Cactus Club Hotel
Joshua Tree, CA. 92252
Hotel Commercial
APN: 0608-051-02, 03, 04
Drainage Study

Submitted to:

San Bernardino County
Department of Public Works
825 East Third Street
San Bernardino, CA 92415

Prepared by:

DRP Enterprises LLC
PO Box 4428
Palm Springs, CA 92263

Prepared: September 25, 2023

City PN: 0608-051-02, 03, 04

_____

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PURPOSE AND SCOPE

The Cactus Club Hotel Commercial project is a 5.3+/- acre lot with the APN: 0608-051-02, 03, 04 owned by Sullivan 80 LLC is located near the Panorama Heights area of Joshua Tree, South of Twentynine Palms Highway in the City of Joshua Tree, County of San Bernardino, California. It is bounded by State Highway 62 (also known as Twentynine Palms Highway) in the north, Miles Square Road on the west, Catus drive on the south and Copper Mountain Road on the easterly side.

The subject site is currently vacant with bare soil gradient from southeasterly to the northwesterly (approximately, 3 to 4 percent slopes). The site drains by sheet flow to the north westerly side. Per FEMA Flood Map the property is in Zone X'. A wash is located on the southerly side of the property flowing from south to the northerly side around the property.

The project proposes to build the Hotel Commercial on approximately 5.3-acre of the lot. The proposed hotel will consist of a lobby, 17 hotel rooms, 3 hotel suites and a hotel restaurant. Associated site improvements include grading and drainage, septic tank and leach field will be built. The site will be designed to retain the existing drainage pattern.

A drainage study is required in exceeding the 10,000 sq ft development for Conditional Use Permit. This report will summarize the hydrologic analyses that were conducted in order to determine the necessary drainage improvements required to provide flood protection for the proposed development and safely convey the runoff through the site during 100-Yr storm event and will also determine if the 100-year storm flows from the onsite projected development will create any significant amount of run-off.

HYDROLOGY METHODOLOGY

Based on the San Bernardino County's hydrology manual, the Unit Hydrograph Method is used in excess of approximately 1 square mile (640 acres) whereas Rational Method analysis is used in the analysis that are less than 1 square mile. The watershed affected by the development was about 5.3-acre and analyzed by the Rational Method described in the San Bernardino County Hydrology Manual to study 100-year storm event. The rational method formula is expressed as:

Q = CIA; Where, Q = Peak discharge, in cubic feet per second (cfs)
C = Runoff Coefficient, portion of rainfall that runs off the surface (no units)
I = Average Rainfall Intensity (in inches/hour) for a duration equal to the Tc for the area
(Note: If the computed Tc is less than 5 minutes, use 5 minutes for the peak discharge, Q)
A = Area of Lot in acre

On the other hand, a wash (coming from the southerly side of the site) was analyzed by the Unit Hydrograph Method.

Intensity–duration data was obtained from San Bernardino County Hydrology Manual Rainfall Intensity data.

The soil type was obtained from the San Bernardino County Hydrology Manual. The predominant soil type obtained from the Manual was determined to be moderate infiltration and moderate-class runoff (type B).

Both existing and ultimate conditions were analyzed. For the existing condition, undeveloped land use was assumed to model current storm discharges and for the proposed condition, building type development condition used.

ONSITE HYDROLOGY

The site is currently undeveloped, has a gradual slope of approximately 3% and it drains by sheet flow from southeasterly to the northwesterly side. For the 100-yr peak flow hydrologic analysis, the existing site is assumed as a single drainage area **DMA-X** (5.3-acre) (**Exhibit-A**). 100-Yr existing condition peak flow rate shall be determined assuming '100-Yr existing conditions is based on 25-Yr storm using AMC II' (Per "San Bernardino County Detention Basin Design Criteria").

The proposed development consists of a hotel with a lobby, hotel rooms, a hotel restaurant. and associated site improvements include grading and drainage, sewer, water, landscaping, driveway, pavement, trash enclosure. For the proposed condition the subject site is also assumed as a single drainage area **DMA-A** (5.3-acre) drains to the northeasterly at the same corner with a slope of about 2% (**Exhibit-B**). The Lot will be graded to surface flow through the site utilizing curb and gutters, and slopes to convey flow into a proposed basin on the northwesterly corner of the property. The site is also proposing sustainable TrueGrid Plus paving technology on internal circulation roads and parking. The grid structure of the pavers allows water to permeate through the surface and infiltrate the ground below reducing the risk of flooding and erosion and allowing water to replenish aquifers and support vegetation growth.

INPUT PARAMETERS

The following values were used in calculating the 100-year storm flow for existing and proposed conditions. The SBC Hydrology Manual was used to determine these hydrological parameters. The area distribution for the project site and time of concentrations for corresponding watersheds are as following:

Drainage Area	Area (AC)	Flow Path (ft)	Elevation Diff (ft)	Time of Conct. (min)
DMA-X (Existing Cond)	**5.3**	**600**	18	13
DMA-A (Proposed Cond)	**5.3**	**1,000**	18	12

Time of Concentration, minutes: Time of concentration (Tc) calculations were performed using Nomograph for Determination of Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds (**Exhibit G**).

Soil Group: San Bernardino County Hydrology Manual was used to determine soil types. Based on San Bernardino County Hydrology Manual **(Exhibit-F)**, the project site is classified as 'soil type B'.

Cover Type	Soil 'B' RI Value	Infiltration Rate, F_P
Existing Cond	91	0.18
Proposed Cond	69	0.56

The cover type was determined based on **Exhibit-H** for the existing land cover and proposed land use of the site. Hydrological computations for the existing site condition were assumed as 'Barren Natural Cover', for the proposed the site condition were assumed as 'Rural Residential'.

Rainfall Intensity, in/hr: The following rainfall depths were utilized in the hydrology analyses. The rainfall values were obtained from the SBC Hydrology Manual based on Figure B-9, D-2 **(Exhibit-K).**

Storm Event	Rainfall Depth (in)
100-Year 1 hour	**1.3**
25-Year 1 hour	**0.95**

The value for Log-Log slope for sub-hourly rainfall intensity is 0.7 for desert areas. The rainfall intensities were obtained from the SBC Hydrology Manual based on Figure D-3 **(Exhibit-L)**. The isohyetal maps from the San Bernardino County Hydrology manual have also been included.

Drainage Area	Time of Conct. (min)	Slope of Intensity (Valley Area)	Rainfall Intensity (in/hr)
DMA-X (Existing Cond)	13	0.7	2.8
DMA-A (Proposed Cond)	12	0.7	4

Actual Impervious Cover, %: The actual impervious cover were obtained from the SBC Hydrology Manual based on Figure C-4 **(Exhibit-H)**:

Type of Project	Impervious Cover (in)
Commercial	**70%**

Peak Flow, cfs: The value for the peak flow was determined once Rainfall Data and Runoff Coefficient values were calculated using the parameters.

Drainage Area	Area (AC)	Runoff Index Values	F_P	a_i (% Imperv)	a_p (% Perv)	Rainfall Intensity, I (in/hr)	Peak Flow, Q (cfs)
DMA-X (Existing Cond)	5.3	91	0.18	0	1	2.8	12.497
DMA-A (Proposed Cond)	5.3	69	0.56	0.3	0.7	4	18.278

The Calculations can be seen in detail in the following Section.

CALCULATIONS

Q=CIA; Where, C = Runoff Coefficient

$$C = \begin{cases} 0.90\,(a_i + \dfrac{(I - F_p)a_p}{I}), & \text{for I greater than } F_p; \\ 0.90\,a_i, & \text{for I less than or equal to } F_p \end{cases}$$

Onsite Peak Flow (Existing Condition) (DMA-X)

For Existing Condition, Runoff Index = 91, AMC-II, F_P = 0.18 in/hr **(Exhibit-I)**

Time of concentration can be determined from Exhibit-G using the following parameters:

ΔE = Elevation difference between the longest flow path upper and lower most points = 18 feet
L = Flow path Length = 600 feet

Time of concentration 't_c' is found 13 minutes.

Rainfall intensity can be determined from Exhibit-L using the following parameters:
t_c = Time of concentration = 13 minutes
Slope, S=0.7 (for valley areas per SB County Hydrology Manual 'Section B.8')

100-Yr 1-hour Precipitation depth = 1.3 inch (**Exhibit-J)**
10-Yr 1-hour Precipitation depth = 0.75 inch (**Exhibit-J)**
So, 25-Yr 1-hour Precipitation depth = 0.95 inch (**Exhibit-K)**

So, 25-Yr Rainfall intensity for 13 min storm, I = 2.8 in/hr (**Exhibit-L)**

As we discussed, 100-Yr 'existing' conditions is based on 25-Yr storm using AMC II

So, DMA-X 100-Year peak flow, $Q = C \times I \times A = 0.90(a_i + ((I-F_p)a_p)/I) \times I \times A$

$$Q = 0.90 \times (0 + ((2.8-0.18) \times 1)/ 2.8) \times 2.8 \times 5.3 = 12.497 \text{ cfs}$$

Onsite Peak Flow (Proposed Condition) (DMA-A)

For Runoff Index = 69, AMC-II, F_P = 0.56 in/hr **(Exhibit-I)**

Time of concentration can be determined from Exhibit-G using the following parameters:

ΔE = Elevation difference between the longest flow path upper and lower most points = 10 feet
L = Flow path Length = 1000 feet

Time of concentration 't_c' is found 12 minutes.

Rainfall intensity can be determined from Exhibit-L using the following parameters:
t_c = Time of concentration = 12 minutes
Slope, S=0.7 (for valley areas per SB County Hydrology Manual 'Section B.8')
100-Yr 1-hour Precipitation depth = 1.3 inch (**Exhibit-J)**

So, 100-Yr Rainfall intensity for 12 min storm, I = 3.6 in/hr (**Exhibit-L)**

So, DMA-A 100-Year peak flow, $Q = C \times I \times A = 0.90(a_i + ((I-F_p)a_p)/I) \times I \times A$

$$Q = 0.90 \times (0.3 + ((4-0.56) \times 0.7)/ 4) \times 4 \times 5.3 = 18.278 \text{ cfs}$$

Volume Mitigation Required (For 100-Year Storm Event)

PER "San Bernardino County Detention Basin Design Criteria", the basin capacity and outlet sizes shall be such that **the post-development peak flow rate generated by the site shall be less than or equal to 90% of the pre-development peak flow rate from the site.**

The post-development peak flow rate generated by the site = 18.28 cfs
90% of the pre-development peak flow rate from the site = 0.9 x 12.497 cfs = 11.25 cfs

Differential of post- and 90% of the pre-development, ΔQ = 18.278 cfs - 11.247 cfs = 7.03 cfs

Time of concentration, T_C = 12 min

Total Volume Mitigation Required after development, $V=1.5(\Delta Q)(Tc)(60)$ = 1.5 x 7.03 x 12 x 60 = 7,593 ft^3

Volume Provided:

The lack of downstream facilities will require mitigation of increased flow. In order to mitigate the increase in runoff and not adversely affect the downstream facilities, the project proposes a basin on the northwesterly corner of the property. On-site flows generated by the proposed project will surface flow through the site utilizing curb and gutters, and slopes to convey flow into the proposed basin. Emergency escapes will be provided in the basin in case of a failure or improper maintenance of the basin. Emergency escapes will allow flow to escape into Twentynine Palms Hwy Road gutter.

Storage Provided by the Infiltration Basin = 1,088 ft^3 (**Exhibit-B)**

The site is also proposing sustainable TrueGrid Plus paving technology which allows water to permeate through the surface and infiltrate the ground below.

Truegrid HS/20 rated sustainable paving system = 62,800 ft^2
Porous pavement thickness = 8/12 ft = 0.67 ft
Porous pavement porosity = 0.4
Available volume in Truegrid sustainable paving system = 62,800 ft^2 x 0.67 ft x 0.4 = 16,831 ft^3 (**Exhibit-B)**

Total Site Storage Provided = 16,831 ft^3 + 1,088 ft^3 = 17,919 ft^3 > 7,593 ft^3

DISCUSSION OF ONSITE HYDROLOGY

100-yr peak flow hydrologic analysis is completed for the project site. For 100-yr storm event, existing watershed DMA-X (5.3 ac) produces 12.497 cfs runoff and the proposed watershed DMA-A (5.3 ac) produces 18.28 cfs runoff. To mitigate the additional 7.03 cfs runoff beyond 90% pre-development, a retention basin and Truegrid sustainable paving system are proposed.

DISCUSSION OF 100-YR FLOODPLAIN

The onsite topographic survey is based on NAVD 1988 datum while this wash analysis is based on terrain data NGVD 1929 obtained from USGS Earth Explorer. Conversion between NAVD 88 and the commonly used NGVD 29 varies spatially; however, over most of the study area the following conversion can be used:

NGVD 29 = NAVD 88 –3.6 feet

Though the project site is located in FEMA 'Zone X', but the site is in DWR Awareness area for 100-Yr storm event with no definitive flood depth. At upstream of the project site there is a wash (**was named as WASH-N**) that make their way from southerly to northerly and passing around the project site (**Exhibit 'C'**). This wash could flood the site because of higher peak flow rates streaming from northerly side during 100-Yr storm event.

The wash watershed is about 720 acres (greater than 1 sq mile), so Unit Hydrograph Method used to calculate peak flows from this **WASH-N** (**Exhibit 'M'**).

To measure any possible flood depth at the subject site, a simulated HEC-RAS model generated for the subject site and for the washes using digital elevation data from USGS Earth Explorer.

Then a steady flow simulation was run using hydrograph data (**2,069 cfs for WASH-N**) as upstream inputs obtained from Unit Hydrograph Method and the percentage of grade along the wash (12%) as downstream data **[Exhibit C].**

The HEC-RAS result **[Exhibit D]** shows sites nearest maximum water surface elevation **[X-Section 135, WASH-N]** is 2373.81 ft (NGVD 1929 DATUM).

NAVD 88 = 2373.81 ft+3.6 ft = 2377.41 ft

Maximum water surface elevation of 2377.41 ft is located far downward from the project site's lowest adjacent grade.

EXHIBIT "A"

EXISTING CONDITION

APN: 0608-051-02, 0608-051-03, 0608-051-04
JOSHUA TREE, CA 92252
SAN BERNARDINO COUNTY

VICINITY MAP

LEGEND:

- CENTERLINE
- PROPERTY LINE
- DRAINAGE AREA BOUNDARY
- DRAINAGE AREA BOUNDARY

OWNER/APPLICANT
SULLIVAN 80 LLC
6 VIA PERGOLA,
RANCHO PALO VERDES, CA 90275

CIVIL ENGINEER

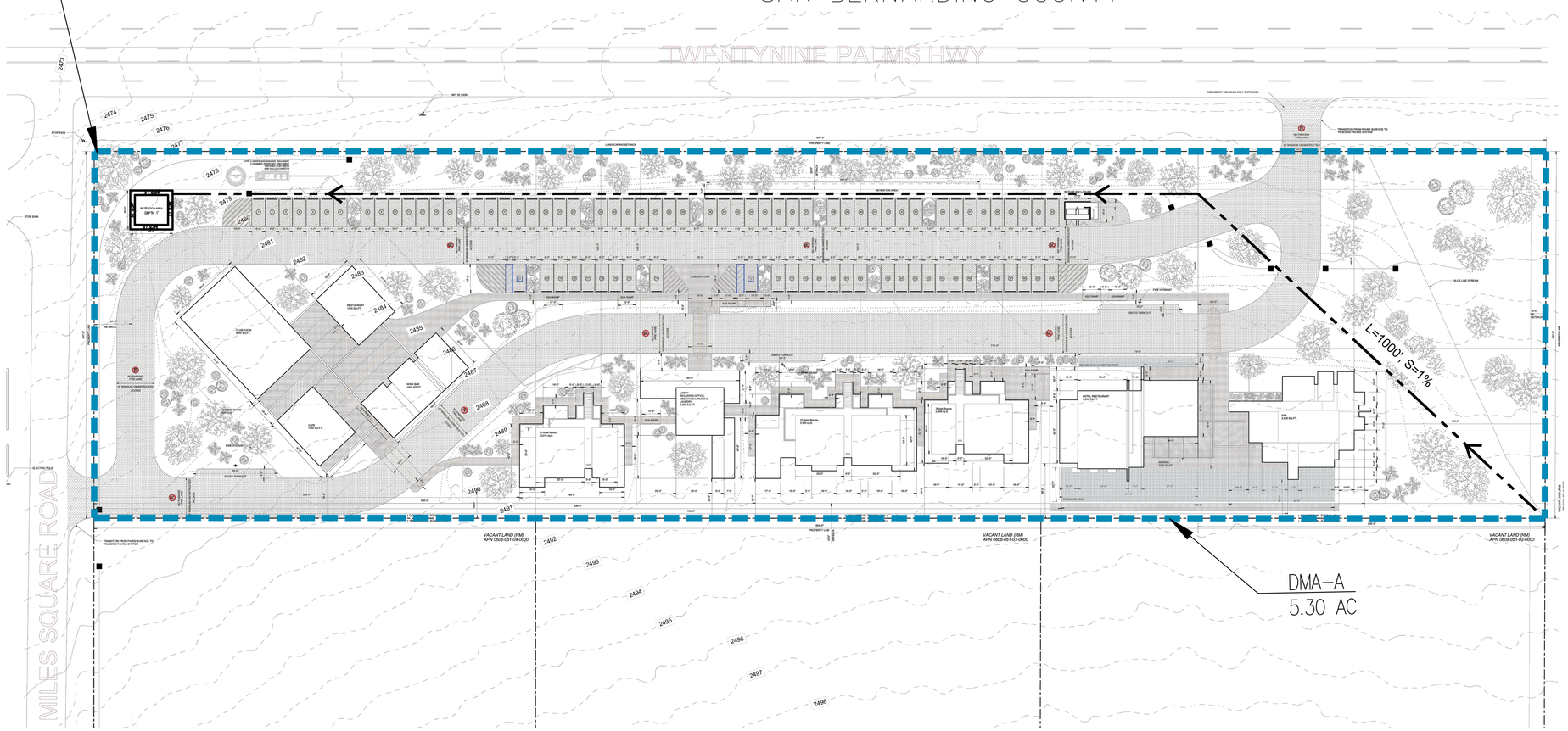
DRP ENTERPRISES LLC
DANIEL PATNEAUDE
MAILING ADDRESS:
PO BOX 4428
PALM SPRINGS, CA 92263
JOANNE C. SINGER, RCE 26900
(760) 625-7426

EXHIBIT 'B'

PROPOSED CONDITION

APN: 0608-051-02, 0608-051-03, 0608-051-04
JOSHUA TREE, CA 92252
SAN BERNARDINO COUNTY

100-YR ONSITE
PEAK FLOW
18.278 CFS



VICINITY MAP

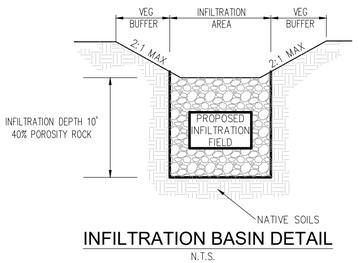
LEGEND:

- CENTERLINE
- PROPERTY LINE
- DRAINAGE AREA BOUNDARY
- DRAINAGE AREA BOUNDARY
- ROADWAY
- WALKWAY
- 2500 TOPOGRAPHY MAJOR LINES
- 2499 TOPOGRAPHY MINOR LINES

OWNER/APPLICANT
SULLIVAN 80 LLC
6 VIA PERGOLA,
RANCHO PALO VERDES, CA 90275

DESIGN AND DRAWINGS
MATTHEW ARCHER STEPHENSON
archer@lamalkal.com
442-205-7932

PERVIOUS - IMPERVIOUS AREA CALCULATIONS		
EXISTING LOT	BEFORE	AFTER
PARCEL AREA	230,203 SF	230,203 SF
BUILDINGS	0 SF	26,500 SF
LOT COVERAGE (BLDG)	0%	11.51%
D/W, WALKS, PAVED	0 SF	135,000 SF
TOTAL IMPERVIOUS %	0%	70%
TOTAL PERVIOUS %	100%	30%



INFILTRATION BASIN DETAIL
N.T.S.

Post-Construction Volume Calculations

Drainage Management Areas (DMA's)	Total Area "A" (Acres)	Impervious Area (Post-Construction) (Acres)	Landscape Area (Acres)	Percent Impervious	Volume Mitigation Required (CF)
DMA-A	5.28	3.71	1.58	70.2	7593

Infiltration Basin Excavated Volume

Proposed Bioretention Facility Name	Bioretention Basin Top Area (SF)	Bioretention Basin Bottom Area (SF)	Ponding Depth d (ft)	Excavated Volume (CF)
BMP-A	728	430	1.00	572

Infiltration Basin Media Volume

Proposed Bioretention Facility Name	Proposed Bioretention Basin Area (SF)	Depth of Media (ft)	Absolute Volume within Media (CF)	Porosity of Media	Actual Volume within Media (CF)
BMP-A	430	3.00	1290	0.40	516

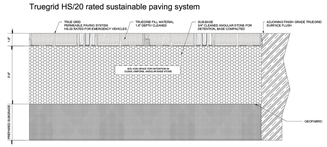
Water Quality Calculations:
Excavated Volume (CF) = (d/3)*(bottom+top+(bottom*top)^0.50) = 572 cubic feet

Media Volume (CF) = Depth x Surface area = 3 x 430 = 1290 cubic feet
Actual Media Vol (CF) = Porosity x Media Vol = 0.4 x 1290 = 516 cubic feet

Bioretention Basin Volume Provided = Excaveted/Volume above Basin (CF) + Volume within Infiltration Layer (CF)
= 1290 + 516 = 1088 cubic feet

Total Volume Provided by the Infiltration basin = 1,088 cubic feet

Truegrid HS/20 rated sustainable paving system



Truegrid HS/20 rated sustainable paving system = 62,800 ft²
Porous pavement thickness = 8/12 ft = 0.67 ft
Porous pavement porosity = 0.4
Available volume in Truegrid sustainable paving system = 62,800 ft² x 0.67 ft x 0.4 = 16831 ft³

TOTAL SITE STORAGE PROVIDED = 16,831 CF + 1,088 CF = 17,919 CF

CIVIL ENGINEER

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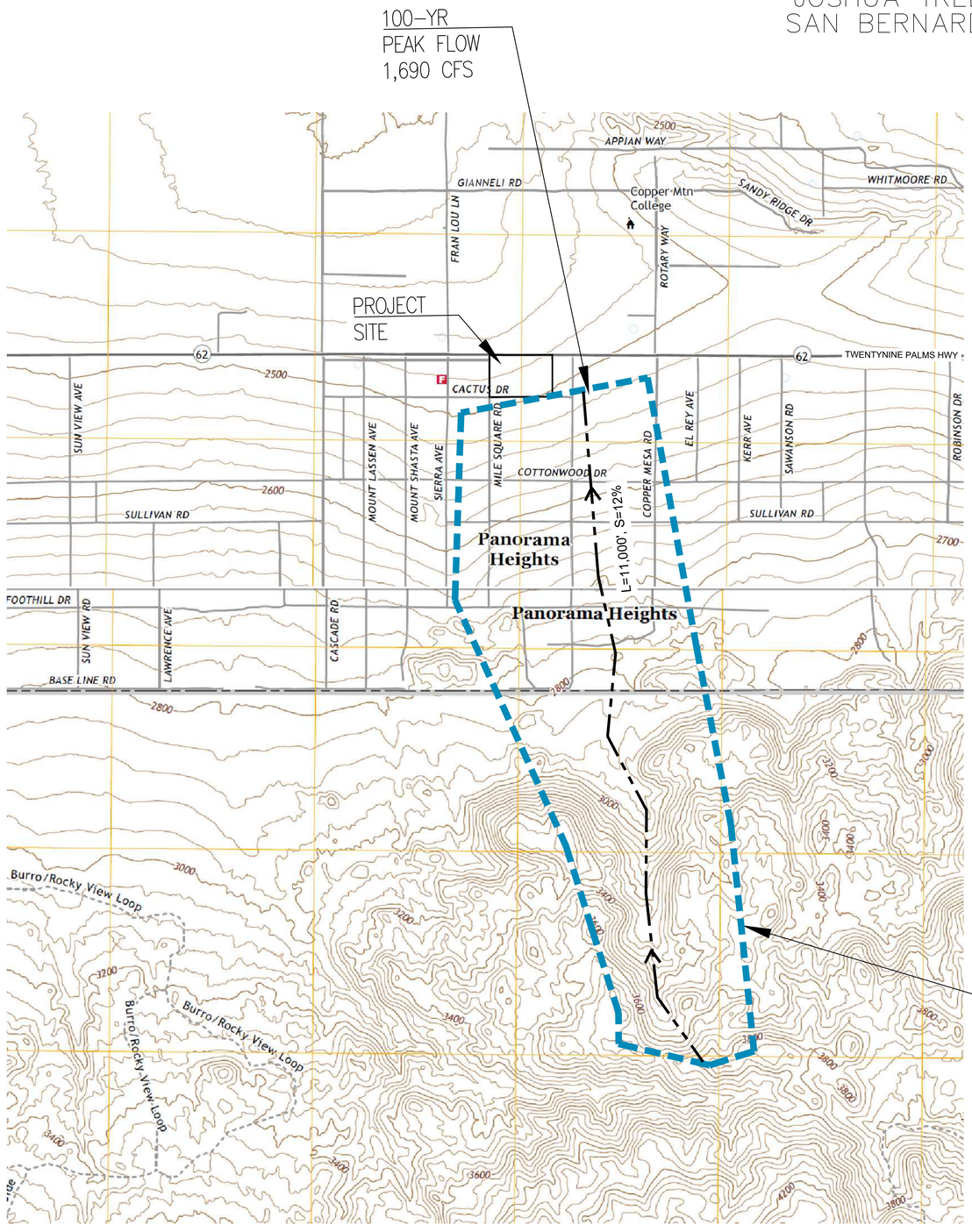
EXHIBIT 'C'

WASH ANALYSIS

APN: 0608-051-02, 0608-051-03, 0608-051-04
JOSHUA TREE, CA 92252
SAN BERNARDINO COUNTY



LEGEND:

- CENTERLINE
- PROPERTY LINE
- DRAINAGE AREA BOUNDARY
- DRAINAGE AREA BOUNDARY

VICINITY MAP

OWNER/APPLICANT
CHRISTIAN KELIIPIO
PALARI HOMES KELIIPIO
65761 TWENTYNINE PALMS
HIGHWAY SOUTH

CIVIL/GEOTECHNICAL ENGINEER
NTS ENGINEERING
NADIM SUNNA P.E. 84197
15333 CULVER DRIVE
SUITE 340
IRVINE, CA 92604
INFO@NTSGEO.COM
(714) 408-0947

0 500' 1000' 2000'
SCALE 1"=1000'

CIVIL ENGINEER

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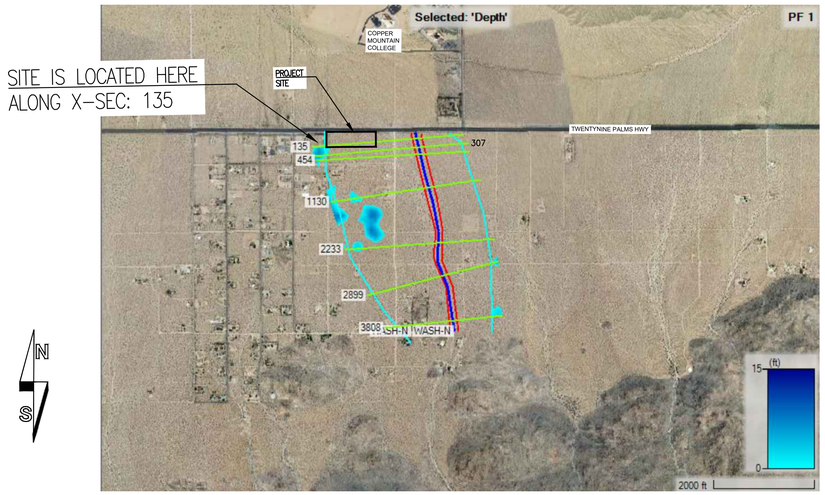
.\NTS ENGINEERING.jpg

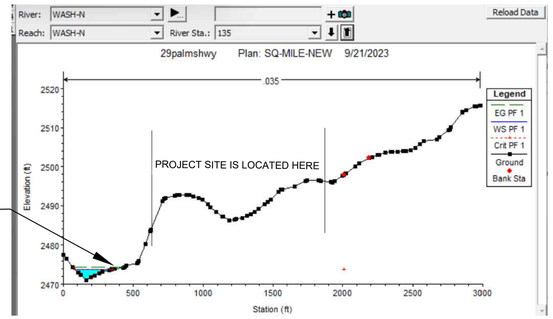
EXHIBIT 'D'

HEC-RAS RESULTS
APN: 0608-051-02, 03, 04
JOSHUA TREE, CA 92252
SAN BERNARDINO COUNTY



VICINITY MAP

X-SEC/STATION: 135



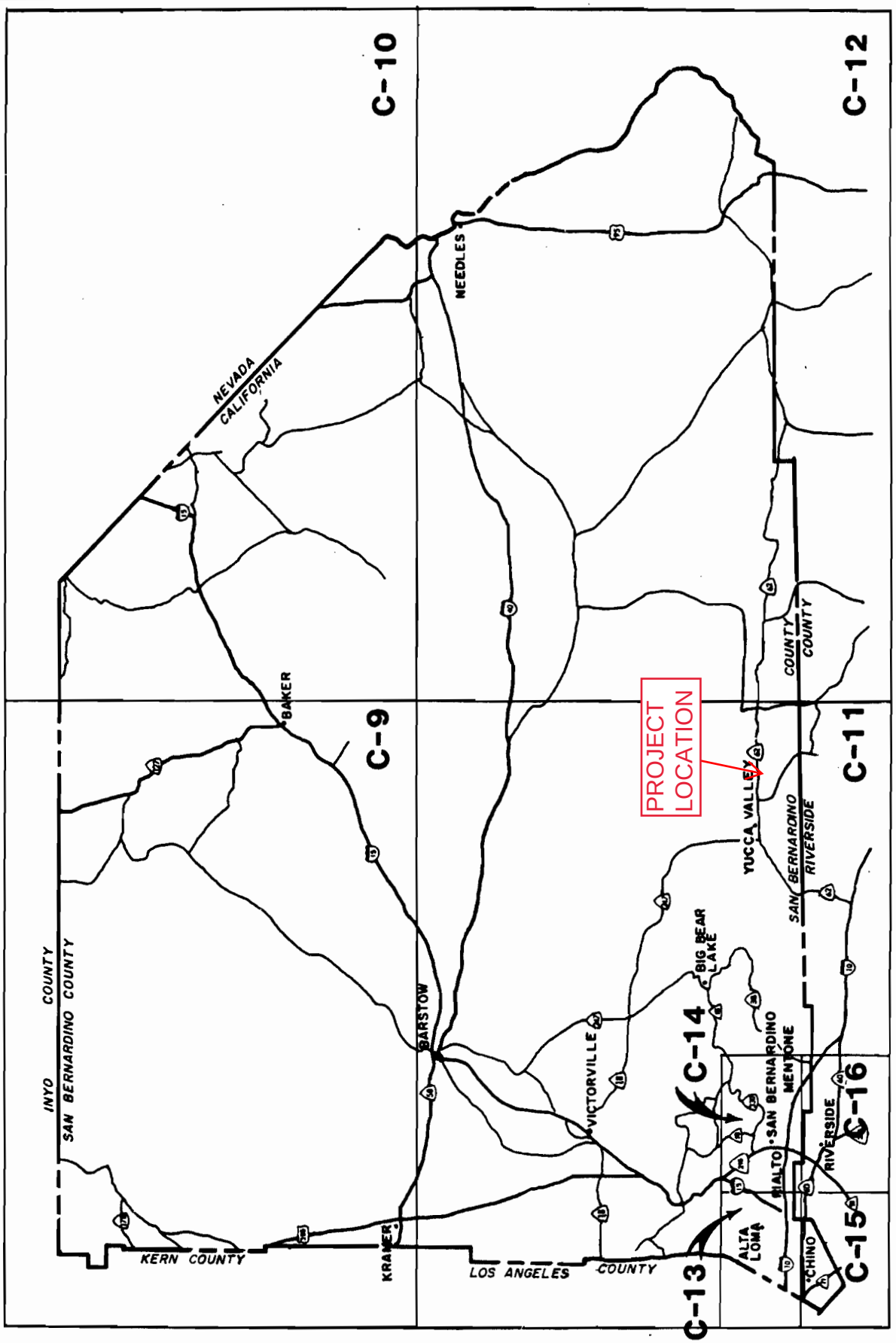
MAX WSE=2373.81'(NGVD29)
=2373.81'+3.6'(NAVD88)
=2377.41'(NAVD88)
BY WASH-N FROM
100-YR STORM EVENT

HEC-RAS RESULTS

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
WASH-N	3808	PF 1	2069.00	2709.56	2700.49	2700.49	2701.18	0.016610		310.75	230.97	0.00
WASH-N	2899	PF 1	2069.00	2649.93	2636.15	2636.15	2637.33	0.014407		237.76	101.73	0.00
WASH-N	2233	PF 1	2069.00	2606.92	2585.48	2585.48	2586.11	0.015628		324.65	260.32	0.00
WASH-N	1130	PF 1	2069.00	2543.52	2530.94	2530.94	2531.48	0.015823		348.36	324.82	0.00
WASH-N	454	PF 1	2069.00	2510.54	2479.67	2479.67	2480.76	0.014311		246.56	112.81	0.00
WASH-N	307	PF 1	2069.00	2505.94	2474.98		2475.12	0.001462		670.17	255.11	0.00
WASH-N	135	PF 1	2069.00	2497.91	2473.81	2473.81	2474.43	0.016854		327.13	266.04	0.00

100-YR STORM MAX
SURFACE ELEVATION
=2373.81' (NGVD 29)

EXHIBIT 'E'



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

SAN BERNARDINO COUNTY
SOIL MAP INDEX

Figure C-I

EXHIBIT 'F'

R4W | R5W | R7W

T4N T3N T2N T1N T1S

SOURCE: 1970 SCS SURVEY

SOURCE: GEOLOGY MAP

SOIL GROUP 'C'

LEGEND

SOIL GROUP BOUNDARY

A SOIL GROUP DESIGNATION

BOUNDARY OF INDICATED SOURCE

INDEX MAP

Scale 1:250,000

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
TRANSVERSE MERCATOR PROJECTION
BLACK NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 11
1985 MAGNETIC DECLINATION FROM TRUE NORTH VARIES FROM 15½° (280 MILS) EASTERLY FOR THE CENTER OF THE WEST EDGE TO 16° (270 MILS) EASTERLY FOR THE CENTER OF THE EAST EDGE

BASE MAP REPRODUCED FROM U.S.G.S. "SAN BERNARDINO" TOPOGRAPHIC MAP

SCALE REDUCED BY 1/2

LOCATION DIAGRAM

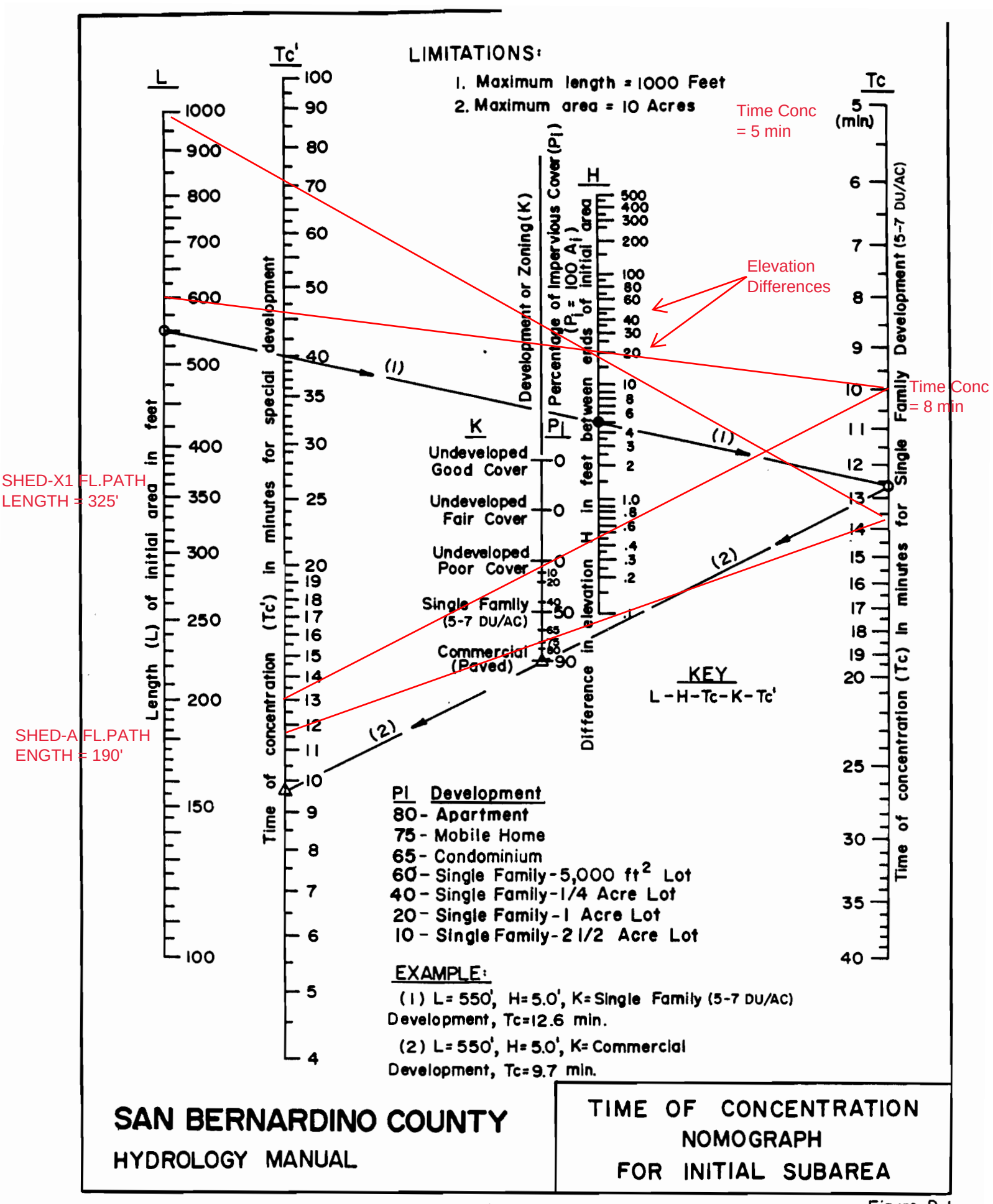
SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP FOR SOUTHCENTRAL AREA

FIGURE C-11

EXHIBIT-G



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

EXHIBIT 'H'

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (1 of 2)

EXHIBIT 'H'

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
AGRICULTURAL COVERS (Continued)					
Legumes, Close Seeded (Alfalfa, sweetclover, timothy, etc.)	Poor	66	77	85	89
	Good	58	72	81	85
Orchards, Evergreen (Citrus, avocados, etc.)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dryland (Annual grasses)	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Pasture, Irrigated (Legumes and perennial grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops (Field crops - tomatoes, sugar beets, etc.)	Poor	72	81	88	91
	Good	67	78	85	89
Small grain (Wheat, oats, barley, etc.)	Poor	65	76	84	88
	Good	63	75	83	87

Notes:

1. All curve numbers are for Antecedent Moisture Condition (AMC) II.
2. Quality of cover definitions:

   Poor-Heavily grazed, regularly burned areas, or areas of high burn potential. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.

   Fair-Moderate cover with 50 percent to 75 percent of the ground surface protected.

   Good-Heavy or dense cover with more than 75 percent of the ground surface protected.
3. See Figure C-2 for definition of cover types.

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (2 of 2)

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EXHIBIT 'F'

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent (2)
Natural or Agriculture	0 - 0	0
Public Park	10 - 25	15
School	30 - 50	40
Single Family Residential: (3)		
2.5 acre lots	5 - 15	10
1 acre lots	10 - 25	20
2 dwellings/acre	20 - 40	30
3-4 dwellings/acre	30 - 50	40
5-7 dwellings/acre	35 - 55	50
8-10 dwellings/acre	50 - 70	60
More than 10 dwellings/acre	65 - 90	80
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 - 100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area shall always be made, and a review of aerial photos, where available, may assist in estimating the percentage of impervious cover in developed areas.

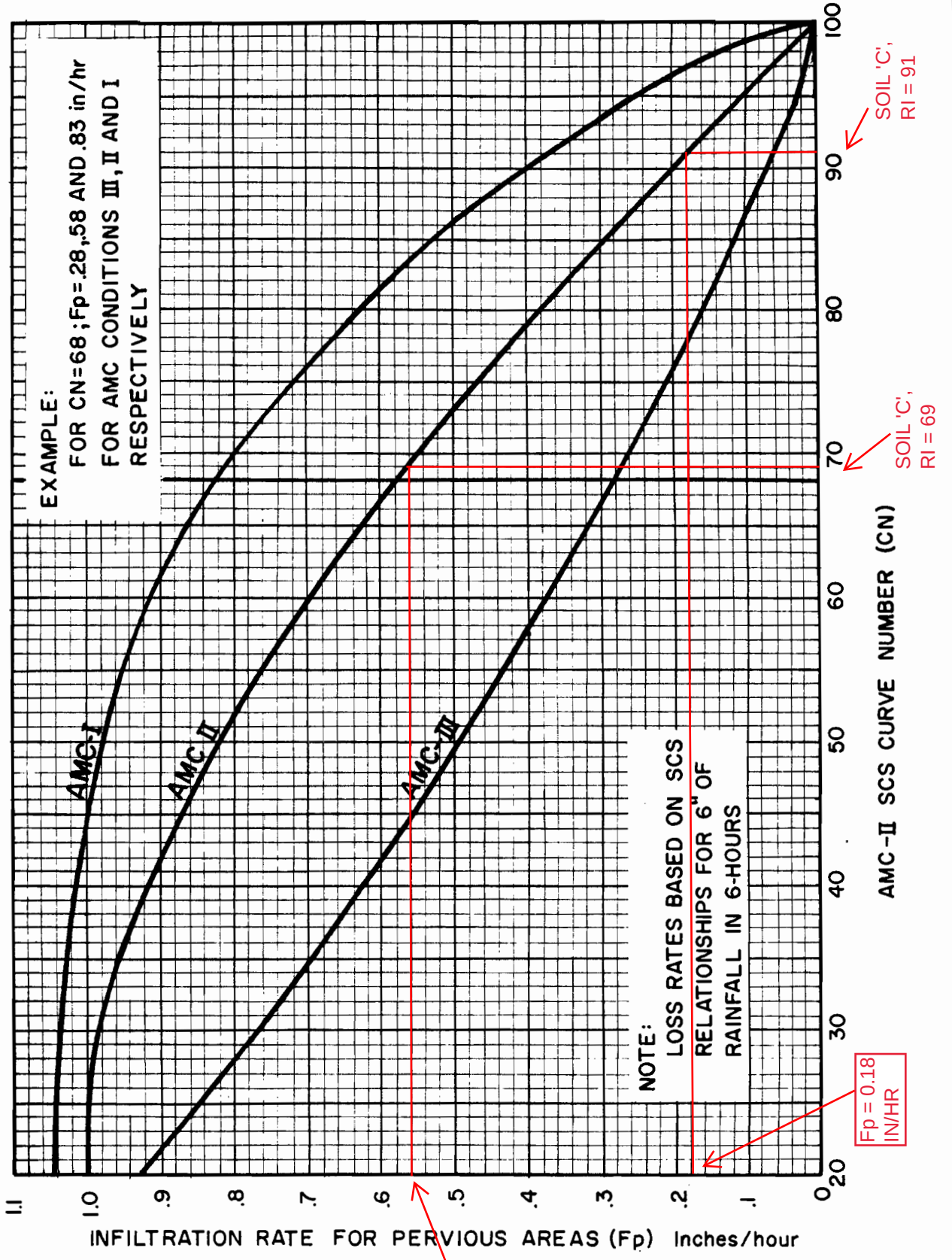
3. For typical equestrian subdivisions increase impervious area 5 percent over the values recommended in the table above.

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

ACTUAL IMPERVIOUS COVER FOR DEVELOPED AREAS

Figure C-4

EXHIBIT 'I'

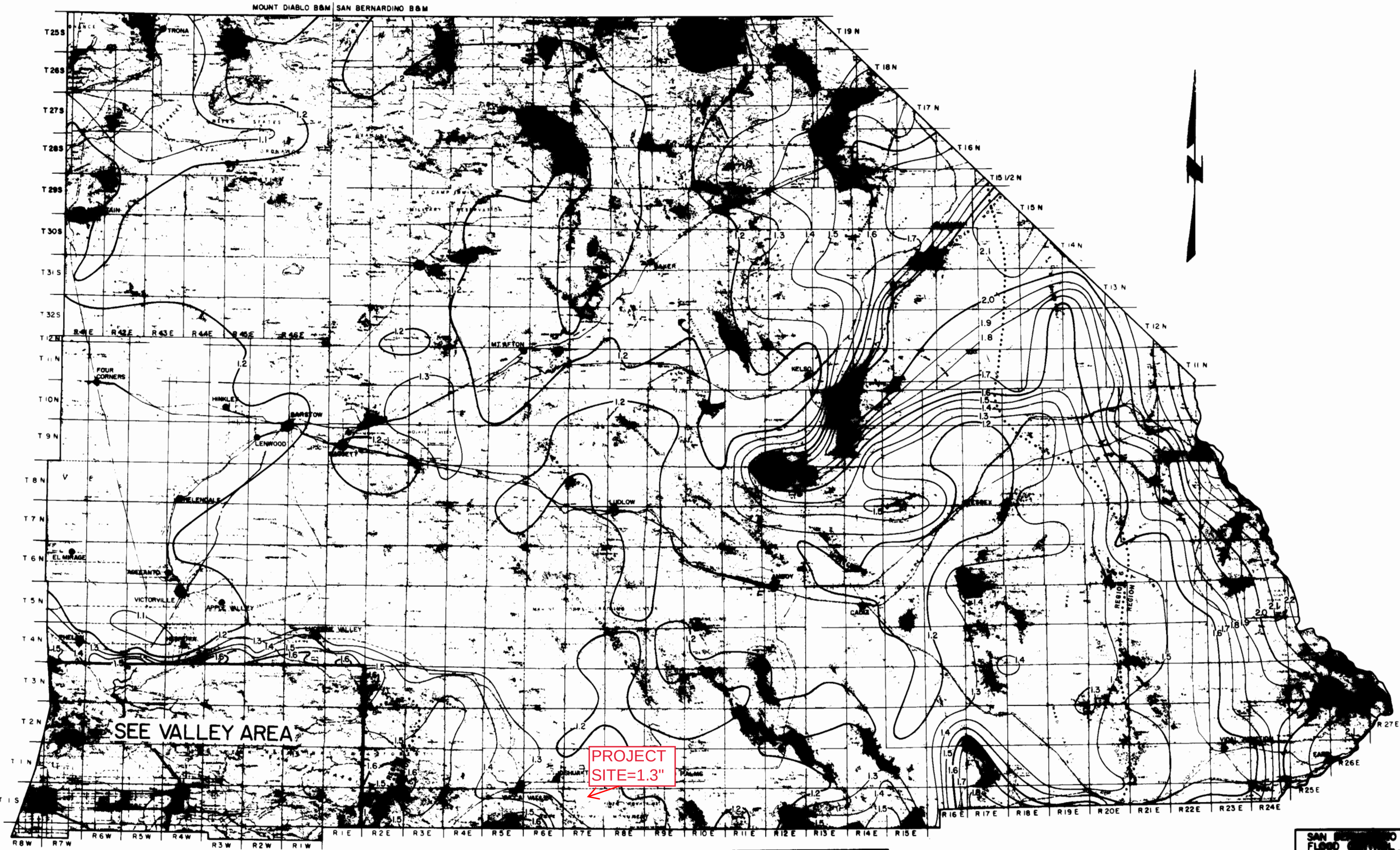


SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6

35



REDUCED DRAWING

0 1 2 3

3 INCHES ON ORIGINAL

LEGEND:

1.2 ISOLINES PRECIPITATION (INCHES)

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT

DESERT AREA

ISOHYETALS

Y_{100} - 100 YEAR 1 HOUR

BASED ON U.S.D.C., N.O.A.A. ATLAS 2, 1973

APPROVED BY

DATE 1982

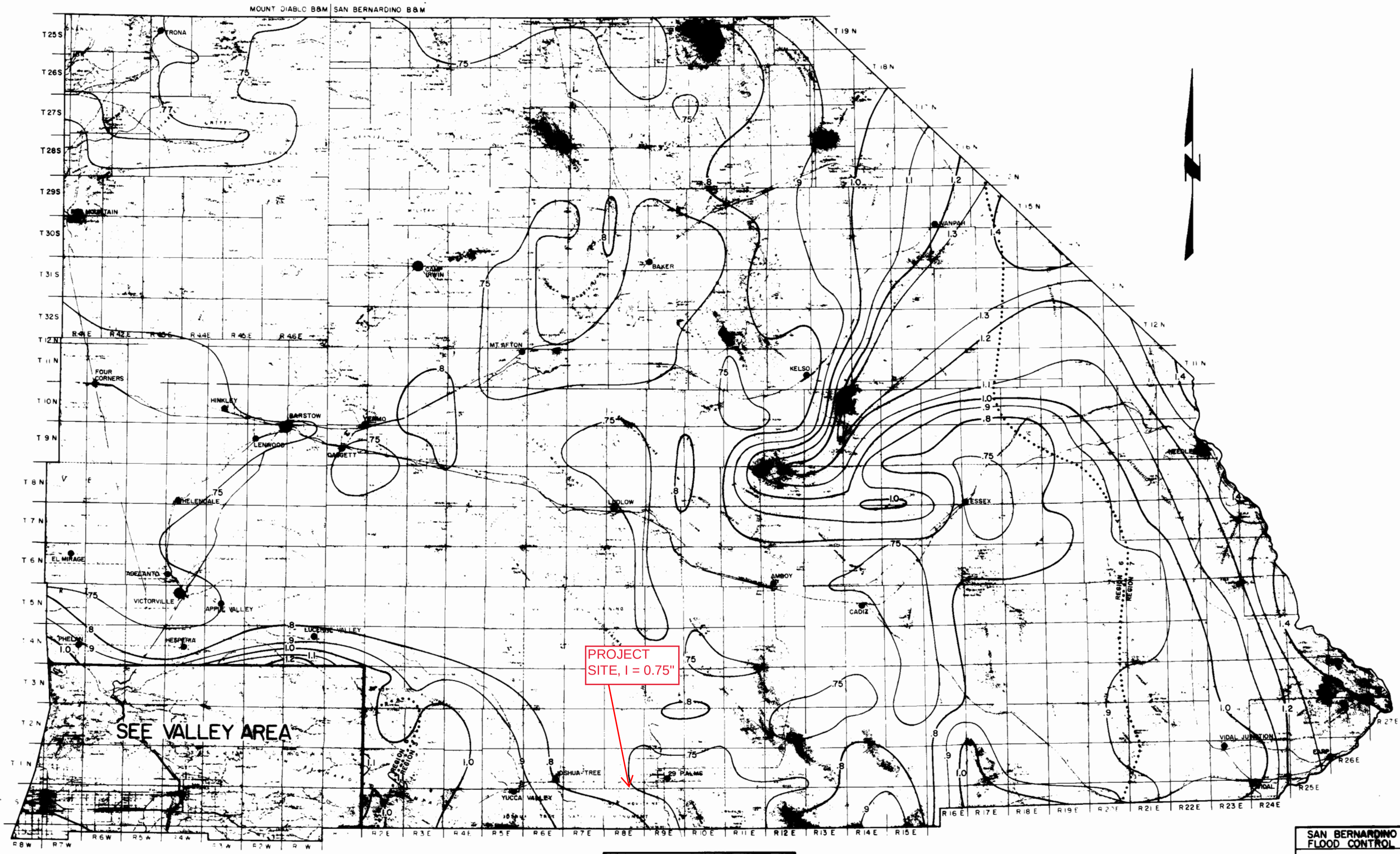
SCALE

EXHIBIT 'J'

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

FIGURE B-10



REDUCED DRAWING
0 1 2 3
3 INCHES ON ORIGINAL

LEGEND:
3.5 ISOLINES PRECIPITATION (INCHES)

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

DESERT AREA
ISOHYETALS
Y_{10} - 10 YEAR 1 HOUR
BASED ON U.S.D.C., N.O.A.A. ATLAS 2, 1973

APPROVED BY
FLOOD CONTROL ENGINEER

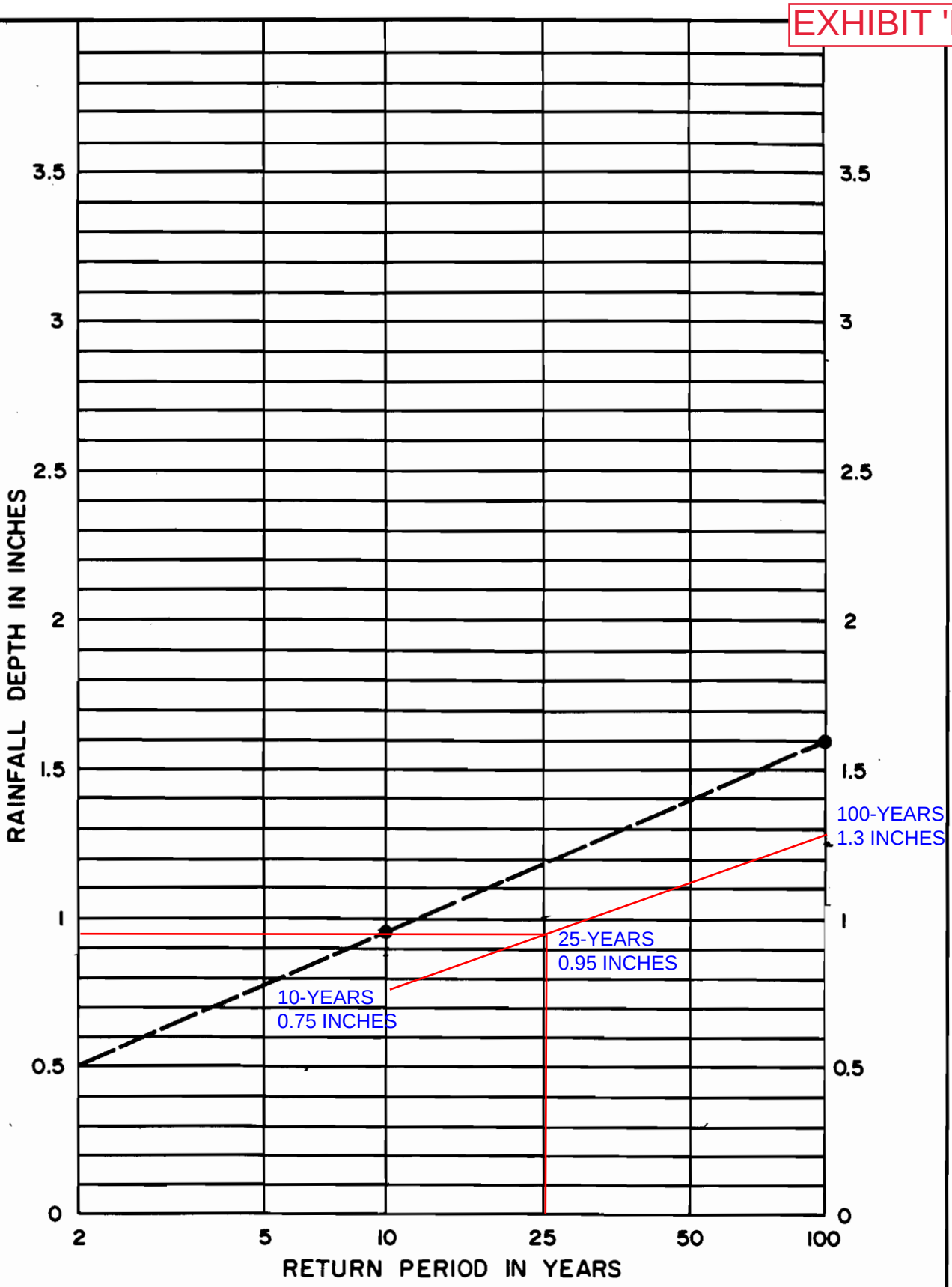
DATE	SCALE	FILE NO.	DRWG. NO.
1982	1" = 6 MI.	WRD-1	9 of 15

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

FIGURE B-9

EXHIBIT 'J'

EXHIBIT 'K'



NOTE:

1. FOR INTERMEDIATE RETURN PERIODS PLOT 10-YEAR AND 100-YEAR ONE HOUR VALUES FROM MAPS, THEN CONNECT POINTS AND READ VALUE FOR DESIRED RETURN PERIOD. FOR EXAMPLE GIVEN 10-YEAR ONE HOUR = 0.95" AND 100-YEAR ONE HOUR = 1.60", 25-YEAR ONE HOUR = 1.18".

REFERENCE: NOAA ATLAS 2, VOLUME XI - CAL., 1973

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

RAINFALL DEPTH VERSUS RETURN PERIOD FOR PARTIAL DURATION SERIES

FIGURE D-2

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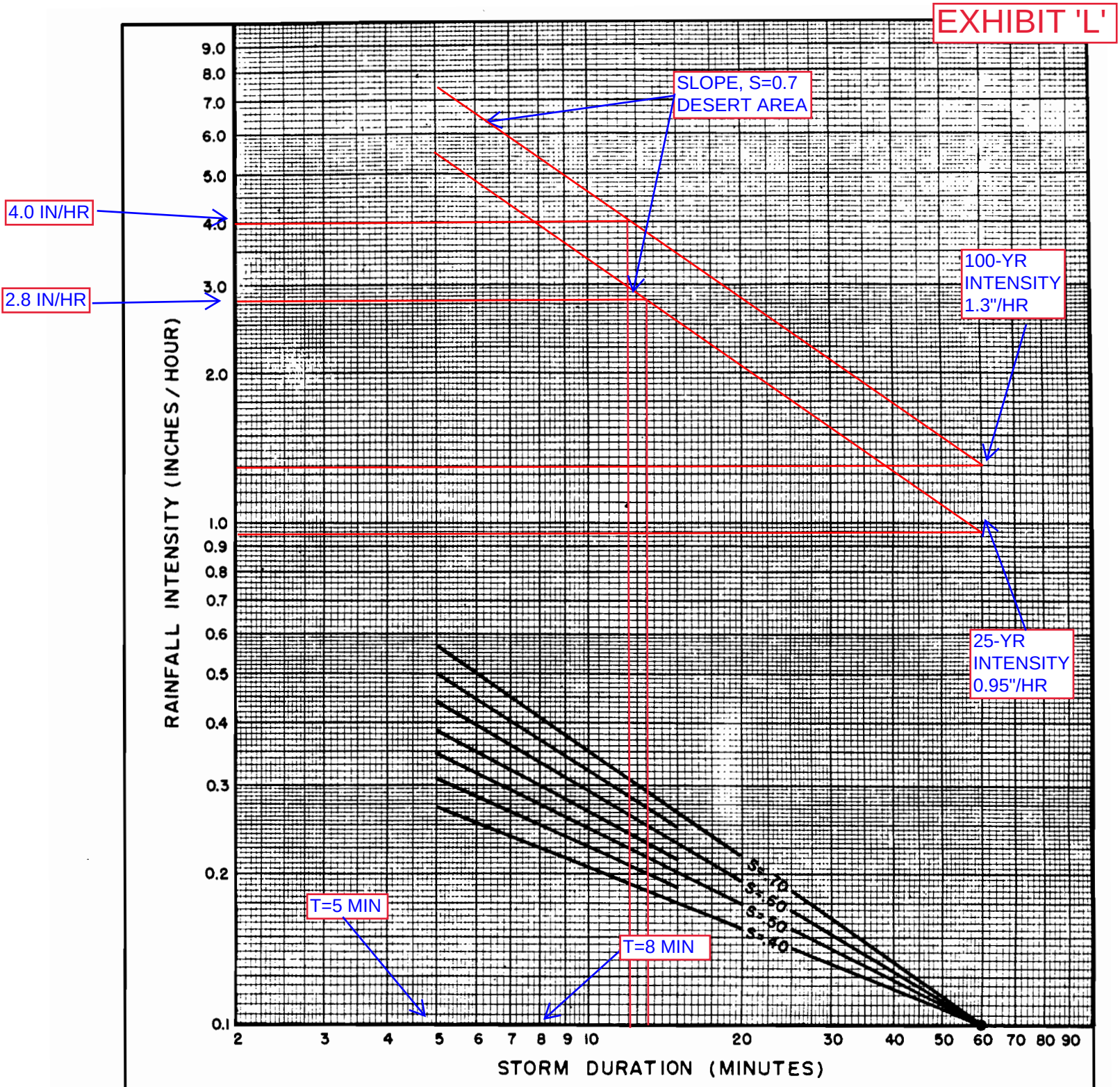
EXHIBIT 'L'



DESIGN STORM FREQUENCY = 100 YEARS 25-YEARS

ONE HOUR POINT RAINFALL = 1.3 INCHES 0.95 INCHES

LOG-LOG SLOPE = 0.7

PROJECT LOCATION = SOUTHWEST-B AREA

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

INTENSITY - DURATION CURVES CALCULATION SHEET

FIGURE D-3

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Watershed Model Schematic

Legend

Hyd.	Origin	Description
1	SCS Runoff	WASH-N

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	304.88	-------	-------	909.73	-------	-------	2069.14	WASH-N

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2069.14	1	613	16,318,456	------	------	------	WASH-N

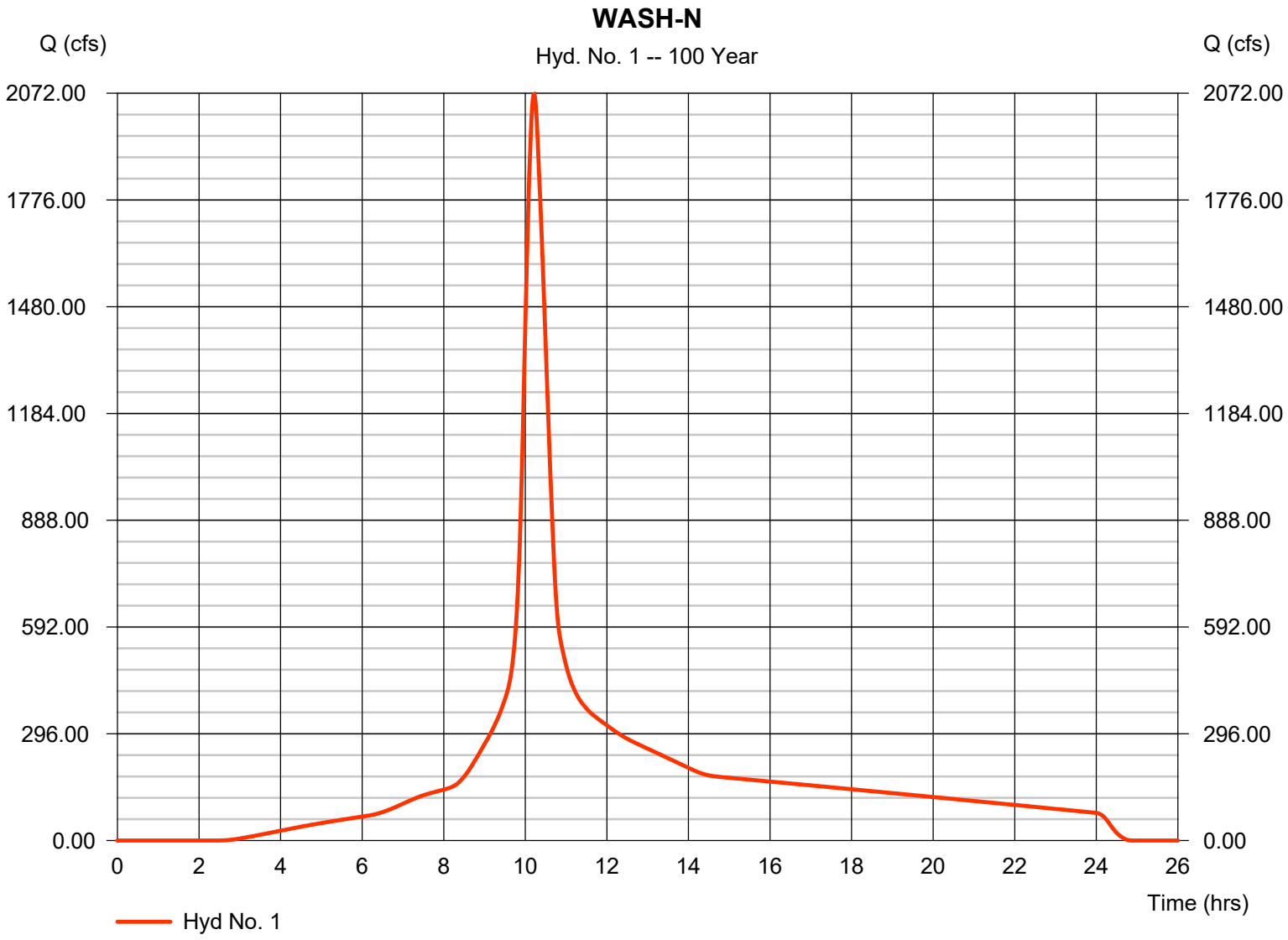
Hydrograph Report

Hyd. No. 1

WASH-N

Hydrograph type	=	SCS Runoff	Peak discharge	=	2069.14 cfs
Storm frequency	=	100 yrs	Time to peak	=	10.22 hrs
Time interval	=	1 min	Hyd. volume	=	16,318,456 cuft
Drainage area	=	720.000 ac	Curve number	=	86*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.80 min
Total precip.	=	7.95 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(720.000 x 86)] / 720.000



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No. 1

WASH-N

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.011	0.011	0.011	
Flow length (ft)	= 0.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 0.00	0.00	0.00	
Land slope (%)	= 0.00	0.00	0.00	
Travel Time (min)	**= 0.00 +**	**0.00 +**	**0.00 =**	**0.00**
Shallow Concentrated Flow				
Flow length (ft)	= 11000.00	0.00	0.00	
Watercourse slope (%)	= 12.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=5.59	0.00	0.00	
Travel Time (min)	**= 32.80 +**	**0.00 +**	**0.00 =**	**32.80**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=0.00			
		0.00		
			0.00	
Flow length (ft)	({0})0.0	0.0	0.0	
Travel Time (min)	**= 0.00 +**	**0.00 +**	**0.00 =**	**0.00**

Total Travel Time, Tc ..... 32.80 min

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	5.2735	4.3000	0.6394	--------
2	7.3653	3.9000	0.6308	--------
3	0.0000	0.0000	0.0000	--------
5	10.8325	4.0000	0.6336	--------
10	13.6013	3.9000	0.6295	--------
25	18.3624	4.0000	0.6330	--------
50	22.3877	4.0000	0.6344	--------
100	27.5266	4.2000	0.6410	--------

File name: MILES SQUARE RD.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	1.27	0.96	0.79	0.69	0.61	0.55	0.50	0.47	0.44	0.41	0.39	0.37
2	1.86	1.40	1.15	0.99	0.88	0.80	0.73	0.68	0.63	0.60	0.56	0.54
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	2.69	2.04	1.68	1.45	1.28	1.16	1.06	0.99	0.92	0.87	0.82	0.78
10	3.43	2.59	2.14	1.84	1.64	1.48	1.36	1.26	1.18	1.11	1.05	0.99
25	4.57	3.45	2.85	2.46	2.18	1.97	1.81	1.67	1.56	1.47	1.39	1.32
50	5.55	4.20	3.46	2.98	2.64	2.39	2.19	2.03	1.90	1.78	1.68	1.60
100	6.64	5.02	4.14	3.57	3.16	2.86	2.62	2.43	2.27	2.13	2.01	1.91

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	7.95
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Hydraflow Table of Contents

WASH.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Thursday, 09 / 21 / 2023

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Hydrograph Return Period Recap 2

100 - Year

Summary Report 3

Hydrograph Reports 4

Hydrograph No. 1, SCS Runoff, WASH-N 4

TR-55 Tc Worksheet 5

IDF Report 6

NOAA Atlas 14, Volume 6, Version 2
Location name: Joshua Tree, California, USA*
Latitude: 34.1346°, Longitude: -116.2197°
Elevation: 2478 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/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.27 (1.06-1.56)	1.86 (1.54-2.27)	2.70 (2.22-3.30)	3.44 (2.82-4.26)	4.58 (3.62-5.84)	5.56 (4.31-7.24)	6.64 (5.03-8.87)	7.87 (5.80-10.8)	9.77 (6.90-14.0)	11.5 (7.82-17.0)
10-min	0.918 (0.756-1.12)	1.33 (1.10-1.63)	1.93 (1.59-2.36)	2.47 (2.02-3.05)	3.28 (2.60-4.19)	3.98 (3.08-5.18)	4.76 (3.60-6.35)	5.65 (4.15-7.75)	7.00 (4.94-10.0)	8.22 (5.61-12.2)
15-min	0.736 (0.612-0.900)	1.07 (0.888-1.31)	1.56 (1.28-1.91)	1.99 (1.63-2.46)	2.65 (2.09-3.38)	3.21 (2.49-4.18)	3.84 (2.90-5.12)	4.55 (3.35-6.25)	5.64 (3.99-8.07)	6.63 (4.52-9.81)
30-min	0.550 (0.454-0.670)	0.798 (0.660-0.976)	1.16 (0.956-1.42)	1.48 (1.21-1.83)	1.97 (1.56-2.52)	2.39 (1.85-3.11)	2.86 (2.16-3.81)	3.39 (2.49-4.65)	4.20 (2.97-6.01)	4.93 (3.37-7.30)
60-min	0.368 (0.305-0.449)	0.535 (0.442-0.654)	0.777 (0.640-0.952)	0.993 (0.812-1.23)	1.32 (1.04-1.68)	1.60 (1.24-2.09)	1.91 (1.45-2.56)	2.27 (1.67-3.12)	2.82 (1.99-4.03)	3.31 (2.26-4.89)
2-hr	0.238 (0.197-0.291)	0.335 (0.277-0.410)	0.475 (0.392-0.582)	0.599 (0.490-0.740)	0.784 (0.620-1.00)	0.939 (0.728-1.22)	1.11 (0.841-1.48)	1.30 (0.959-1.79)	1.59 (1.12-2.27)	1.84 (1.25-2.72)
3-hr	0.182 (0.151-0.223)	0.255 (0.210-0.311)	0.358 (0.295-0.439)	0.449 (0.367-0.555)	0.584 (0.462-0.746)	0.698 (0.541-0.910)	0.822 (0.622-1.10)	0.960 (0.706-1.32)	1.16 (0.822-1.66)	1.34 (0.913-1.98)
6-hr	0.114 (0.094-0.139)	0.159 (0.131-0.195)	0.223 (0.184-0.273)	0.278 (0.227-0.344)	0.360 (0.285-0.459)	0.427 (0.331-0.557)	0.501 (0.379-0.669)	0.581 (0.428-0.798)	0.699 (0.494-1.00)	0.798 (0.545-1.18)
12-hr	0.067 (0.056-0.082)	0.096 (0.079-0.117)	0.135 (0.111-0.166)	0.169 (0.138-0.209)	0.219 (0.173-0.280)	0.260 (0.201-0.339)	0.304 (0.229-0.405)	0.351 (0.258-0.483)	0.421 (0.297-0.602)	0.479 (0.327-0.709)
24-hr	0.041 (0.036-0.047)	0.059 (0.052-0.068)	0.085 (0.075-0.098)	0.107 (0.094-0.125)	0.139 (0.118-0.168)	0.166 (0.137-0.203)	0.194 (0.157-0.244)	0.225 (0.177-0.290)	0.269 (0.204-0.363)	0.307 (0.225-0.427)
2-day	0.023 (0.021-0.027)	0.035 (0.031-0.040)	0.050 (0.044-0.058)	0.064 (0.056-0.075)	0.084 (0.071-0.101)	0.101 (0.083-0.124)	0.119 (0.096-0.149)	0.138 (0.109-0.179)	0.167 (0.126-0.225)	0.191 (0.140-0.266)
3-day	0.016 (0.014-0.019)	0.025 (0.022-0.028)	0.036 (0.032-0.042)	0.046 (0.040-0.054)	0.061 (0.052-0.074)	0.074 (0.061-0.090)	0.087 (0.070-0.110)	0.102 (0.080-0.132)	0.124 (0.094-0.167)	0.142 (0.104-0.198)
4-day	0.013 (0.011-0.015)	0.019 (0.017-0.022)	0.028 (0.025-0.033)	0.037 (0.032-0.043)	0.049 (0.041-0.059)	0.059 (0.049-0.072)	0.070 (0.056-0.088)	0.082 (0.064-0.106)	0.099 (0.075-0.134)	0.115 (0.084-0.160)
7-day	0.008 (0.007-0.009)	0.012 (0.010-0.014)	0.018 (0.016-0.021)	0.023 (0.020-0.027)	0.031 (0.026-0.037)	0.037 (0.031-0.045)	0.044 (0.036-0.055)	0.052 (0.041-0.067)	0.063 (0.048-0.085)	0.073 (0.053-0.102)
10-day	0.006 (0.005-0.006)	0.009 (0.008-0.010)	0.013 (0.011-0.015)	0.017 (0.015-0.020)	0.022 (0.019-0.027)	0.027 (0.022-0.033)	0.032 (0.026-0.041)	0.038 (0.030-0.049)	0.047 (0.035-0.063)	0.054 (0.039-0.075)
20-day	0.003 (0.002-0.003)	0.005 (0.004-0.005)	0.007 (0.006-0.008)	0.009 (0.008-0.011)	0.012 (0.010-0.015)	0.015 (0.012-0.019)	0.018 (0.015-0.023)	0.021 (0.017-0.028)	0.026 (0.020-0.035)	0.030 (0.022-0.042)
30-day	0.002 (0.002-0.002)	0.003 (0.003-0.004)	0.005 (0.004-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.011)	0.011 (0.009-0.014)	0.013 (0.011-0.017)	0.016 (0.012-0.020)	0.019 (0.014-0.026)	0.022 (0.016-0.031)
45-day	0.001 (0.001-0.002)	0.002 (0.002-0.003)	0.004 (0.003-0.004)	0.005 (0.004-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.010)	0.010 (0.008-0.012)	0.012 (0.009-0.015)	0.014 (0.011-0.019)	0.016 (0.012-0.023)
60-day	0.001 (0.001-0.001)	0.002 (0.002-0.002)	0.003 (0.003-0.004)	0.004 (0.003-0.005)	0.006 (0.005-0.007)	0.007 (0.005-0.008)	0.008 (0.006-0.010)	0.009 (0.007-0.012)	0.012 (0.009-0.016)	0.013 (0.010-0.019)

[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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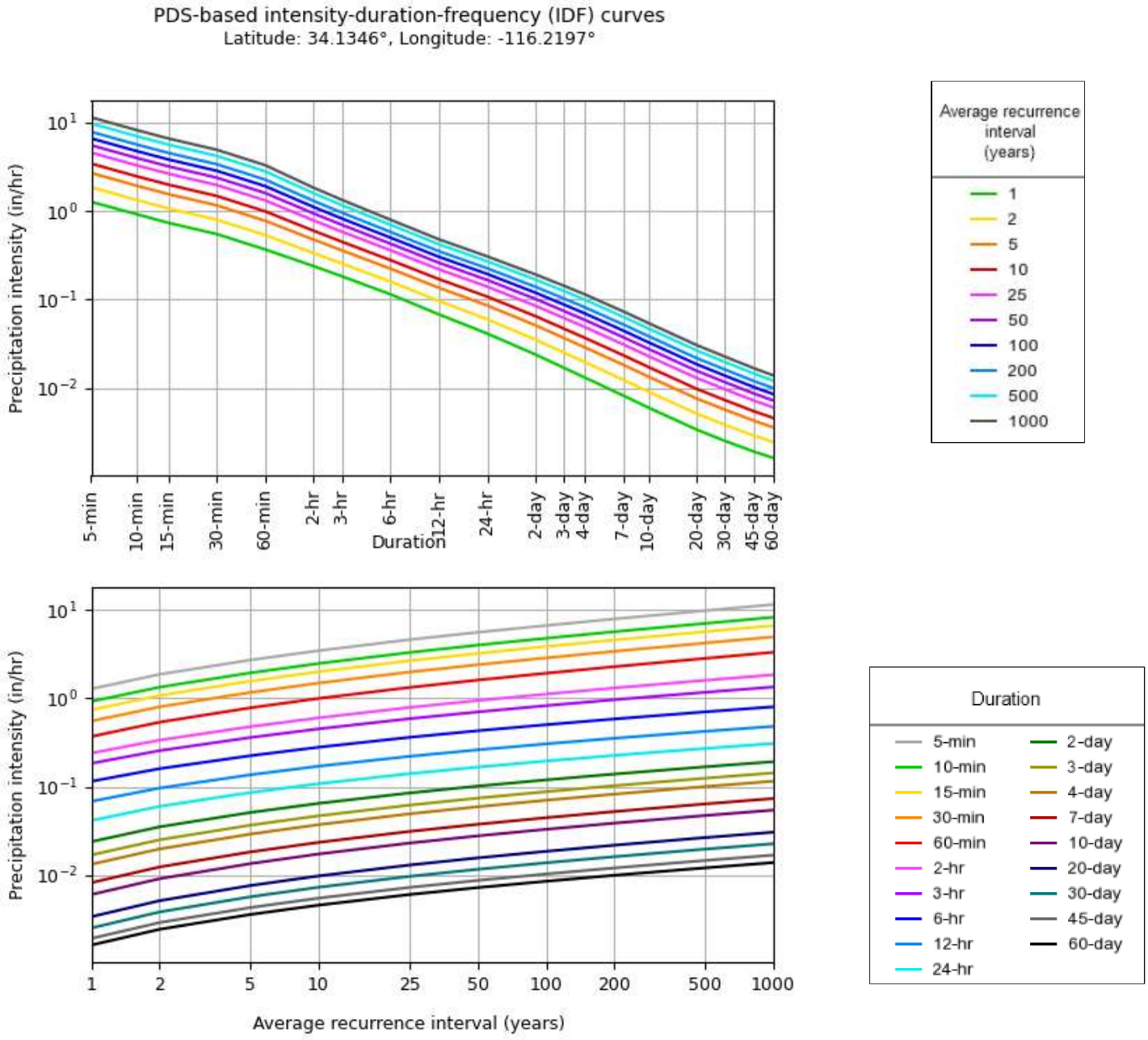
PF graphical



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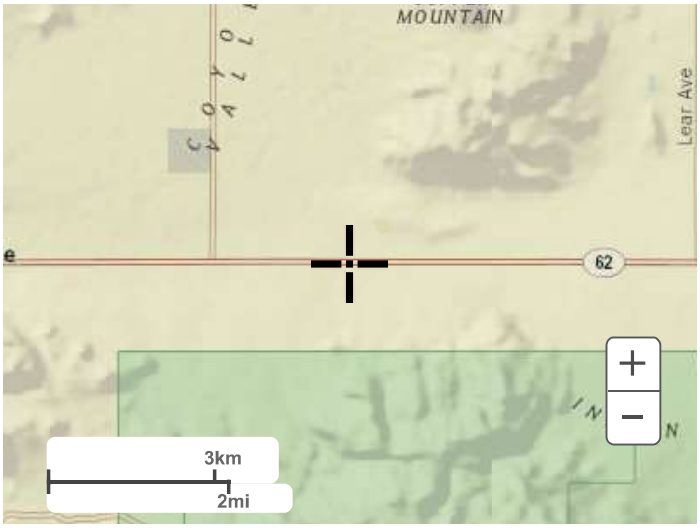
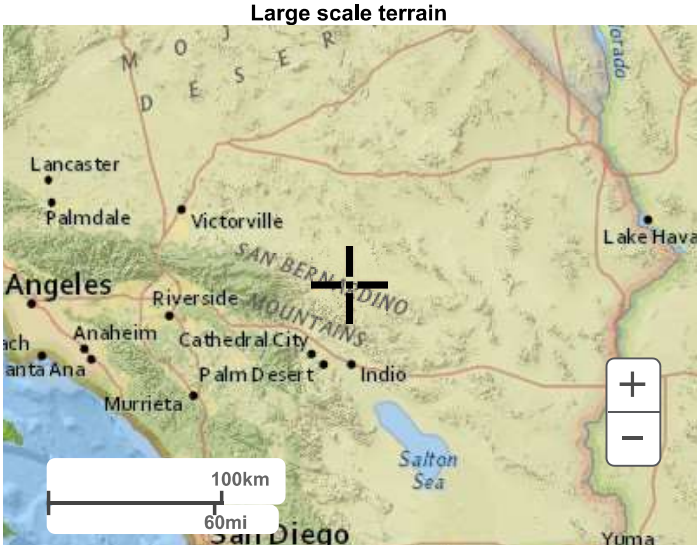
Maps & aerials

Small scale terrain

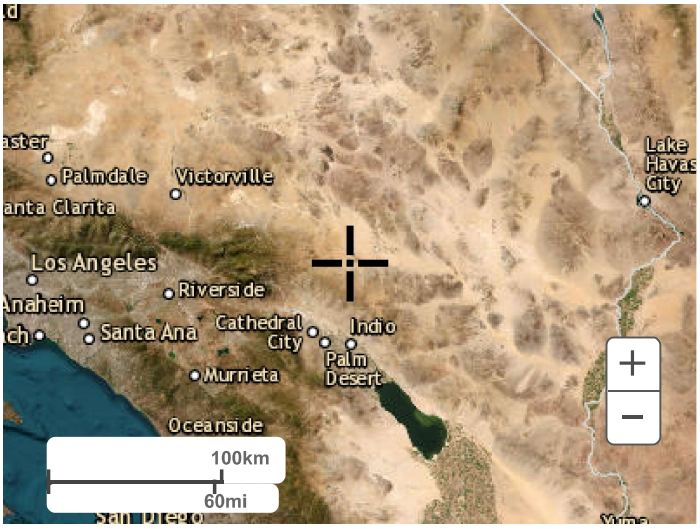


Large scale terrain



Large scale map

Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

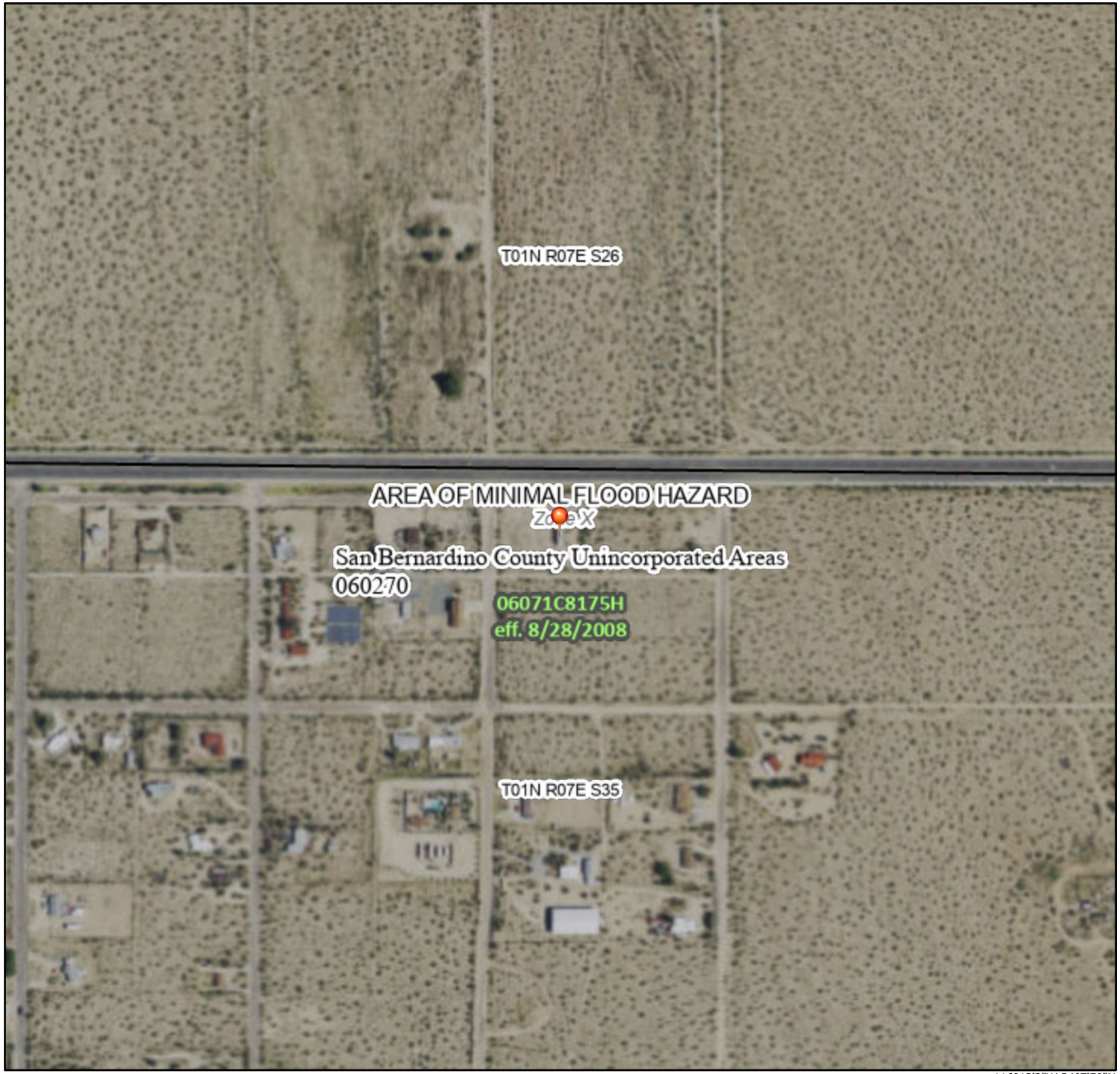
Disclaimer

EXHIBIT 'N'

National Flood Hazard Layer FIRMette

FEMA

116°13'39"W 34°8'20"N



116°13'2"W 34°7'50"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/22/2023 at 11:02 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11 North. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from digital orthophotography collected by the U.S. Department of Agriculture Farm Service Agency. This imagery was flown in 2005 and was produced with a 1-meter ground sample distance.

This map may reflect more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to confirm to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

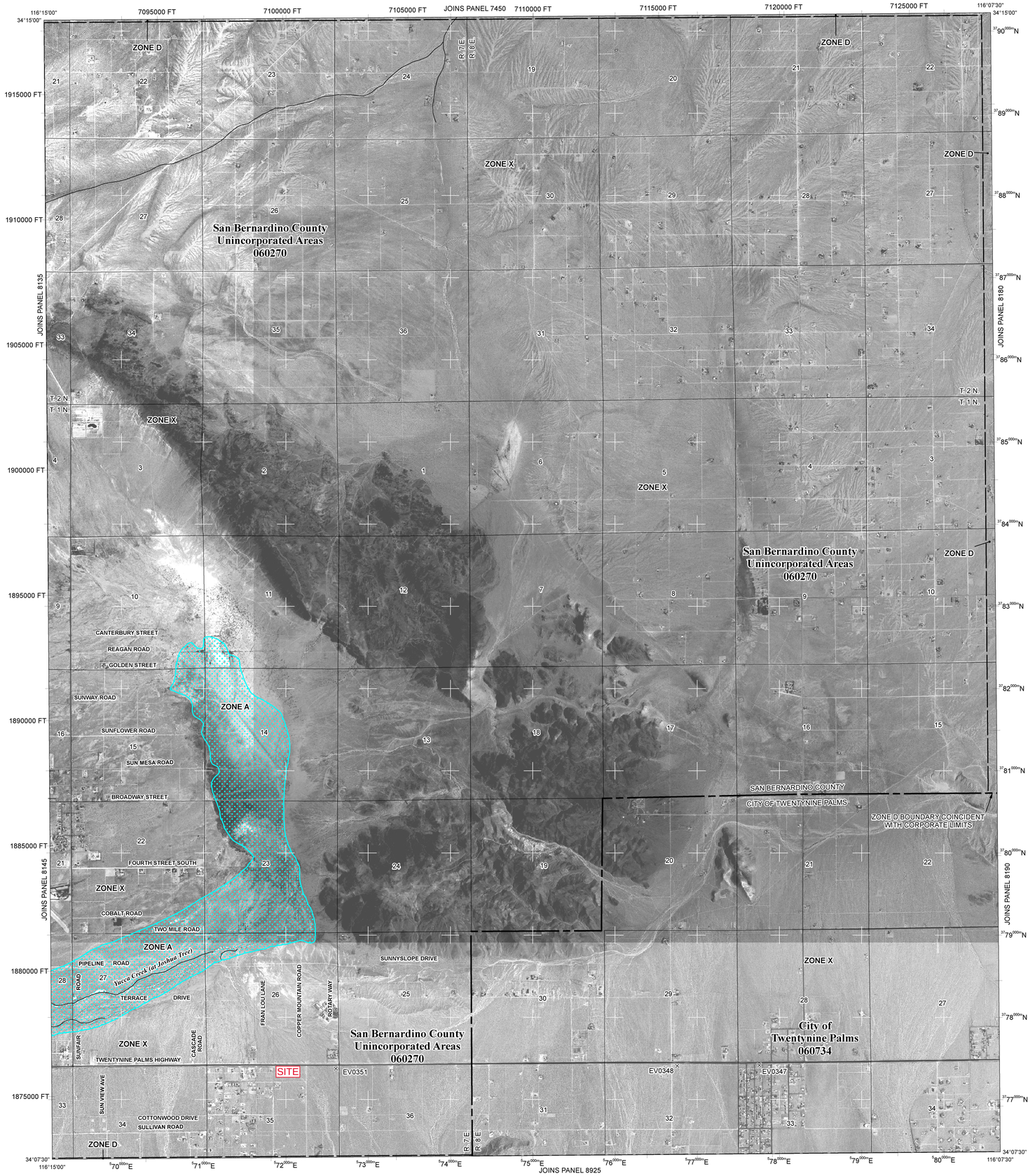
Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.

EXHIBIT 'N'



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAS)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A — Cross section line

23 — — — 23 — Transect line

87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere

5 76'000"N — 1000-meter Universal Transverse Mercator grid values, zone 11N

600000 FT — 5000-foot grid ticks: California State Plane coordinate system, zone V (FIPSZONE 0405), Lambert Conformal Conic projection

DX5510 × — Bench mark (see explanation in Notes to Users section of this FIRM panel)

●M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
March 18, 1996

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
August 28, 2008 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

600 0 600 1200 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 8175H

FIRM

FLOOD INSURANCE RATE MAP

SAN BERNARDINO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 8175 OF 9400

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN BERNARDINO COUNTY	060270	8175	H
TWENTYNINE PALMS, CITY OF	060734	8175	H

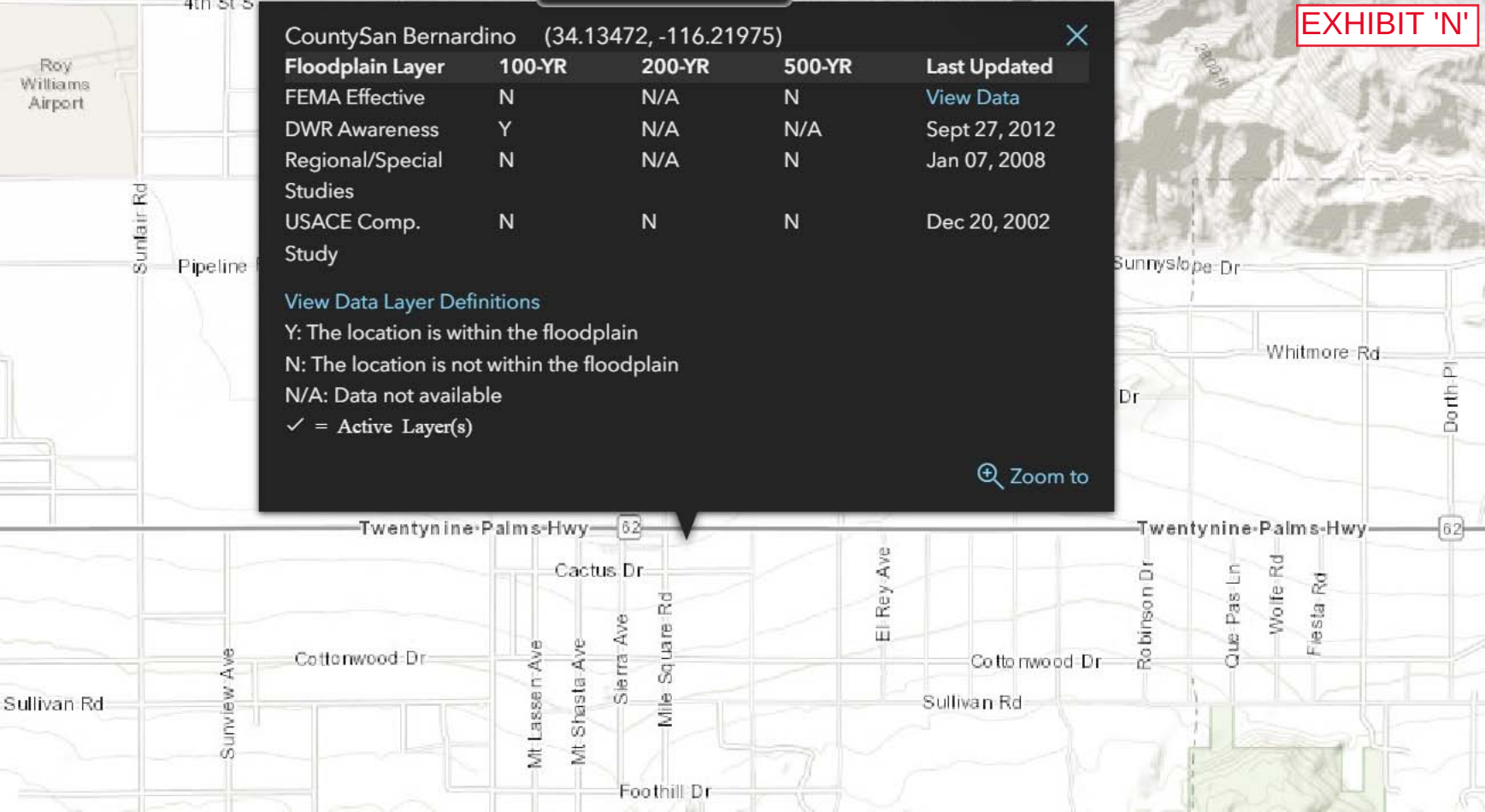
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06071C8175H

MAP REVISED
AUGUST 28, 2008

Federal Emergency Management Agency

EXHIBIT 'N'


CountySan Bernardino (34.13472, -116.21975)
Floodplain Layer | 100-YR | 200-YR | 500-YR | Last Updated
FEMA Effective | N | N/A | N | View Data
DWR Awareness | Y | N/A | N/A | Sept 27, 2012
Regional/Special Studies | N | N/A | N | Jan 07, 2008
USACE Comp. Study | N | N | N | Dec 20, 2002
View Data Layer Definitions
Y: The location is within the floodplain
N: The location is not within the floodplain
N/A: Data not available
✓ = Active Layer(s)
Zoom to
Roy Williams Airport
Sunflair Rd
Pipeline
Sunnyslope Dr
Whitmore Rd
Twentynine Palms Hwy
62
Cactus Dr
Cottonwood Dr
Sullivan Rd
Sunview Ave
Mt Lassen Ave
Mt Shasta Ave
Sierra Ave
Mile Square Rd
El Rey Ave
Robinson Dr
Que Pas Ln
Wolfe Rd
Fiesta Rd
Foothill Dr