Tentative Tract No. 22450

APN 3046-011-07 & 08
Hesperia, CA 92344

Hydrology Report

Prepared for:
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Original: July 23, 2021
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Prepared under the supervision of:

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STATE OF CALIFORNIA

Table of Contents

Discussion

OVERVIEW

Tentative Tract No. 22450 is located on the north side of Palm Street in between Afton Avenue and Mesa Avenue in Hesperia, California. The tentative tract map was previously approved as Tentative Tract Map 16570 with a retention basin sized to accommodate 13.5 ft3 of storage per 100 ft2 of imperviousness. Prior discussions with plan check personnel approved the continued use of 13.5 ft3 of storage per 100 ft2 of imperviousness for sizing purposes.

The property consists of undeveloped desert land that is proposed to be developed into a 36-lot single family residential development. The site is bordered to the west by Afton Avenue that consists of dirt road, to the east by Mesa Avenue which is partially paved and to the south by Palm Street which is paved with curb and gutter along the southerly edge. Palm Street was constructed as a slanted section and carries runoff in the gutter on the south side easterly. The north side of the site is bordered by vacant land. The existing sites terrain flows in an easterly and northeasterly direction at a slope of approximately 1-2%. 8.19 acres drain to the northeast to Mesa Avenue, while 1.60 acres drains east to Palm Street (See Existing Condition Hydrology Exhibit). According to NRCS websoil survey, Hydrologic Soil Class A is the dominant soil type throughout the area (See Reference Material Section). The sites drainage comprises of sheet flow and shallow concentrated flow that drains to the east and northeast. 8.19 aces drains northeast and is intercepted by Mesa Avenue and conveyed north down the historical drainage path. 1.60 acres drains east to the Palm Street/Mesa Avenue intersection and continues to drain east down Palm Street. The surrounding roads including Afton Avenue, Mesa Avenue and Palm Street convey offsite flows past the site so that the site does not have offsite tributary drainage flows (see Figure 1).

Figure 1. Offsite Drainage Patterns

This project proposes to construct 36 single family residential lots with associated street, storm drain and utility improvements. Drainage will be conveyed in curb and gutter through the site. Lots 6 through 14 that front Palm Street (2.02 acres), will include on lot amended soil strips and basins to treat runoff that will then discharge to Palm Street and continue to drain east. The remaining portion of the site (7.78 acres) will drain to Lot A,

A proposed infiltration basin and then discharge to Mesa Avenue. 2 curb opening catch basins are proposed in Wildwood Street that will intercept onsite runoff and convey flows to the onsite retention basin via an onsite storm drain. Flow that exceeds the basin capacity will spill east to Mesa Avenue via a concrete overflow spillway.

PURPOSE

The purpose of this report is to discuss the hydrologic characteristics of the site and quantify the sites existing and proposed 100-year flow runoff quantities. Calculations will be performed to verify drainage infrastructure is adequately sized to convey the 100-year flow in a safe manner. This report will demonstrate the proposed infiltration basin and on lot basin are sized to retain a minimum of 13.5 ft3 of storage per 100 sq ft of impervious surface. This strategy is consistent with the strategies approved in the previous drainage report that was developed to support the previously approved tentative map no 16570.

CRITERIA

The criteria utilized in this report are set forth by the San Bernardino County Hydrology Manual. AES software was used to perform computations.

RESULTS

Onsite rational method analysis indicates 8.19 acres of the site that drains northeast to Mesa Avenue produces a 100-year peak flow rate of 19.91 cfs in the existing condition. The southerly drainage that totals 1.6 acres produces 4.34 cfs and dicharges to the Palm Street/Mesa Avenue intersection. In the proposed condition 7.78 acres will drain northeast to Mesa Avenue and produce a 100-year peak flow rate of 22.46 cfs. A retention basin is proposed that will provide 27,209 ft3 of retentions storage (See retention basin sizing). This is larger than the volume required based on 13.5 ft3 of storage per 100 ft2 of impervious surface which was determined to be 25,872 ft3. Therefore the basin has 1,337 ft3 of additional storage capacity.

IMPERVIOUS AREA & RETENTION VOLUME CALCULATION

36 Lots	=	104,238 S.F
NEW STREET	=	87,404 S.F
TOTAL IMPERVIOUS	=	191,642 S.F

RETENTION VOLUME:

$$\frac{\text{191,642 SQ.FT IMPERVIOUS AREA X 13.5 CU.FT}}{\text{100 SQ.FT}} = \text{25,872 CU.FT.}$$

Lots 6-14 will not drain to the infiltration basin on Lot A and will instead drain south to Palm Street. These lots will contain an amended soil strip and an infiltration basin within the front yards. Each lot should provide a minimum of 250 ft amended soil strip and a 433 ft2 infiltration basin with 0.5 ft of ponding and 1 ft of gravel substrate. (See Table 1 below). This storage volume is adequate to address 13.5 ft3 of storage per 100 ft2 of impervious area for each lot.

Table 1. Site Design - Ammended Soil Strip and Infiltration Basin Sizing

DA (WQMP)	2	3	4	5	6	7	8	9	10
Lot #	6	7	8	9	10	11	12	13	14
Trib Imperv (ft2)	2964	2964	2827	2964	2827	2964	2827	2964	2827
Soil Strip Area (fft2)	250	250	250	250	250	250	250	250	250
Ratio	0.084	0.084	0.088	0.084	0.088	0.084	0.088	0.084	0.088
Retained (ft3)	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
Remainder	389.7	389.7	371.2	389.7	371.2	389.7	371.2	389.7	371.2
Ponding Surf Area (ft2)	433	433	433	433	433	433	433	433	433
Ponding Depth (ft)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Area of Gravel (ft2)	433	433	433	433	433	433	433	433	433
Depth of Gravel	1	1	1	1	1	1	1	1	1
Porosity (%)	40	40	40	40	40	40	40	40	40
Retained Volume (ft3)	389.7	389.7	389.7	389.7	389.7	389.7	389.7	389.7	389.7

Table 2. Storage Volume Calculation Summary

Lot	Imperv (ft2)	Minimum Volume ft3 (Imperv/100 X 13.5)
6	2964	400
7	2964	400
8	2827	382
9	2964	400
10	2827	382
11	2964	400
12	2827	382
13	2964	400
14	2827	382

Hydraulic calculations indicate two 10 ft proposed catch basins on Wildwood Street are adequately sized to intercept the 100-year storm event in a safe manner. The hydraulic calculation assumed flows will spill over the crown of the road and 50% of the total flow will spill into each catch basin. The catch basins will be connected via an 18-inch Reinforced Concrete Pipe (Reach A) that will then be conveyed to the retention basin via an 18-inch Reinforced Concrete Pipe (Reach B). The retention basin will include a dry well at the invert to help facilitate drawdown. The retention basin will also be constructed with a 6 ft spillway that will discharge to Mesa Avenue. Hydrologic and hydraulic calculations indicate the drainage systems are adequately sized to convey the 100-year storm event in safe manner. Calculations and exhibits accompany this discussion to further illustrate these findings.

Reference Material

General Information
Homepage
Progress Reports
FAQ
Glossary

Precipitation Frequency
Data Server
GIS Grids
Maps
Time Series
Temporals
Documents

Probable Maximum Precipitation
Documents

Miscellaneous
Publications
Storm Analysis
Record Precipitation

Contact Us
Inquiries

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA

Data description

Data type: Precipitation depth | **Units:** English | **Time series type:** Partial duration

Select location

1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: Longitude: Submit

b) By station (list of CA stations): Select station

c) By address Search

2) Use map (if ESRI interactive map is not loading, try adding the host: **https://js.arcgis.com/** to the firewall, or contact us at hdsc.questions@noaa.gov):

a) Select location
Move crosshair or double click

b) Click on station icon
Show stations on map

Location information:
Name: Hesperia, California, USA*
Latitude: 34.4095°
Longitude: -117.3695°
Elevation: 3560.81 ft **

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 6, Version 2

PF tabular | PF graphical | Supplementary information | Print page

PDS-based 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	**0.088** (0.073-0.108)	**0.124** (0.103-0.152)	**0.172** (0.142-0.211)	**0.211** (0.173-0.261)	**0.265** (0.210-0.339)	**0.308** (0.238-0.402)	**0.352** (0.266-0.470)	**0.397** (0.292-0.546)	**0.461** (0.324-0.660)	**0.510** (0.347-0.757)
10-min	**0.127** (0.105-0.155)	**0.178** (0.147-0.218)	**0.246** (0.203-0.302)	**0.303** (0.247-0.374)	**0.380** (0.301-0.486)	**0.441** (0.342-0.576)	**0.504** (0.381-0.674)	**0.570** (0.418-0.783)	**0.660** (0.465-0.946)	**0.731** (0.498-1.09)
15-min	**0.153** (0.127-0.187)	**0.215** (0.178-0.263)	**0.298** (0.246-0.365)	**0.366** (0.299-0.452)	**0.460** (0.364-0.588)	**0.534** (0.413-0.696)	**0.610** (0.461-0.815)	**0.689** (0.505-0.947)	**0.798** (0.562-1.14)	**0.885** (0.602-1.31)
30-min	**0.230** (0.190-0.281)	**0.323** (0.267-0.395)	**0.447** (0.368-0.547)	**0.549** (0.449-0.678)	**0.690** (0.545-0.861)	**0.800** (0.619-1.04)	**0.914** (0.690-1.22)	**1.03** (0.759-1.42)	**1.20** (0.843-1.72)	**1.33** (0.902-1.97)
60-min	**0.324** (0.268-0.395)	**0.454** (0.376-0.555)	**0.628** (0.518-0.770)	**0.772** (0.631-0.954)	**0.970** (0.767-1.24)	**1.13** (0.872-1.47)	**1.29** (0.971-1.72)	**1.45** (1.07-2.00)	**1.68** (1.19-2.41)	**1.87** (1.27-2.77)
2-hr	**0.474** (0.392-0.578)	**0.638** (0.527-0.779)	**0.858** (0.708-1.05)	**1.04** (0.853-1.29)	**1.30** (1.03-1.66)	**1.51** (1.17-1.96)	**1.72** (1.30-2.30)	**1.94** (1.43-2.67)	**2.26** (1.59-3.24)	**2.51** (1.71-3.73)
3-hr	**0.596** (0.493-0.727)	**0.791** (0.654-0.966)	**1.06** (0.870-1.29)	**1.28** (1.04-1.58)	**1.59** (1.26-2.03)	**1.84** (1.42-2.40)	**2.10** (1.59-2.81)	**2.38** (1.75-3.27)	**2.77** (1.95-3.97)	**3.09** (2.10-4.58)
6-hr	**0.846** (0.700-1.03)	**1.11** (0.920-1.36)	**1.48** (1.22-1.81)	**1.79** (1.46-2.21)	**2.23** (1.76-2.84)	**2.58** (2.00-3.37)	**2.95** (2.23-3.95)	**3.35** (2.46-4.61)	**3.92** (2.77-5.63)	**4.39** (2.99-6.51)
12-hr	**1.10** (0.913-1.35)	**1.49** (1.23-1.82)	**2.01** (1.66-2.47)	**2.46** (2.01-3.04)	**3.09** (2.44-3.95)	**3.60** (2.79-4.69)	**4.13** (3.12-5.53)	**4.71** (3.46-6.47)	**5.53** (3.89-7.92)	**6.19** (4.22-9.19)
24-hr	**1.49** (1.32-1.71)	**2.07** (1.84-2.39)	**2.87** (2.54-3.32)	**3.54** (3.10-4.13)	**4.50** (3.81-5.42)	**5.27** (4.37-6.48)	**6.08** (4.92-7.65)	**6.94** (5.47-8.99)	**8.18** (6.18-11.0)	**9.18** (6.71-12.8)
2-day	**1.72** (1.52-1.98)	**2.40** (2.13-2.77)	**3.35** (2.96-3.87)	**4.16** (3.64-4.84)	**5.32** (4.50-6.40)	**6.26** (5.19-7.69)	**7.26** (5.88-9.15)	**8.35** (6.58-10.8)	**9.92** (7.50-13.4)	**11.2** (8.20-15.7)
3-day	**1.84** (1.63-2.12)	**2.58** (2.28-2.97)	**3.60** (3.18-4.16)	**4.48** (3.93-5.23)	**5.76** (4.88-6.94)	**6.81** (5.65-8.37)	**7.93** (6.42-9.99)	**9.15** (7.21-11.9)	**10.9** (8.26-14.7)	**12.4** (9.06-17.3)
4-day	**1.99** (1.76-2.29)	**2.78** (2.46-3.20)	**3.89** (3.43-4.49)	**4.84** (4.24-5.64)	**6.23** (5.28-7.50)	**7.37** (6.11-9.06)	**8.59** (6.96-10.8)	**9.93** (7.82-12.9)	**11.9** (8.98-16.0)	**13.5** (9.86-18.8)
7-day	**2.22** (1.97-2.56)	**3.10** (2.74-3.57)	**4.31** (3.81-4.98)	**5.36** (4.70-6.25)	**6.88** (5.83-8.29)	**8.13** (6.75-9.99)	**9.47** (7.67-11.9)	**10.9** (8.62-14.2)	**13.1** (9.87-17.6)	**14.8** (10.8-20.7)
10-day	**2.38** (2.11-2.74)	**3.30** (2.92-3.81)	**4.59** (4.05-5.30)	**5.70** (4.99-6.64)	**7.30** (6.19-8.79)	**8.62** (7.15-10.6)	**10.0** (8.13-12.6)	**11.6** (9.12-15.0)	**13.8** (10.4-18.6)	**15.7** (11.4-21.9)
20-day	**2.85** (2.52-3.28)	**3.95** (3.50-4.55)	**5.48** (4.84-6.34)	**6.80** (5.96-7.93)	**8.71** (7.38-10.5)	**10.3** (8.53-12.6)	**12.0** (9.68-15.1)	**13.8** (10.9-17.9)	**16.4** (12.4-22.2)	**18.7** (13.6-26.1)
30-day	**3.35** (2.97-3.85)	**4.63** (4.10-5.34)	**6.41** (5.66-7.40)	**7.94** (6.99-9.25)	**10.1** (8.80-12.2)	**12.0** (9.93-14.7)	**13.9** (11.3-17.5)	**16.1** (12.6-20.8)	**19.2** (14.5-25.9)	**21.8** (15.9-30.4)
45-day	**3.98** (3.53-4.59)	**5.45** (4.83-6.28)	**7.49** (6.61-8.65)	**9.25** (8.10-10.8)	**11.8** (9.99-14.2)	**13.9** (11.5-17.1)	**16.1** (13.1-20.3)	**18.6** (14.7-24.1)	**22.2** (16.8-30.0)	**25.2** (18.4-35.3)
60-day	**4.55** (4.03-5.23)	**6.13** (5.43-7.07)	**8.33** (7.36-9.63)	**10.2** (8.96-11.9)	**13.0** (11.0-15.6)	**15.3** (12.7-18.8)	**17.7** (14.4-22.3)	**20.4** (16.1-26.5)	**24.4** (18.4-32.9)	**27.7** (20.3-38.7)

[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 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.

Estimates from the table in CSV format: Precipitation frequency estimates Submit

Main Link Categories:
Home | OWP

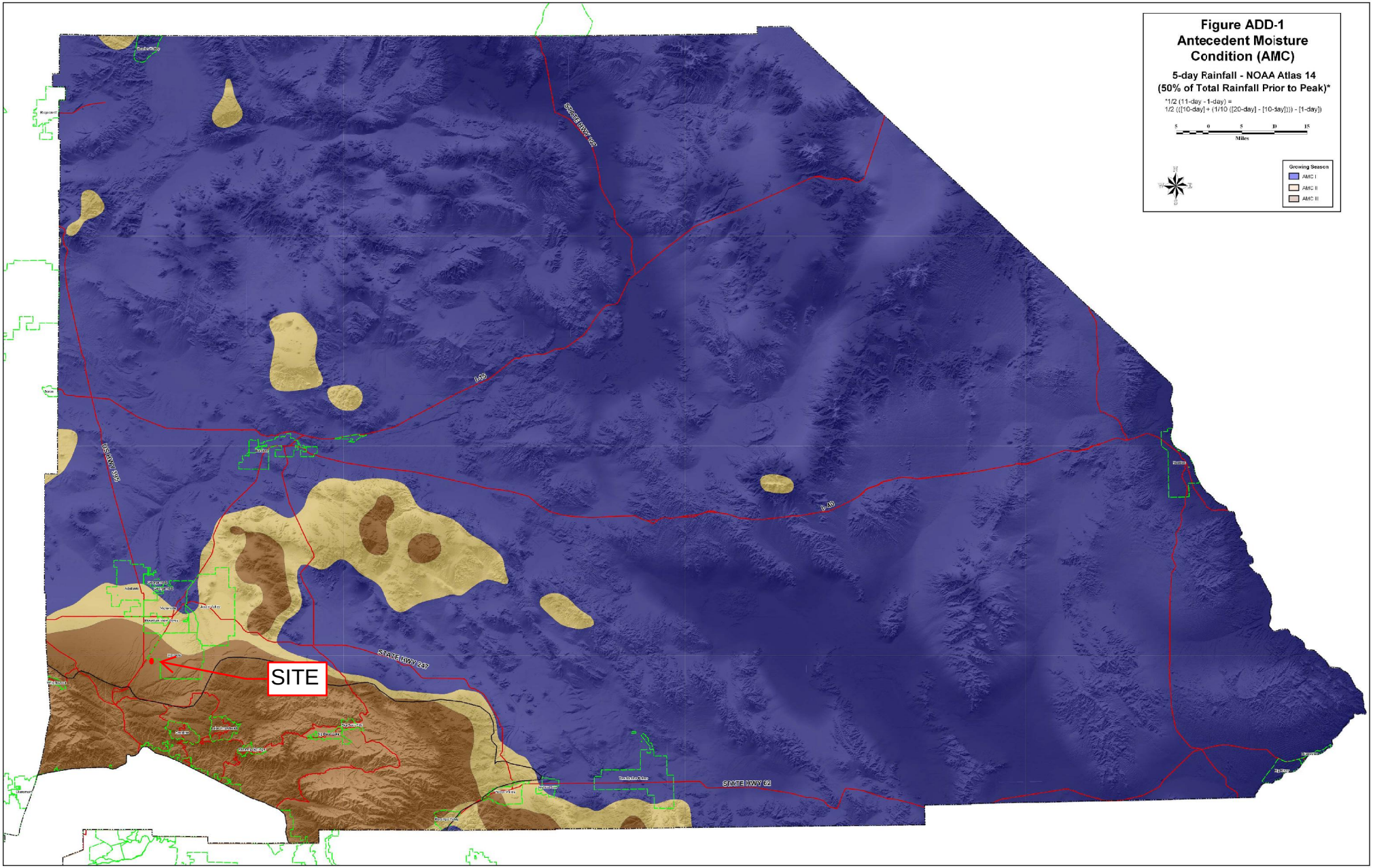
Figure ADD-1
Antecedent Moisture Condition (AMC)
5-day Rainfall - NOAA Atlas 14
(50% of Total Rainfall Prior to Peak)*
*1/2 (11-day - 1-day) =
1/2 ([10-day] + (1/10 ([20-day] - [10-day]))) - [1-day])
5 0 5 10 15
Miles
Growing Season
AMC I
AMC II
AMC III
STATE HWY 237
I-35
US HWY 385
I-40
STATE HWY 237
STATE HWY 92
SITE

Map Scale: 1:1,670 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N 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: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 12, May 27, 2020

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

Date(s) aerial images were photographed: Jun 26, 2019—Jul 8, 2019

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
134	HESPERIA LOAMY FINE SAND, 2 TO 5 PERCENT SLOPES	9.7	100.0%
Totals for Area of Interest		**9.7**	**100.0%**

San Bernardino County, California, Mojave River Area

134—HESPERIA LOAMY FINE SAND, 2 TO 5 PERCENT SLOPES

Map Unit Setting

National map unit symbol: hks7
Elevation: 200 to 4,000 feet
Mean annual precipitation: 6 to 9 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 150 to 250 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Hesperia and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hesperia

Setting

Landform: Fan aprons
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite sources

Typical profile

H1 - 0 to 6 inches: loamy fine sand
H2 - 6 to 60 inches: sandy loam, coarse sandy loam
H2 - 6 to 60 inches:

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A

Ecological site: R030XE006CA - COARSE LOAMY
Hydric soil rating: No

Minor Components

Cajon
Percent of map unit: 5 percent
Hydric soil rating: No

Wrightwood
Percent of map unit: 5 percent
Hydric soil rating: No

Bull trail
Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed soils
Percent of map unit: 2 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 12, May 27, 2020

Rational Methods

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******************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2011 Advanced Engineering Software (aes)
            Ver. 18.0  Release Date: 07/01/2011  License ID 1501

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* Tract 16570                                                            *
* Existing Condition                                                     *
* 100 Year Storm Event                                                   *
 ************************************************************************

  FILE NAME: 16570E.DAT
  TIME/DATE OF STUDY: 20:22 11/30/2021
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2900

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  =====  ======  =====  =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

******************************************************************************
  FLOW PROCESS FROM NODE      0.00 TO NODE      1.00 IS CODE =  21
------------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   845.00
  ELEVATION DATA: UPSTREAM(FEET) =   3568.00  DOWNSTREAM(FEET) =   3553.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.515
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.054
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL POOR COVER
  "OPEN BRUSH"               A        8.19      0.35     1.000    81   17.51
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =     19.91
  TOTAL AREA(ACRES) =      8.19   PEAK FLOW RATE(CFS) =     19.91

********************************************************************************
  FLOW PROCESS FROM NODE      0.00 TO NODE      2.00 IS CODE =  21
--------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   663.00
  ELEVATION DATA: UPSTREAM(FEET) =   3568.00  DOWNSTREAM(FEET) =   3553.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.227
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.369
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL POOR COVER
  "OPEN BRUSH"               A        1.60      0.35     1.000    81   15.23
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      4.34
  TOTAL AREA(ACRES) =      1.60   PEAK FLOW RATE(CFS) =      4.34
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.6  TC(MIN.) =     15.23
  EFFECTIVE AREA(ACRES) =      1.60  AREA-AVERAGED Fm(INCH/HR)=  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.35  AREA-AVERAGED Ap = 1.000
  PEAK FLOW RATE(CFS)   =       4.34
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
******************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
        (c) Copyright 1983-2011 Advanced Engineering Software (aes)
            Ver. 18.0  Release Date: 07/01/2011  License ID 1501

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* Tract 16570                                                            *
* Proposed Condition                                                     *
* 100 Year Storm Event                                                   *
 ************************************************************************

  FILE NAME: 16570P.DAT
  TIME/DATE OF STUDY: 21:39 11/30/2021
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.7000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2900

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  =====  ======  =====  =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

******************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
------------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   486.00
  ELEVATION DATA: UPSTREAM(FEET) =   3567.30  DOWNSTREAM(FEET) =   3563.64

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.007
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.762
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        1.42      0.74     0.600    52   13.01
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      4.24
  TOTAL AREA(ACRES) =      1.42   PEAK FLOW RATE(CFS) =      4.24

********************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     13.00 IS CODE =  61
--------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) = 3563.64  DOWNSTREAM ELEVATION(FEET) = 3555.91
  STREET LENGTH(FEET) =   325.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.55
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.36
    HALFSTREET FLOOD WIDTH(FEET) =   10.27
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.66
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.33
  STREET FLOW TRAVEL TIME(MIN.) =   1.48   Tc(MIN.) =   14.49
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.488
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        0.23      0.74     0.600    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.63
  EFFECTIVE AREA(ACRES) =      1.65    AREA-AVERAGED Fm(INCH/HR) =  0.45
```

```
 AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.60
 TOTAL AREA(ACRES) =        1.6        PEAK FLOW RATE(CFS) =       4.52

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.36   HALFSTREET FLOOD WIDTH(FEET) =  10.27
 FLOW VELOCITY(FEET/SEC.) =  3.63   DEPTH*VELOCITY(FT*FT/SEC.) =   1.32
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.00 =     811.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     13.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   14.49
 RAINFALL INTENSITY(INCH/HR) =   3.49
 AREA-AVERAGED Fm(INCH/HR) =  0.45
 AREA-AVERAGED Fp(INCH/HR) =  0.74
 AREA-AVERAGED Ap =  0.60
 EFFECTIVE STREAM AREA(ACRES) =       1.65
 TOTAL STREAM AREA(ACRES) =       1.65
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.52

****************************************************************************
 FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   420.00
 ELEVATION DATA: UPSTREAM(FEET) =   3560.00  DOWNSTREAM(FEET) =   3555.91

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.655
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.062
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "3-4 DWELLINGS/ACRE"       A        2.60      0.74     0.600    52   11.65
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
 SUBAREA RUNOFF(CFS) =      8.46
 TOTAL AREA(ACRES) =      2.60   PEAK FLOW RATE(CFS) =      8.46

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     13.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   11.65
```

```
 RAINFALL INTENSITY(INCH/HR) =   4.06
 AREA-AVERAGED Fm(INCH/HR) =  0.45
 AREA-AVERAGED Fp(INCH/HR) =  0.74
 AREA-AVERAGED Ap =  0.60
 EFFECTIVE STREAM AREA(ACRES) =       2.60
 TOTAL STREAM AREA(ACRES) =       2.60
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       8.46

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1        4.52   14.49    3.488  0.74( 0.45) 0.60       1.6      10.00
     2        8.46   11.65    4.062  0.74( 0.45) 0.60       2.6      12.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       12.78   11.65    4.062  0.74( 0.45) 0.60       3.9      12.00
     2       11.64   14.49    3.488  0.74( 0.45) 0.60       4.2      10.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      12.78    Tc(MIN.) =    11.65
 EFFECTIVE AREA(ACRES) =       3.93   AREA-AVERAGED Fm(INCH/HR) =  0.45
 AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.60
 TOTAL AREA(ACRES) =        4.2
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.00 =     811.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     15.00 IS CODE =  61
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) = 3555.91  DOWNSTREAM ELEVATION(FEET) = 3551.11
 STREET LENGTH(FEET) =   206.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 20.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  10.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.02
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.48
   HALFSTREET FLOOD WIDTH(FEET) =   16.21
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.62
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.23
```

```
  STREET FLOW TRAVEL TIME(MIN.) =   0.74   Tc(MIN.) =   12.40
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.890
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        0.15      0.74     0.600    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    0.15      SUBAREA RUNOFF(CFS) =    0.47
  EFFECTIVE AREA(ACRES) =      4.08    AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        4.4        PEAK FLOW RATE(CFS) =      12.78
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.48   HALFSTREET FLOOD WIDTH(FEET) =  16.13
  FLOW VELOCITY(FEET/SEC.) =  4.58   DEPTH*VELOCITY(FT*FT/SEC.) =   2.20
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     15.00 =    1017.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.40
  RAINFALL INTENSITY(INCH/HR) =   3.89
  AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       4.08
  TOTAL STREAM AREA(ACRES) =       4.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      12.78

****************************************************************************
  FLOW PROCESS FROM NODE     14.00 TO NODE     15.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   547.00
  ELEVATION DATA: UPSTREAM(FEET) =   3554.50  DOWNSTREAM(FEET) =   3551.11

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.179
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.541
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        1.47      0.74     0.600    52   14.18
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
```

```
  SUBAREA RUNOFF(CFS) =      4.10
  TOTAL AREA(ACRES) =      1.47   PEAK FLOW RATE(CFS) =      4.10

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.18
  RAINFALL INTENSITY(INCH/HR) =   3.54
  AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       1.47
  TOTAL STREAM AREA(ACRES) =       1.47
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.10

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       12.78   12.40    3.890  0.74( 0.45) 0.60       4.1      12.00
      1       11.64   15.25    3.366  0.74( 0.45) 0.60       4.4      10.00
      2        4.10   14.18    3.541  0.74( 0.45) 0.60       1.5      14.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       16.77   12.40    3.890  0.74( 0.45) 0.60       5.4      12.00
      2       16.16   14.18    3.541  0.74( 0.45) 0.60       5.7      14.00
      3       15.50   15.25    3.366  0.74( 0.45) 0.60       5.9      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      16.77    Tc(MIN.) =    12.40
  EFFECTIVE AREA(ACRES) =       5.36   AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        5.9
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     15.00 =    1017.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     17.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  3546.59  DOWNSTREAM(FEET) =  3545.87
  FLOW LENGTH(FEET) =    35.80   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.49
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
```

```
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      16.77
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =   12.46
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     17.00 =    1052.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.46
  RAINFALL INTENSITY(INCH/HR) =   3.88
  AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       5.36
  TOTAL STREAM AREA(ACRES) =       5.87
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      16.77

****************************************************************************
  FLOW PROCESS FROM NODE     16.00 TO NODE     17.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   665.00
  ELEVATION DATA: UPSTREAM(FEET) =   3564.88  DOWNSTREAM(FEET) =   3551.13

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.048
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.969
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        1.69      0.74     0.600    52   12.05
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      5.36
  TOTAL AREA(ACRES) =      1.69   PEAK FLOW RATE(CFS) =      5.36

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.05
  RAINFALL INTENSITY(INCH/HR) =   3.97
  AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74
```

```
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       1.69
  TOTAL STREAM AREA(ACRES) =       1.69
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.36

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       16.77   12.46    3.876  0.74( 0.45) 0.60       5.4      12.00
      1       16.16   14.24    3.530  0.74( 0.45) 0.60       5.7      14.00
      1       15.50   15.32    3.355  0.74( 0.45) 0.60       5.9      10.00
      2        5.36   12.05    3.969  0.74( 0.45) 0.60       1.7      16.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       22.01   12.05    3.969  0.74( 0.45) 0.60       6.9      16.00
      2       21.99   12.46    3.876  0.74( 0.45) 0.60       7.1      12.00
      3       20.86   14.24    3.530  0.74( 0.45) 0.60       7.4      14.00
      4       19.93   15.32    3.355  0.74( 0.45) 0.60       7.6      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      22.01    Tc(MIN.) =    12.05
  EFFECTIVE AREA(ACRES) =       6.88   AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        7.6
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     17.00 =    1052.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     18.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  3545.87  DOWNSTREAM(FEET) =  3542.25
  FLOW LENGTH(FEET) =    32.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  20.24
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      22.01
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =   12.07
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     18.00 =    1084.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     18.00 TO NODE     18.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.07
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.963
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
```

```
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        0.22      0.74     0.600    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    0.22      SUBAREA RUNOFF(CFS) =    0.70
  EFFECTIVE AREA(ACRES) =      7.10   AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        7.8       PEAK FLOW RATE(CFS) =      22.46

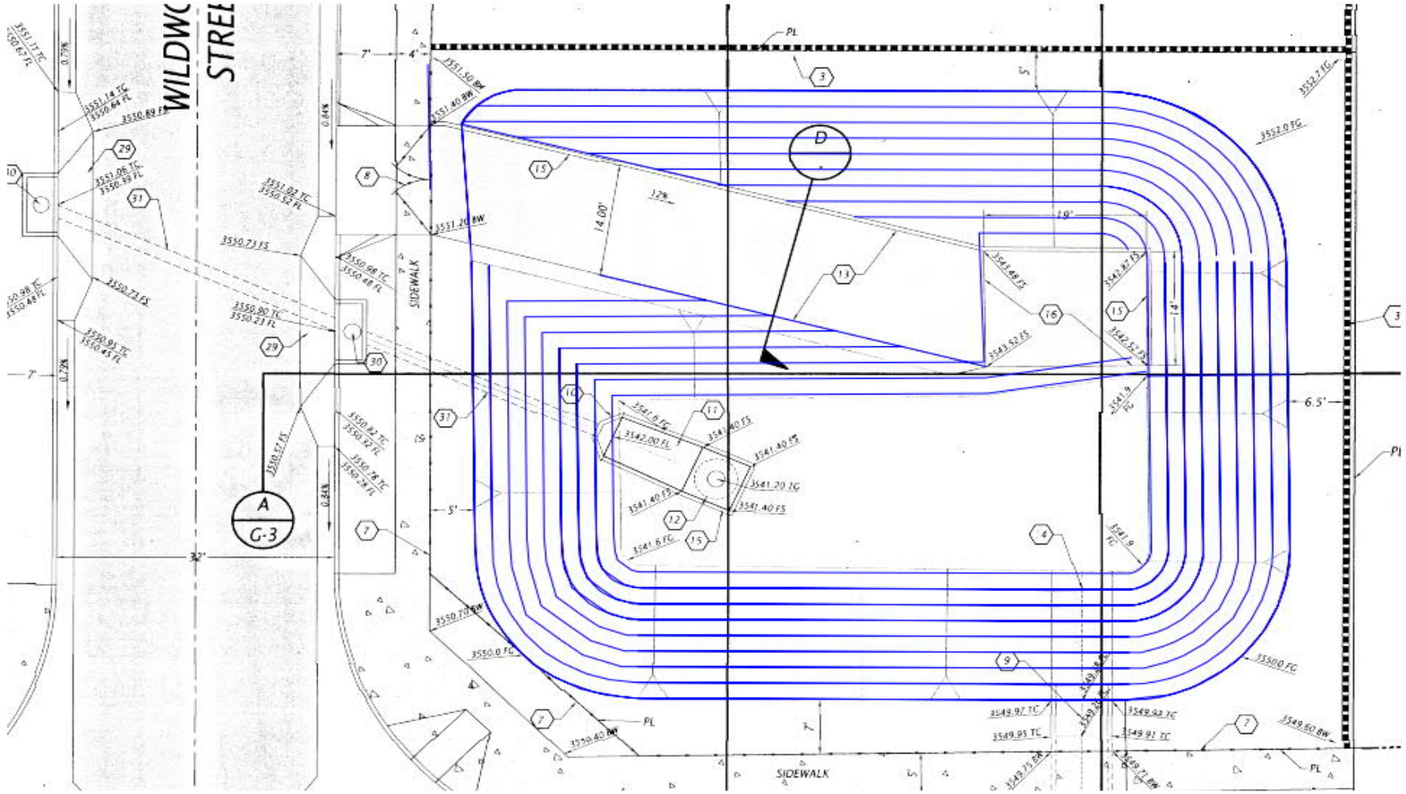
****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   710.00
  ELEVATION DATA: UPSTREAM(FEET) =   3567.00  DOWNSTREAM(FEET) =   3554.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.673
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.831
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        2.02      0.74     0.600    52   12.67
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      6.16
  TOTAL AREA(ACRES) =      2.02   PEAK FLOW RATE(CFS) =      6.16
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.0  TC(MIN.) =     12.67
  EFFECTIVE AREA(ACRES) =      2.02  AREA-AVERAGED Fm(INCH/HR)=  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       6.16
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Basin Sizing Calculations

Basin Storage

Elevation (ft)	Depth (ft)	Area (ft2)	Volume (ft3)	Total Volume (FT3)	Location
3541.2	0.0	0.0	0.0	0.0	Basin Invert
3541.9	0.7	1427.8	499.7	499.7	Base of Slope
3549.3	8.1	5810.7	26710.0	27209.7	Spillway Invert
3550.0	8.8	6994.0	4481.6	31691.4	Top of Basin



Hydraulic Calculations

Catch Basin Sizing Wildwood Street

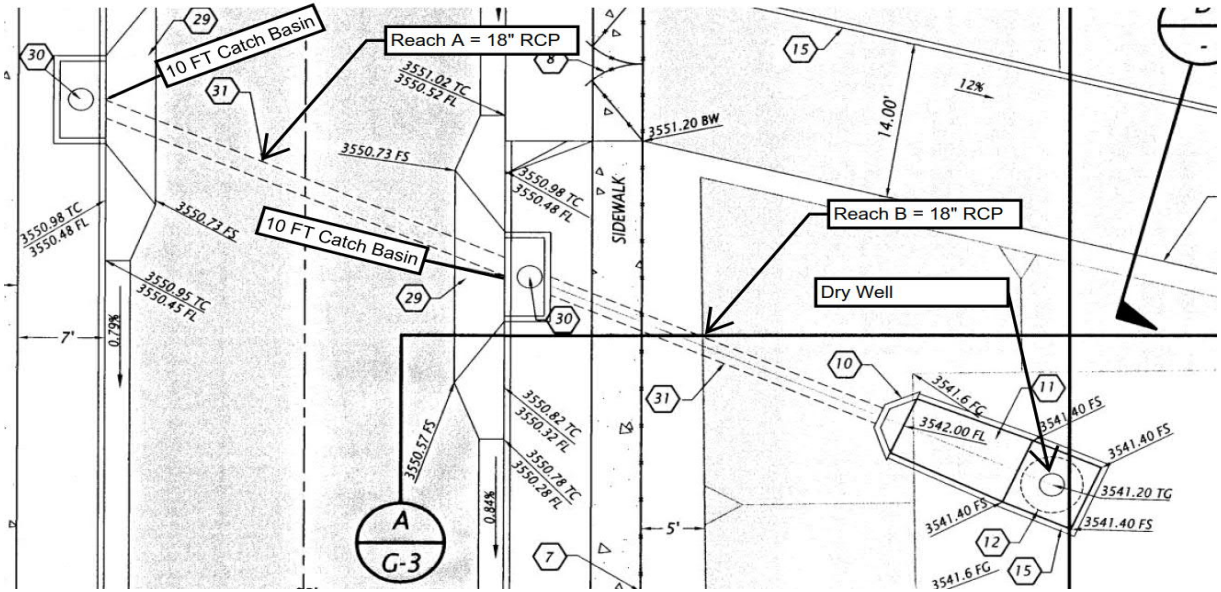
```
**************************************************************************
>>>>SUMP TYPE BASIN INPUT INFORMATION<<<<
--------------------------------------------------------------------------

  Curb Inlet Capacities are approximated based on the Bureau of
  Public Roads nomograph plots for flowby basins and sump basins.

  BASIN INFLOW(CFS) =  11.00   22cfs/2 catch basins=11cfs
  BASIN OPENING(FEET) =  0.67
  DEPTH OF WATER(FEET) =  0.67

  >>>>CALCULATED ESTIMATED SUMP BASIN WIDTH(FEET) =      6.50

==========================================================================
```



Storm Drain Pipe Sizing Calculation Reach A

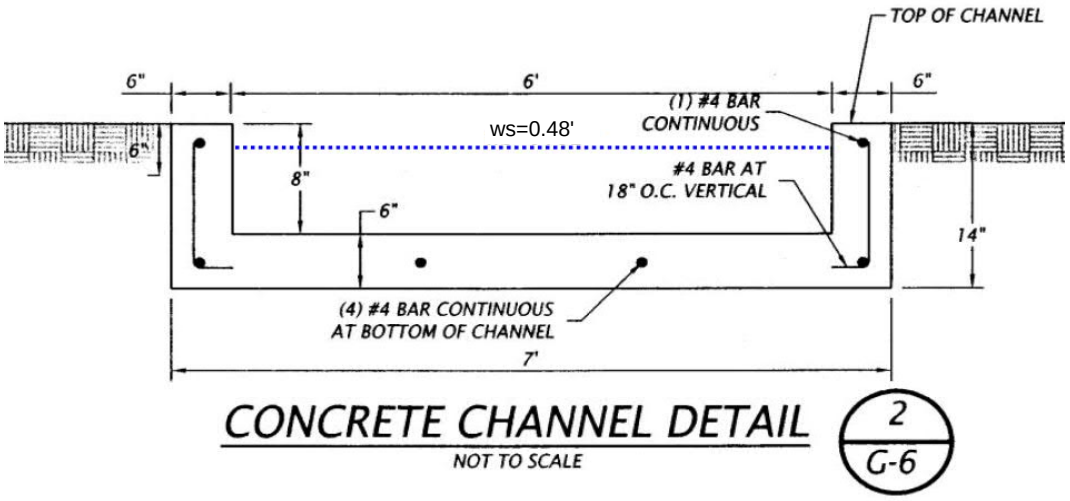
```
**************************************************************************
>>>>PIPEFLOW HYDRAULIC INPUT INFORMATION<<<<
--------------------------------------------------------------------------
  PIPE DIAMETER(FEET) =  1.500
  PIPE SLOPE(FEET/FEET) =  0.0200
  PIPEFLOW(CFS) =      11.00
  MANNINGS FRICTION FACTOR = 0.013000
==========================================================================
  CRITICAL-DEPTH FLOW INFORMATION:
--------------------------------------------------------------------------
  CRITICAL DEPTH(FEET) =    1.27
  CRITICAL FLOW AREA(SQUARE FEET) =    1.596
  CRITICAL FLOW TOP-WIDTH(FEET) =  1.081
  CRITICAL FLOW PRESSURE + MOMENTUM(POUNDS) =       205.41
  CRITICAL FLOW VELOCITY(FEET/SEC.) =    6.894
  CRITICAL FLOW VELOCITY HEAD(FEET) =         0.74
  CRITICAL FLOW HYDRAULIC DEPTH(FEET) =    1.48
  CRITICAL FLOW SPECIFIC ENERGY(FEET) =         2.01
==========================================================================
  NORMAL-DEPTH FLOW INFORMATION:
--------------------------------------------------------------------------
  NORMAL DEPTH(FEET) =    0.96
  FLOW AREA(SQUARE FEET) =    1.20
  FLOW TOP-WIDTH(FEET) =    1.440
  FLOW PRESSURE + MOMENTUM(POUNDS) =       227.40
  FLOW VELOCITY(FEET/SEC.) =         9.202
  FLOW VELOCITY HEAD(FEET) =         1.315
  HYDRAULIC DEPTH(FEET) =    0.83
  FROUDE NUMBER =    1.780
  SPECIFIC ENERGY(FEET) =         2.28
==========================================================================
```

Storm Drain Pipe Sizing Calculation Reach B

```
**************************************************************************
>>>>PIPEFLOW HYDRAULIC INPUT INFORMATION<<<<
--------------------------------------------------------------------------
  PIPE DIAMETER(FEET) =  1.500
  PIPE SLOPE(FEET/FEET) =  0.1100
  PIPEFLOW(CFS) =      22.00
  MANNINGS FRICTION FACTOR = 0.013000
==========================================================================
  CRITICAL-DEPTH FLOW INFORMATION:
--------------------------------------------------------------------------
  CRITICAL DEPTH(FEET) =    1.48
  CRITICAL FLOW AREA(SQUARE FEET) =    1.762
  CRITICAL FLOW TOP-WIDTH(FEET) =  0.364
  CRITICAL FLOW PRESSURE + MOMENTUM(POUNDS) =       612.72
  CRITICAL FLOW VELOCITY(FEET/SEC.) =   12.488
  CRITICAL FLOW VELOCITY HEAD(FEET) =         2.42
  CRITICAL FLOW HYDRAULIC DEPTH(FEET) =    4.84
  CRITICAL FLOW SPECIFIC ENERGY(FEET) =         3.90
==========================================================================
  NORMAL-DEPTH FLOW INFORMATION:
--------------------------------------------------------------------------
  NORMAL DEPTH(FEET) =    0.86
  FLOW AREA(SQUARE FEET) =    1.06
  FLOW TOP-WIDTH(FEET) =    1.482
  FLOW PRESSURE + MOMENTUM(POUNDS) =       913.40
  FLOW VELOCITY(FEET/SEC.) =       20.852
  FLOW VELOCITY HEAD(FEET) =         6.751
  HYDRAULIC DEPTH(FEET) =    0.71
  FROUDE NUMBER =    4.356
  SPECIFIC ENERGY(FEET) =         7.62
==========================================================================
```

Spillway Calculation

```
*******************************************************************************
>>>>CHANNEL INPUT INFORMATION<<<<
-------------------------------------------------------------------------------
   CHANNEL Z1(HORIZONTAL/VERTICAL) =    0.00
        Z2(HORIZONTAL/VERTICAL) =    0.00
   BASEWIDTH(FEET) =     6.00
   CONSTANT CHANNEL SLOPE(FEET/FEET) = 0.020000
   UNIFORM FLOW(CFS) =       22.46
   MANNINGS FRICTION FACTOR = 0.0150
===============================================================================
   NORMAL-DEPTH FLOW INFORMATION:
-------------------------------------------------------------------------------
   >>>>> NORMAL DEPTH(FEET) =   0.48
   FLOW TOP-WIDTH(FEET) =        6.00
   FLOW AREA(SQUARE FEET) =          2.90
   HYDRAULIC DEPTH(FEET) =     0.48
   FLOW AVERAGE VELOCITY(FEET/SEC.) =     7.76
   UNIFORM FROUDE NUMBER =    1.968
   PRESSURE + MOMENTUM(POUNDS) =         381.23
   AVERAGED VELOCITY HEAD(FEET) =      0.934
   SPECIFIC ENERGY(FEET) =      1.417
===============================================================================
   CRITICAL-DEPTH FLOW INFORMATION:
-------------------------------------------------------------------------------
   CRITICAL FLOW TOP-WIDTH(FEET) =        6.00
   CRITICAL FLOW AREA(SQUARE FEET) =         4.54
   CRITICAL FLOW HYDRAULIC DEPTH(FEET) =     0.76
   CRITICAL FLOW AVERAGE VELOCITY(FEET/SEC.) =     4.95
   CRITICAL DEPTH(FEET) =     0.76
   CRITICAL FLOW PRESSURE + MOMENTUM(POUNDS) =         322.50
   AVERAGED CRITICAL FLOW VELOCITY HEAD(FEET) =      0.380
   CRITICAL FLOW SPECIFIC ENERGY(FEET) =      1.137
===============================================================================
```



Hydrology Exhibits

PLOT PLAN AND TOPO

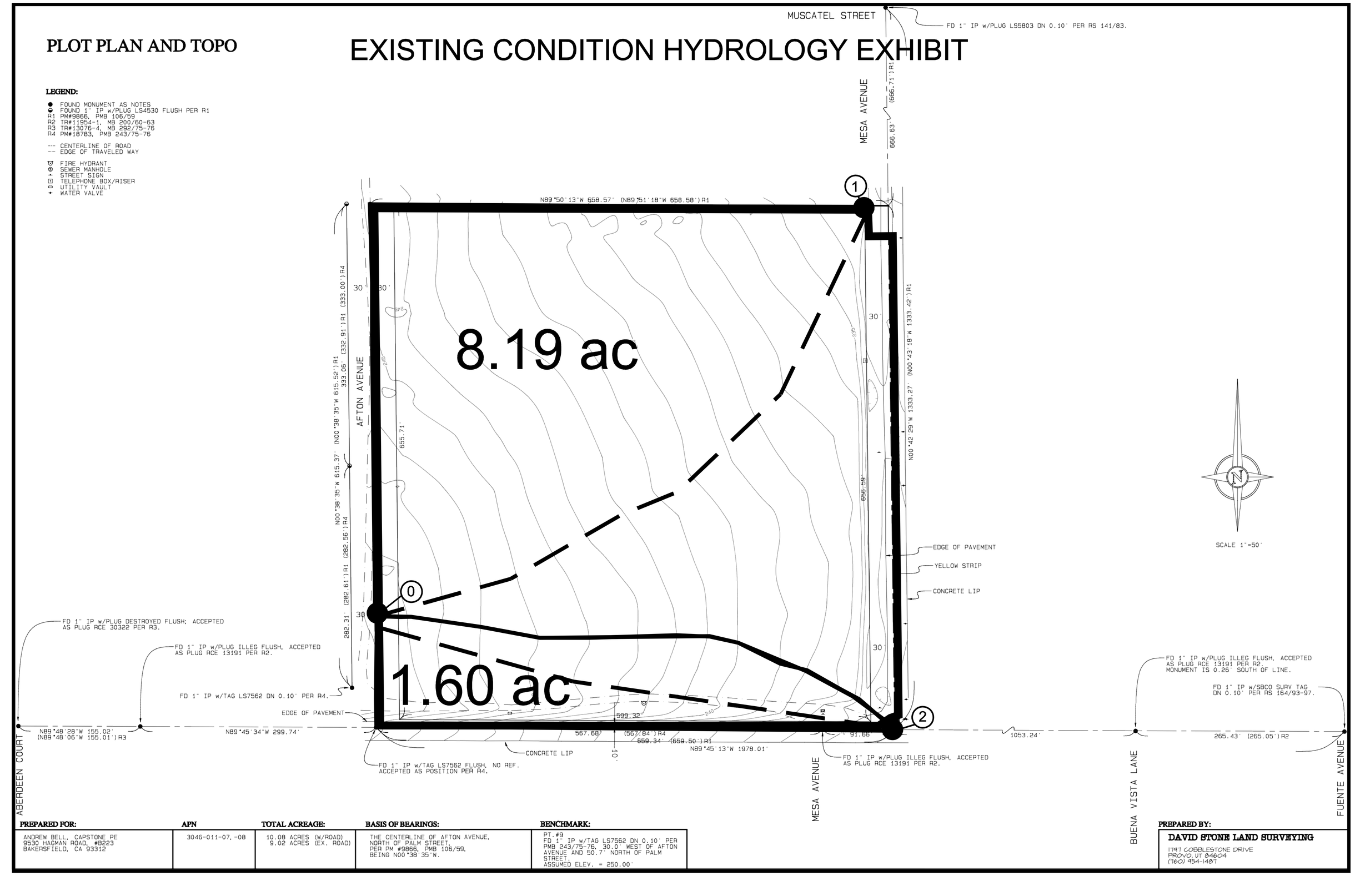
EXISTING CONDITION HYDROLOGY EXHIBIT

LEGEND:

- ● FOUND MONUMENT AS NOTES
- ◒ FOUND 1" IP w/PLUG LS4530 FLUSH PER R1
- R1 PM#9866, PMB 106/59
- R2 TR#11954-1, MB 200/60-63
- R3 TR#13076-4, MB 292/75-76
- R4 PM#18783, PMB 243/75-76

--- CENTERLINE OF ROAD
-- EDGE OF TRAVELED WAY

- FIRE HYDRANT
- SEWER MANHOLE
- STREET SIGN
- TELEPHONE BOX/RISER
- UTILITY VAULT
- WATER VALVE



PREPARED FOR:	APN	TOTAL ACREAGE:	BASIS OF BEARINGS:	BENCHMARK:
ANDREW BELL, CAPSTONE PE 9530 HAGMAN ROAD, #B223 BAKERSFIELD, CA 93312	3046-011-07, -08	10.08 ACRES (W/ROAD) 9.02 ACRES (EX. ROAD)	THE CENTERLINE OF AFTON AVENUE, NORTH OF PALM STREET, PER PM #9866, PMB 106/59, BEING N00°38'35"W.	PT.#9 FD 1" IP w/TAG LS7562 DN 0.10' PER PMB 243/75-76, 30.0' WEST OF AFTON AVENUE AND 50.7' NORTH OF PALM STREET. ASSUMED ELEV. = 250.00'

PREPARED BY:

DAVID STONE LAND SURVEYING

1197 COBBLESTONE DRIVE
PROVO, UT 84604
(760) 954-1487

PROPOSED CONDITION HYDROLOGY EXHIBIT

Scale 1"=40'