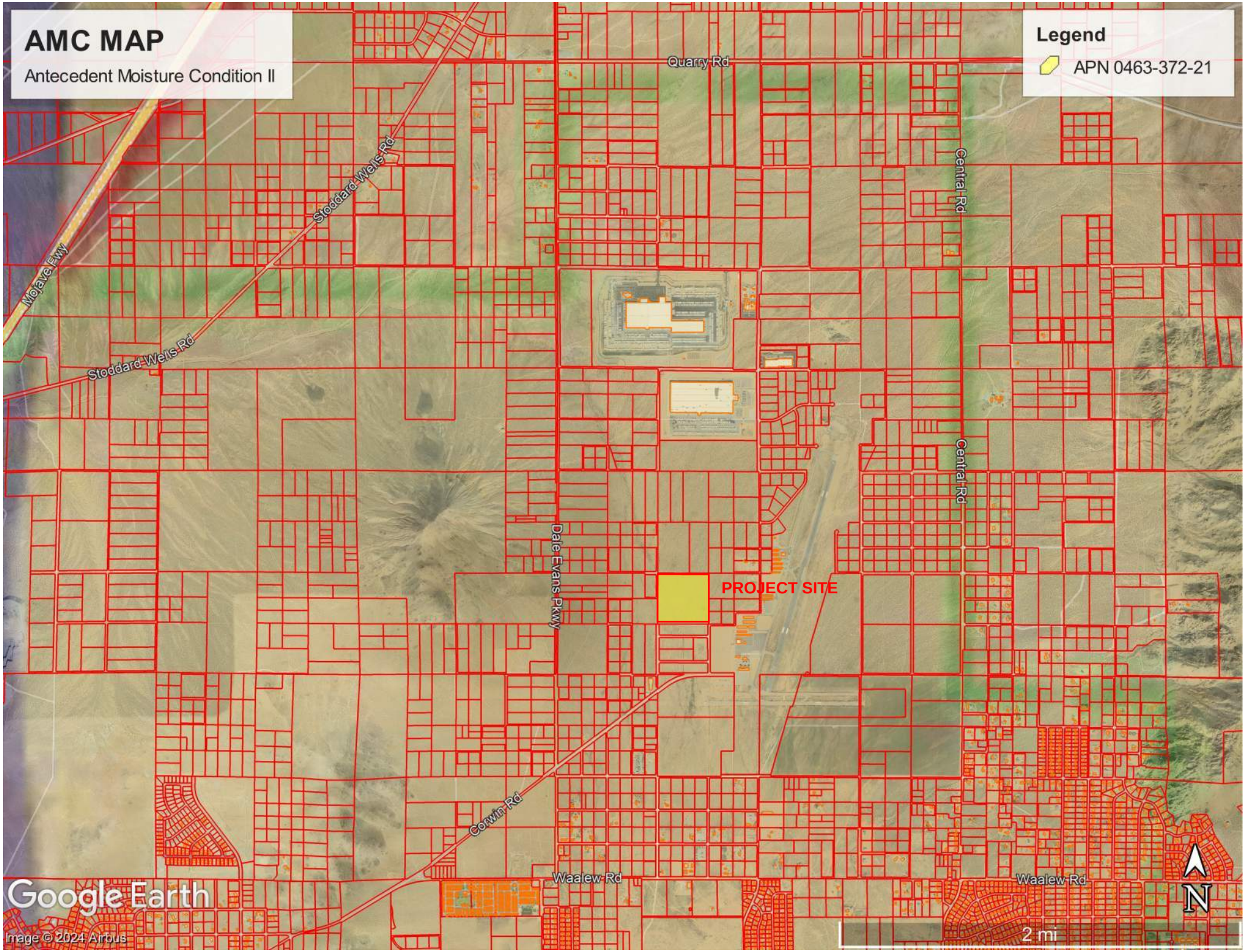
*1/2 (11-day - 1-day) =
1/2 (([10-day] + (1/10 ([20-day] - [10-day]))) - [1-day])

5 0 5 10 15
Miles

N
W E
S

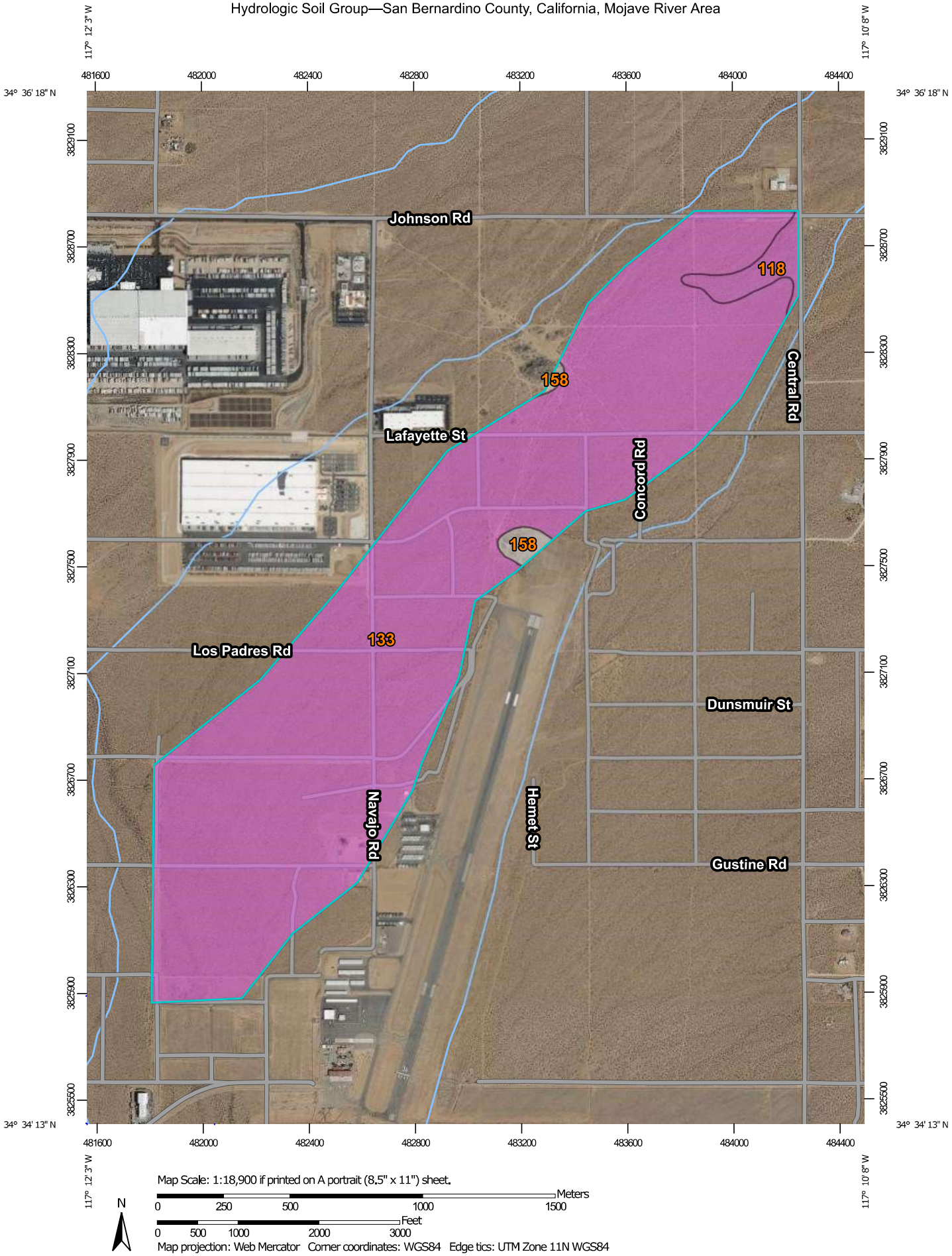
Growing Season
- AMC I
- AMC II
- AMC III

Baxter Valley
Ridgecrest
STATE HWY 127
I-15
Barstow
Boron
US HWY 395
Needles
I-40
Adelanto
George AFB
George AFB
Victorville
Apple Valley
Mountain View Acres
Hesperia
STATE HWY 247
Wrightwood
Big Bear City
Big Bear Lake
Crestline
Lake Arrowhead
Running Springs
Twentynine Palms
STATE HWY 62
Yucca Valley
Joshua Tree
Morongo Valley
Claremont
Parker Dam
Big River


AMC MAP
Antecedent Moisture Condition II
Legend
APN 0463-372-21
Quarry Rd
Stoddard Wells Rd
Mojave Fwy
Stoddard Wells Rd
Central Rd
Central Rd
Dale Evans Pkwy
PROJECT SITE
Corwin Rd
Waalew Rd
Waalew Rd
N
2 mi
Google Earth
Image © 2024 Airbus

SOILS MAP

Hydrologic Soil Group—San Bernardino County, California, Mojave River Area



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.

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: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 15, Aug 30, 2023

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

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

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
118	CAJON-ARIZO COMPLEX, 2 TO 15 PERCENT SLOPES*	A	13.3	2.5%
133	HELENDALE-BRYMAN LOAMY SANDS, 2 TO 5 PERCENT SLOPES*	A	515.5	96.5%
158	ROCK OUTCROP-LITHIC TORRIORTHENTS COMPLEX, 15 TO 50 PERCENT SLOPES*		5.6	1.0%
Totals for Area of Interest			**534.4**	**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

NOAA ATLAS 14 POINT RAINFALLS

NOAA Atlas 14, Volume 6, Version 2
Location name: Apple Valley, California, USA*
Latitude: 34.5874°, Longitude: -117.1897°
Elevation: 3035 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	0.081 (0.066-0.099)	0.114 (0.094-0.140)	0.161 (0.132-0.198)	0.202 (0.164-0.250)	0.260 (0.205-0.334)	0.308 (0.238-0.404)	0.360 (0.271-0.483)	0.416 (0.305-0.574)	0.498 (0.350-0.714)	0.565 (0.384-0.839)
10-min	0.116 (0.095-0.142)	0.164 (0.135-0.201)	0.231 (0.189-0.284)	0.289 (0.235-0.358)	0.373 (0.294-0.478)	0.442 (0.341-0.578)	0.516 (0.389-0.692)	0.597 (0.438-0.822)	0.713 (0.502-1.02)	0.810 (0.551-1.20)
15-min	0.140 (0.115-0.171)	0.198 (0.163-0.243)	0.279 (0.229-0.344)	0.349 (0.285-0.433)	0.451 (0.356-0.578)	0.535 (0.413-0.700)	0.624 (0.471-0.837)	0.722 (0.529-0.994)	0.863 (0.607-1.24)	0.979 (0.666-1.45)
30-min	0.190 (0.157-0.233)	0.270 (0.222-0.331)	0.380 (0.312-0.468)	0.476 (0.388-0.591)	0.615 (0.485-0.788)	0.729 (0.563-0.953)	0.851 (0.641-1.14)	0.984 (0.721-1.36)	1.18 (0.828-1.69)	1.34 (0.908-1.98)
60-min	0.238 (0.196-0.291)	0.336 (0.277-0.413)	0.474 (0.389-0.584)	0.594 (0.483-0.737)	0.767 (0.604-0.983)	0.909 (0.701-1.19)	1.06 (0.800-1.42)	1.23 (0.900-1.69)	1.47 (1.03-2.10)	1.66 (1.13-2.47)
2-hr	0.339 (0.279-0.415)	0.459 (0.378-0.564)	0.627 (0.515-0.771)	0.770 (0.627-0.955)	0.976 (0.769-1.25)	1.14 (0.882-1.50)	1.32 (0.995-1.77)	1.51 (1.11-2.08)	1.78 (1.26-2.56)	2.01 (1.36-2.98)
3-hr	0.412 (0.339-0.505)	0.551 (0.453-0.676)	0.742 (0.609-0.913)	0.905 (0.737-1.12)	1.14 (0.896-1.46)	1.32 (1.02-1.73)	1.52 (1.15-2.04)	1.74 (1.27-2.39)	2.04 (1.43-2.92)	2.28 (1.55-3.38)
6-hr	0.564 (0.464-0.691)	0.744 (0.613-0.913)	0.990 (0.813-1.22)	1.20 (0.975-1.48)	1.49 (1.17-1.91)	1.72 (1.33-2.25)	1.97 (1.48-2.64)	2.23 (1.63-3.07)	2.59 (1.82-3.72)	2.88 (1.96-4.28)
12-hr	0.729 (0.600-0.893)	0.964 (0.793-1.18)	1.28 (1.05-1.58)	1.54 (1.26-1.92)	1.91 (1.51-2.45)	2.20 (1.70-2.88)	2.50 (1.89-3.36)	2.82 (2.07-3.89)	3.26 (2.30-4.68)	3.61 (2.46-5.36)
24-hr	0.960 (0.852-1.10)	1.28 (1.14-1.48)	1.71 (1.51-1.98)	2.07 (1.81-2.41)	2.56 (2.17-3.08)	2.94 (2.44-3.62)	3.34 (2.70-4.20)	3.75 (2.95-4.86)	4.32 (3.26-5.83)	4.76 (3.48-6.66)
2-day	1.15 (1.02-1.32)	1.56 (1.38-1.80)	2.10 (1.86-2.43)	2.55 (2.24-2.97)	3.16 (2.68-3.81)	3.63 (3.02-4.47)	4.12 (3.34-5.19)	4.62 (3.64-5.98)	5.30 (4.01-7.16)	5.84 (4.26-8.16)
3-day	1.25 (1.11-1.44)	1.72 (1.52-1.98)	2.34 (2.06-2.70)	2.84 (2.49-3.30)	3.52 (2.99-4.24)	4.05 (3.36-4.98)	4.59 (3.72-5.78)	5.15 (4.06-6.67)	5.91 (4.46-7.97)	6.50 (4.75-9.08)
4-day	1.32 (1.17-1.52)	1.83 (1.62-2.10)	2.49 (2.20-2.88)	3.03 (2.65-3.53)	3.76 (3.19-4.53)	4.33 (3.59-5.32)	4.90 (3.97-6.17)	5.49 (4.33-7.12)	6.30 (4.76-8.51)	6.93 (5.06-9.68)
7-day	1.44 (1.28-1.66)	1.97 (1.75-2.27)	2.68 (2.37-3.09)	3.26 (2.85-3.79)	4.05 (3.43-4.87)	4.66 (3.87-5.73)	5.29 (4.28-6.66)	5.94 (4.68-7.69)	6.82 (5.16-9.21)	7.52 (5.49-10.5)
10-day	1.52 (1.35-1.75)	2.08 (1.84-2.39)	2.81 (2.48-3.25)	3.42 (3.00-3.98)	4.26 (3.61-5.12)	4.91 (4.08-6.03)	5.58 (4.52-7.02)	6.27 (4.94-8.12)	7.23 (5.46-9.76)	7.98 (5.83-11.1)
20-day	1.73 (1.54-2.00)	2.37 (2.10-2.73)	3.23 (2.86-3.73)	3.95 (3.46-4.60)	4.94 (4.19-5.95)	5.72 (4.75-7.03)	6.53 (5.29-8.22)	7.38 (5.81-9.55)	8.54 (6.46-11.5)	9.47 (6.92-13.2)
30-day	1.96 (1.73-2.25)	2.68 (2.38-3.09)	3.67 (3.24-4.24)	4.50 (3.94-5.24)	5.66 (4.80-6.81)	6.57 (5.46-8.08)	7.53 (6.10-9.48)	8.53 (6.72-11.0)	9.92 (7.50-13.4)	11.0 (8.05-15.4)
45-day	2.31 (2.05-2.66)	3.18 (2.82-3.66)	4.36 (3.86-5.04)	5.37 (4.70-6.25)	6.79 (5.75-8.17)	7.92 (6.58-9.74)	9.11 (7.38-11.5)	10.4 (8.17-13.4)	12.1 (9.16-16.4)	13.5 (9.88-18.9)
60-day	2.52 (2.24-2.90)	3.46 (3.06-3.98)	4.75 (4.20-5.49)	5.85 (5.13-6.81)	7.42 (6.29-8.93)	8.69 (7.21-10.7)	10.0 (8.12-12.6)	11.4 (9.02-14.8)	13.5 (10.2-18.2)	15.1 (11.0-21.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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

Please refer to NOAA Atlas 14 document for more information.

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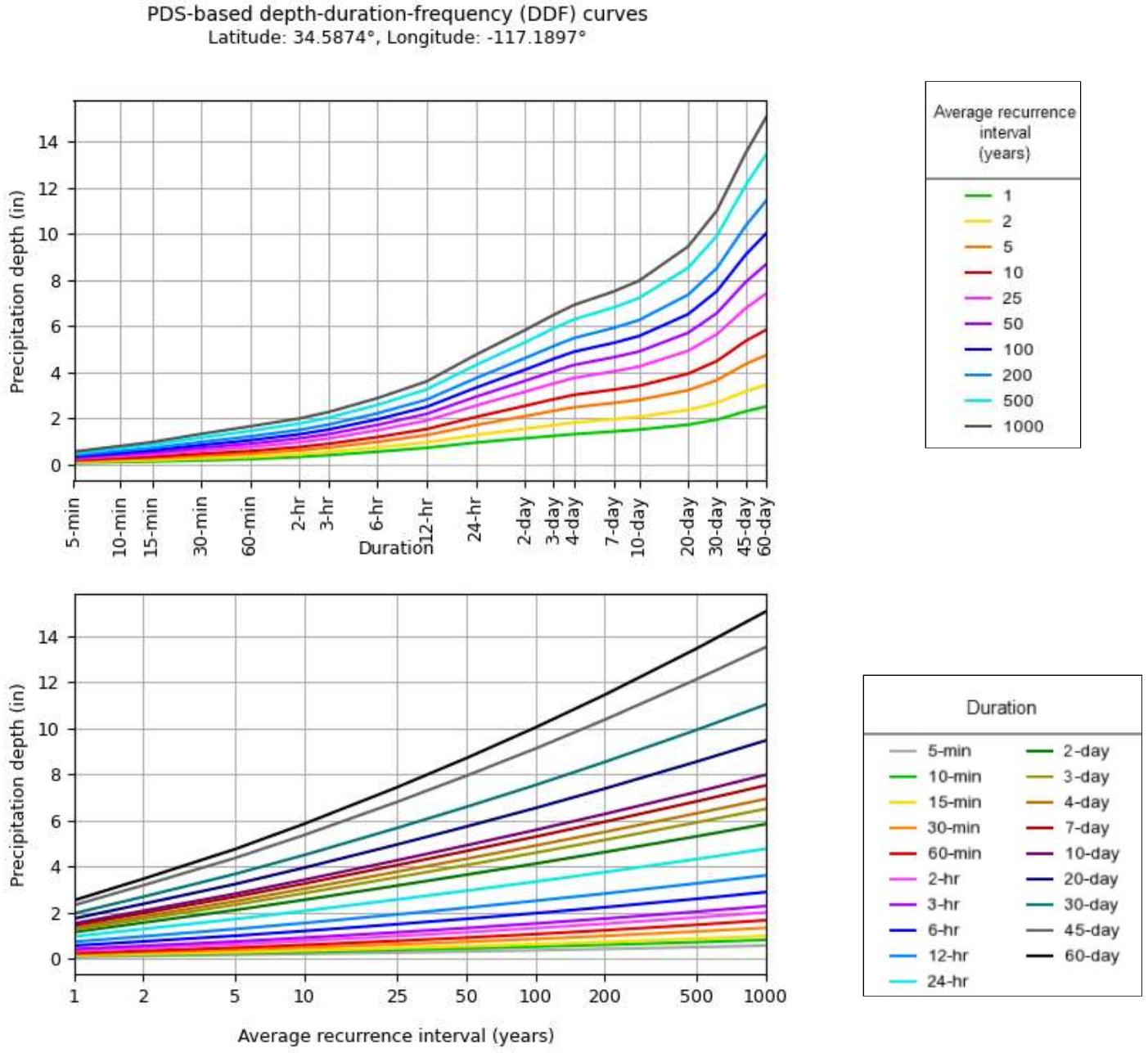
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Sun Sep 1 21:30:14 2024

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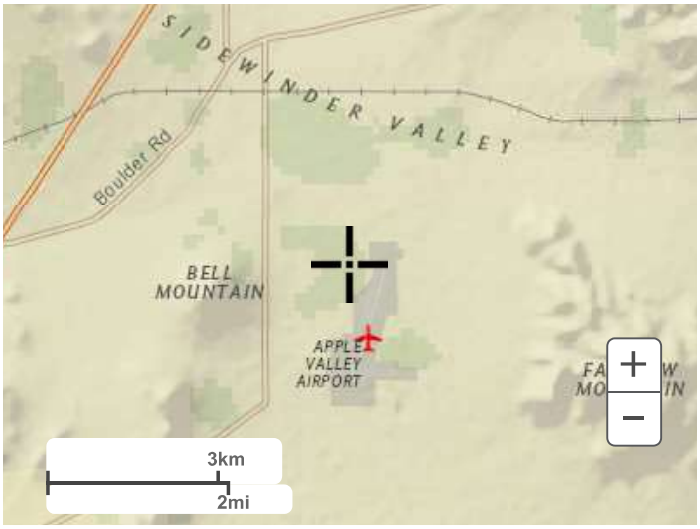
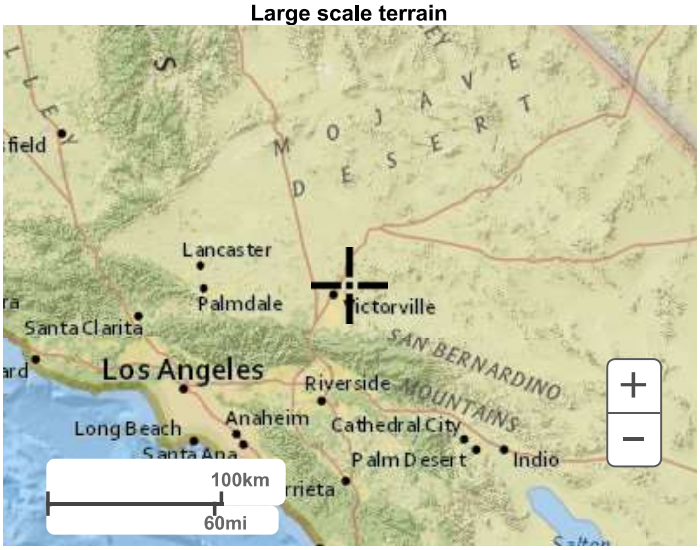
Maps & aerials

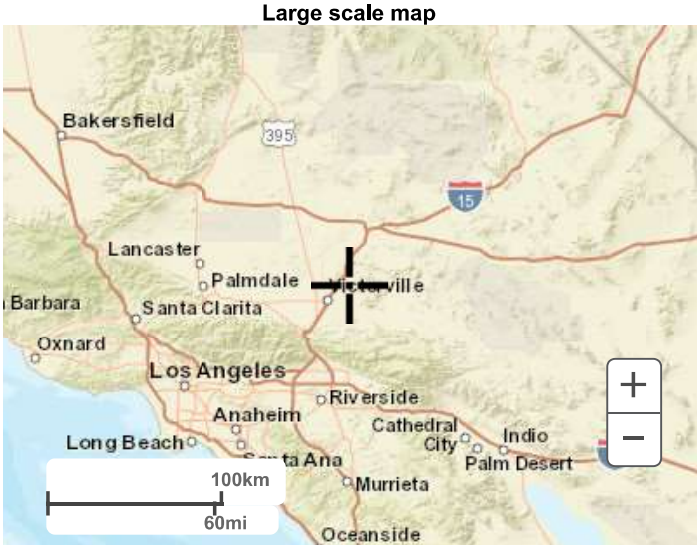
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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