FEBRAURY 2013

PRELIMINARY HYDROLOGY STUDY

FOR
PHEALN PINON HILLS C.S.D. ADIMISTRATION FACILITIES
SHEEP CREEK ROAD
IN
PHELAN, CALIFORNIA
(A.P.N. 3066-264-10)

FOR

STEENO DESIGN STUDIO
11774 HESPERIA ROAD, SUITE B1
HESPERIA, CA 92345
760-244-5001

BY
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P.O. BOX 1861
APPLE VALLEY, CA 92307
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Jerry L. Miles 2-8-13

REGISTERED PROFESSIONAL ENGINEER
JERRY L. MILES
NO. 42593
EXP. 3-31-14
CIVIL
STATE OF CALIFORNIA

PURPOSE

This off-site and on-site drainage evaluation was prepared for submittal of a site plan approval submittal package for the proposed PPHCSD Administration facility on Sheep Creek Road in Phelan. This evaluation is being performed to determine if off-site drainage flows that will affect the proposed development and provide a preliminary drainage evaluation for the proposed on-site facilities. All of the developed 100-year on-site generated drainage flows will be retained on-site.

DESCRIPTION OF DRAINAGE AREAS

The subject lot is located on the east side of Sheep Creek Road south of Phelan Road. The subject site is rectangle shaped and is approximately 4.5 net acres in size. The site is located near the top of a small ridge with moderately sloping to the northeast.

A field evaluation showed that no off-site natural drainage courses cross the site (see attached Aerial Photo and Off-Site Drainage Area Map). A major drainage wash collects most of the drainage flows from the south and conducts those flows to the northeast south of the project. Developed land to the south of the south collect and conduct other off-site flows to the east. Sheep Creek Road collects all the off-site drainage flows from the west and conducts those flows northerly along the west property boundary. Therefore, little to no off-site flow enters the subject site.

DESCRIPTION OF OFF-SITE WATERSHED TO SHEEP CREEK ROAD

The subject off-site watershed slopes moderately to the northeast. Sheep Creek Road along the front of the subject parcel slopes to the north at approximately 3% and conducts all drainage flows from the west towards Phelan Road. The proposed driveway should be constructed with a high point at the street right-of-way per County standards and all the drainage flows from this watershed will be contained in the half width proposed street section. These improvements will ensure that any off-site drainage flows will not enter the subject site. The development types in this watershed varied from vacant land to commercial development. The entire watershed was assumed to have a soil Type "B" per the San Bernardino County Hydrology Manual.

DESCRIPTION OF OFF-SITE WATERSHED TO SHEEP CREEK ROAD

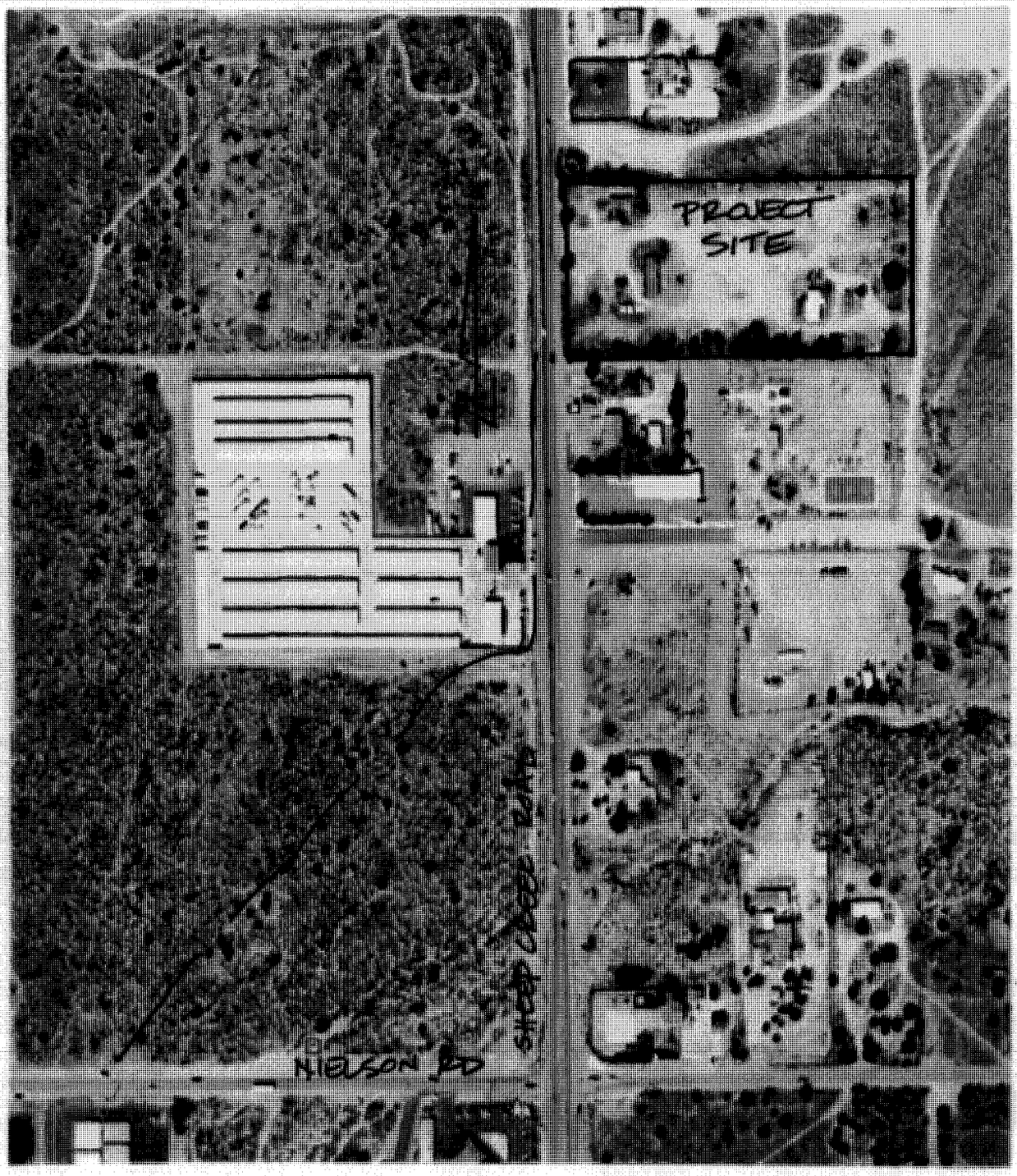
The existing site slopes moderately to the northeast and is vacant and undeveloped. The proposed development type was assumed to be commercial. The on-site watershed was assumed to have a soil Type "B" per the San Bernardino County Hydrology Manual. The proposed building pads will be elevated above the surrounding proposed driveways. Drainage swales will be constructed to conduct drainage flows to storm drain inlets or to the back of the parcel, maintaining natural drainage patterns, to the proposed landscape and retention areas (see attached Site Plan). Preliminary retention volumes were determined using a simplified hydrograph method. The proposed retention basin capacities exceed the calculated retention volumes generated by collect all of the 100-year on-site drainage flows. A final hydrology study will be needed to establish the exact on-site drainage facilities and the required retention volumes.

SUMMARY

It was determined that off-site drainage flows do not enter the site and the proposed driveway and graded berms along the street right-of-way should help to ensure this after the development is built. All on-site drainage flows will be collected and directed to retention basins at the rear of the parcel. On-site retention volumes were established by assuming the collection of all on-site 100-year drainage flows and the retention basin capacities exceed those retention volume requirements.

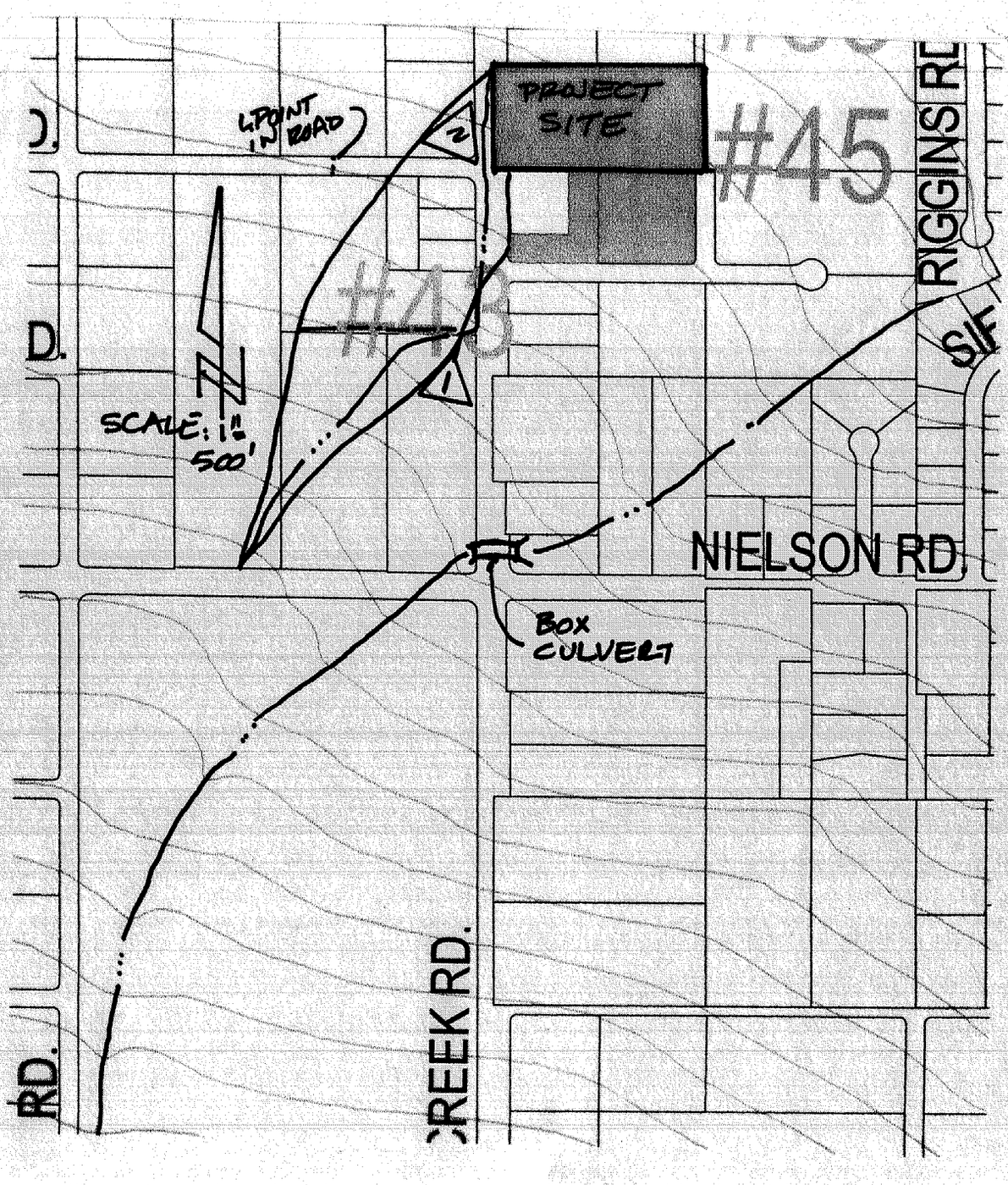
OFF-SITE DRAINAGE CALCULATIONS

AERIAL PHOTO



PPHCSD ADMINISTRATION FACILITY
SHEEP CREEK ROAD, PHELAN, CA
A.P.N. 3066-264-10

OFF-SITE DRAINAGE AREA MAP



PPHCSD ADMINISTRATION FACILITY
SHEEP CREEK ROAD, PHELAN, CA
A.P.N. 3066-264-10

RATIONAL METHOD STUDY FORM APN 3066-264-10

SAN BERNARDINO COUNTY HYDROLOGY MANUAL	STUDY NAME: PRICED ADMINSITE: OFF-SITE 10 -YEAR STORM 1-HOUR RAINFALL (INCH)= 0.9 ; SLOPE = 0.70	Calculated by JLM Date 2-1-13 Checked by _____ Date _____ Page 1 of 2

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_i min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
OFF-SITE 1	6.1	6.1	B	UN-DEV		15.5	2.6	0.34	0.39	12.4 cfs				
											950	0.043	—	INITIAL SUB-AREA
OFF-SITE 2	7.15	13.25	B	COMM	3.5	19.0	2.05	0.07	0.18	22.3 cfs				
											850	0.039	4.1	STREET SECTION

Figure D-6

RATIONAL METHOD STUDY FORM APN 3066-264-10

SAN BERNARDINO COUNTY HYDROLOGY MANUAL

STUDY NAME: PPH CSD ADMIN SITE: OFF-SITE

100-YEAR STORM 1-HOUR RAINFALL (INCH) = 1.30 ; SLOPE = 0.70

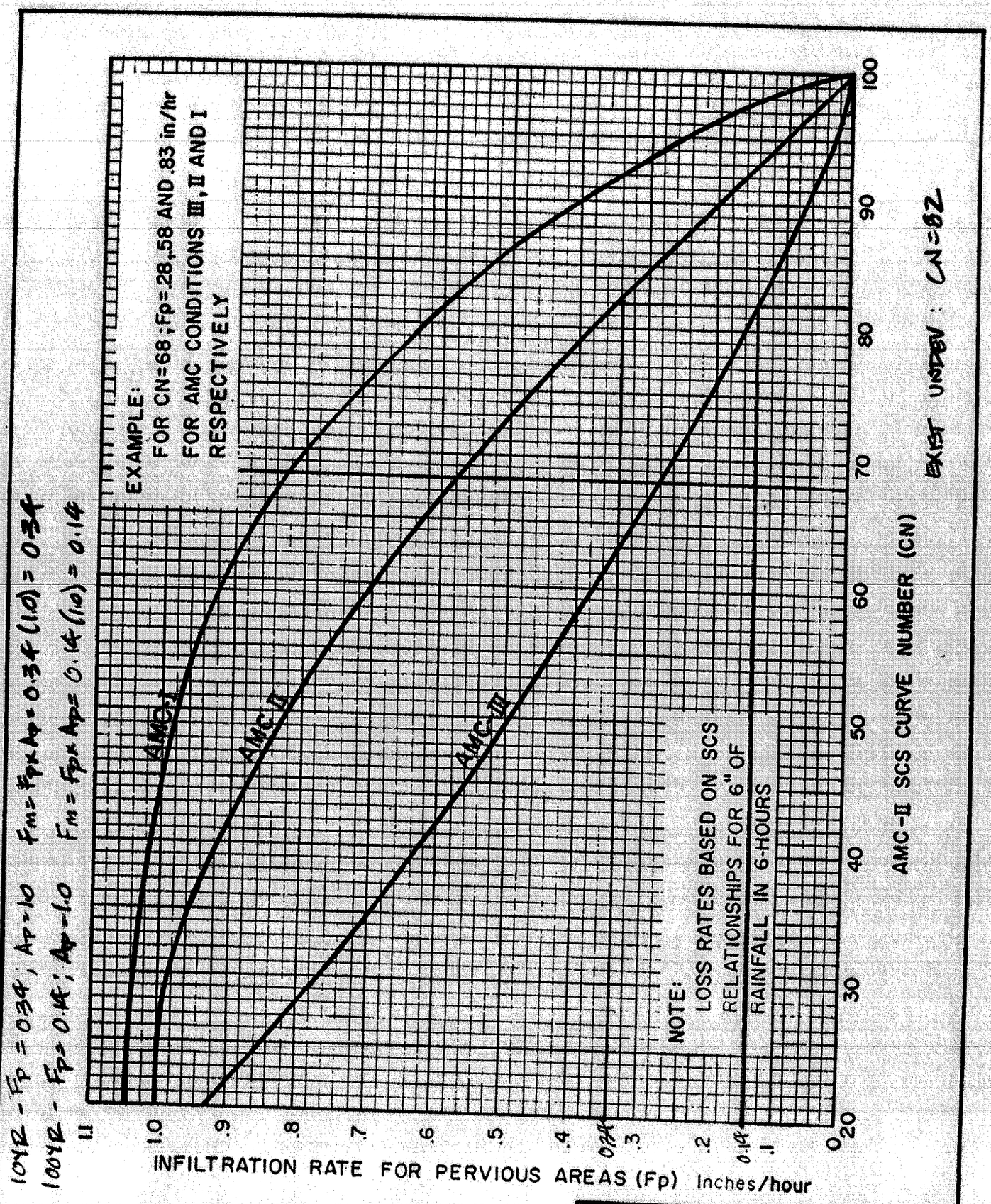
Calculated by JLM Date 2-1-13

Checked by _____ Date _____

Page ____ of ____

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_t min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
OFF-SITE 1	6.1	6.1	B	UN-DEV	33	15.5	3.3	0.14	0.14	17.53	950	0.043	—	INITIAL SUB-AREA
OFF-SITE 2	7.15	13.25	B	COMM		18.8	2.90	0.04	0.08	32.63	850	0.039	4.3	STREET SECTION

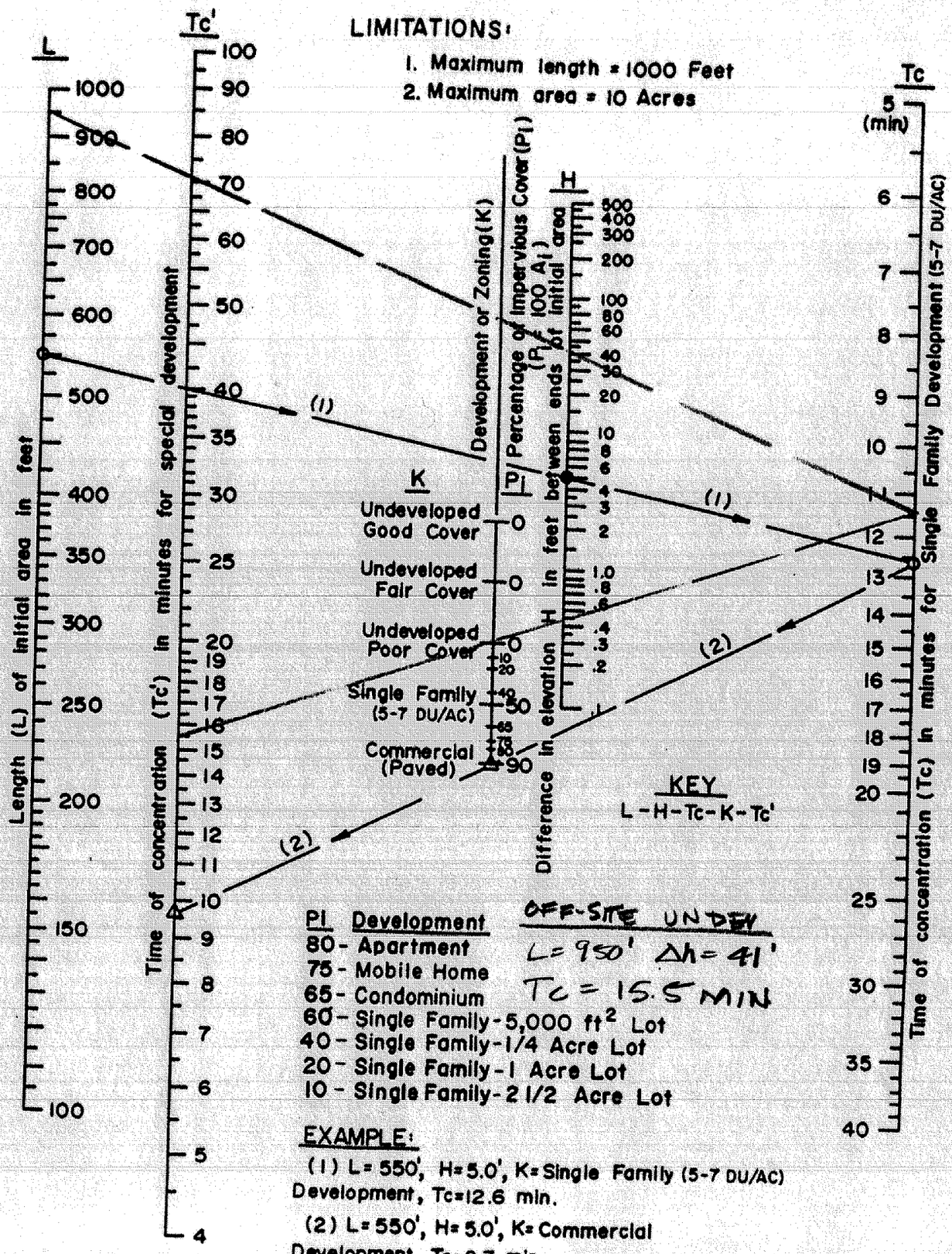
Figure D-6



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6



LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres

PI	Development
80	Apartment
75	Mobile Home
65	Condominium
60	Single Family-5,000 ft² Lot
40	Single Family-1/4 Acre Lot
20	Single Family-1 Acre Lot
10	Single Family-2 1/2 Acre Lot

OFF-SITE UNDEV
L=950' Δh=41'
Tc=15.5 MIN

EXAMPLE:

(1) L=550', H=5.0', K=Single Family (5-7 DU/AC) Development, Tc=12.6 min.

(2) L=550', H=5.0', K=Commercial Development, Tc=9.7 min.

OFF-SITE

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

NO C&G - GRADED FLOW LINE

$Q_{100} = 17.35$ cfs
$n = 0.03$
$S = 3.9\%$

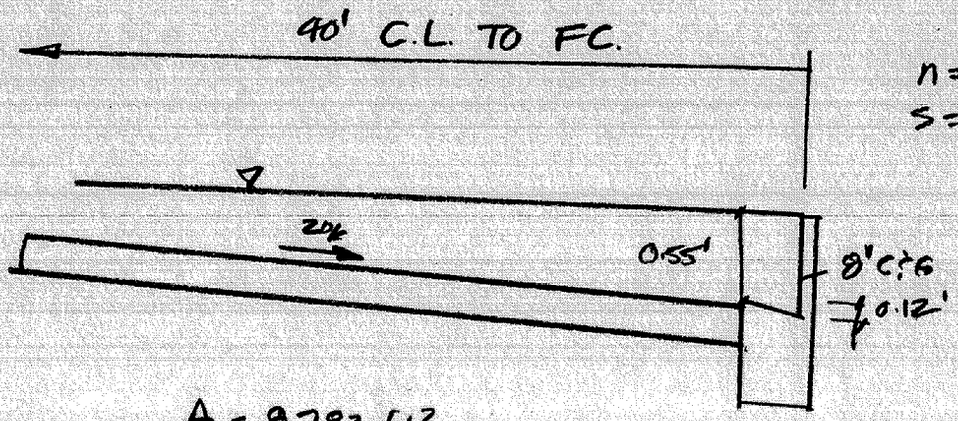
TRY $d = 0.6$ ft
$A = 4.14$ ft^2
$P = 13.9124'$
$R = A/P = (4.14 ft^2 / 13.9124') = 0.2976'$

$$Q_{MAX} = \frac{1.49}{0.03}(4.14 ft^2)(0.2976)^{2/3}(0.039)^{1/2} = 18.10 \text{ cfs.}$$

OK

$V = 4.37$ fps

HALF STEET w/ C&G SECTION.



$n = 0.013$
$S = 0.025$

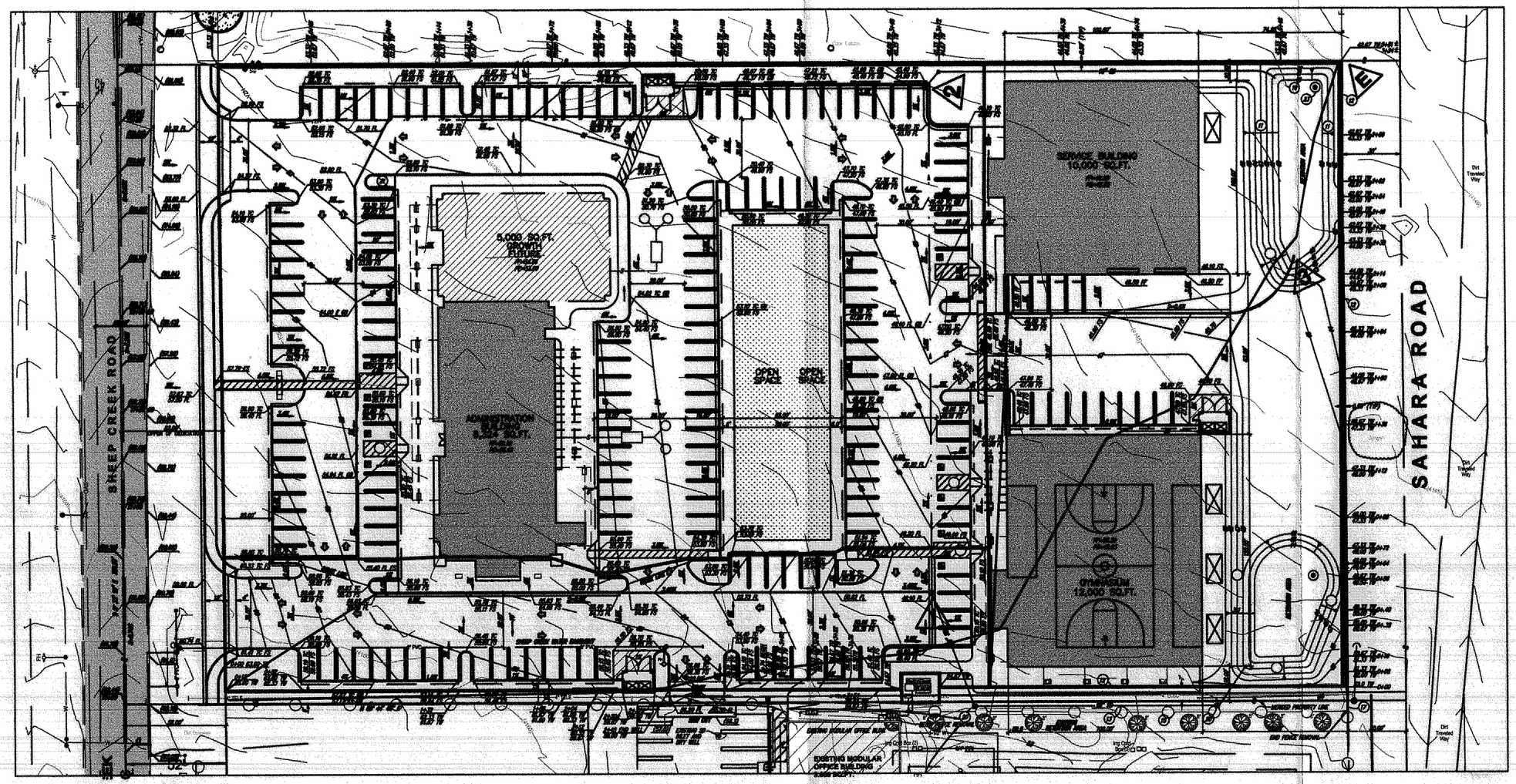
$A = 8.783$ ft^2
$P = 30.176$ ft
$R = A/P = 0.2911$ ft

$$Q = \frac{1.49}{0.013}(8.783 ft^2)(0.2911)^{2/3}(0.025)^{1/2} = 50.50 \text{ cfs}$$

$V = 5.75$ fps

$Q_{100} = 17.35$ cfs

ON-SITE DRAINAGE CALCULATIONS



SCALE: 1" = 60'

ON-SITE DRAINAGE AREA INFORMATION

EXISTING

E

RATIONAL METHOD (PER S.B. CO. HYDROLOGY MANUAL)
Q = 0.90 (I-Fm)A
Tc = 15 min
10 YR: Fm = 0.34 100 YR: Fm = 0.14
I(10) = 2.40 in/hr
I(100) = 3.40 in/hr
A = 4.41 AC
Q(10) = 0.9 x (2.40 - 0.34) x 4.41 = 8.18 cfs
Q(100) = 0.9 x (3.40 - 0.14) x 4.41 = 12.94 cfs

PROPOSED

1

RATIONAL METHOD (PER S.B. CO. HYDROLOGY MANUAL)
Q = 0.90 (I-Fm)A
Tc = 7 min
10 YR: Fm = 0.07 100 YR: Fm = 0.04
I(10) = 4.2 in/hr
I(100) = 5.70 in/hr
A = 0.67 AC
Q(10) = 0.9 x (4.20 - 0.07) x 0.67 = 2.49 cfs
Q(100) = 0.9 x (5.70 - 0.04) x 0.67 = 3.41 cfs

PROPOSED

2

RATIONAL METHOD (PER S.B. CO. HYDROLOGY MANUAL)
Q = 0.90 (I-Fm)A
Tc = 8 min
10 YR: Fm = 0.07 100 YR: Fm = 0.04
I(10) = 3.70 in/hr
I(100) = 5.30 in/hr
A = 2.31 AC
Q(10) = 0.9 x (3.70 - 0.07) x 2.31 = 7.55 cfs
Q(100) = 0.9 x (5.30 - 0.04) x 2.31 = 10.94 cfs

PROPOSED

3

RATIONAL METHOD (PER S.B. CO. HYDROLOGY MANUAL)
Q = 0.90 (I-Fm)A
Tc = 10 min
10 YR: Fm = 0.07 100 YR: Fm = 0.04
I(10) = 3.15 in/hr
I(100) = 4.50 in/hr
A = 1.35 AC
Q(10) = 0.9 x (3.15 - 0.07) x 1.35 = 3.74 cfs
Q(100) = 0.9 x (4.50 - 0.04) x 1.35 = 5.42 cfs

LEGEND

1 INDICATES AREA CONCENTRATION POINT
INDICATES DRAINAGE FLOW PATH
INDICATES PROPOSED ON-SITE DRAINAGE AREA
INDICATES EXISTING ON-SITE DRAINAGE AREA

ON-SITE DRAINAGE AREA MAP

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RATIONAL METHOD STUDY FORM APN 3066-264-10

SAN BERNARDINO COUNTY HYDROLOGY MANUAL

STUDY NAME: PPH CSD ADMIN SITE : ON-SITE

10 -YEAR STORM 1-HOUR RAINFALL (INCH)= 0.90 ; SLOPE = 0.70

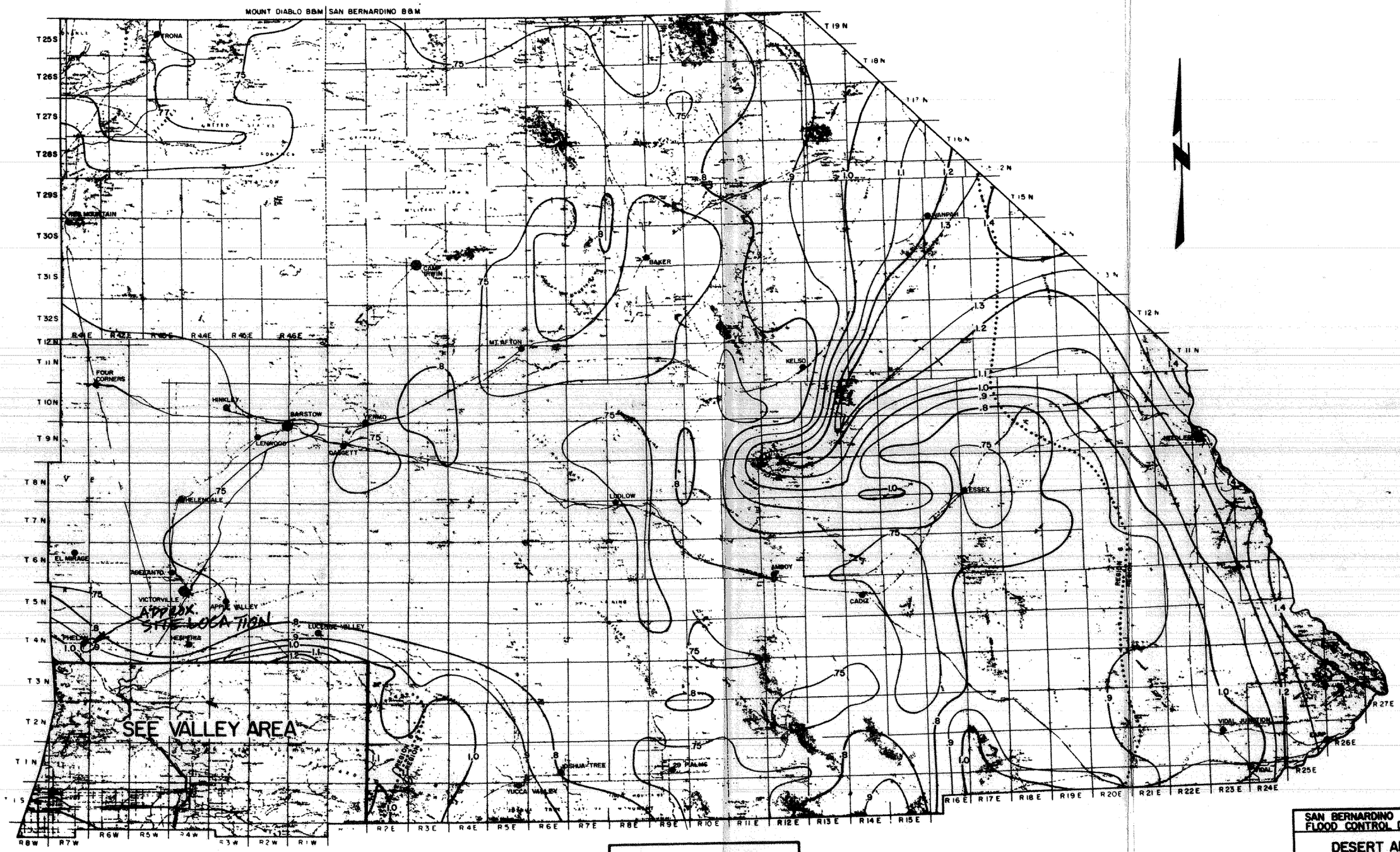
Calculated by JLM Date 2-1-13

Checked by _____ Date _____

Page 1 of 2

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_i min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
EXIST (E)	4.41	4.41	B	UN-DEV		15	2.4	0.34	0.34	8.18cfs	758	0.029	—	INITIAL SUB-AREA
PROPOSED (1)	0.67	0.67	B	COMM		7	4.2	0.07	0.07	2.49cfs	382	0.031	—	INITIAL SUB-AREA
PROPOSED (2)	2.31	2.31	B	COMM		8	3.7	0.07	0.07	7.55cfs	591	0.026	—	INITIAL SUB-AREA
PROPOSED (3)	1.35	1.35	B	COMM		10MIN	3.15	0.07	0.07	3.74cfs	355	0.014	—	INITIAL SUB-AREA
COMB (2) & (3)	3.36	3.36	B	COMM		9MIN	3.4	0.07	0.07	10.1cfs	—	—	—	COMBINED AREA

Figure D-6



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

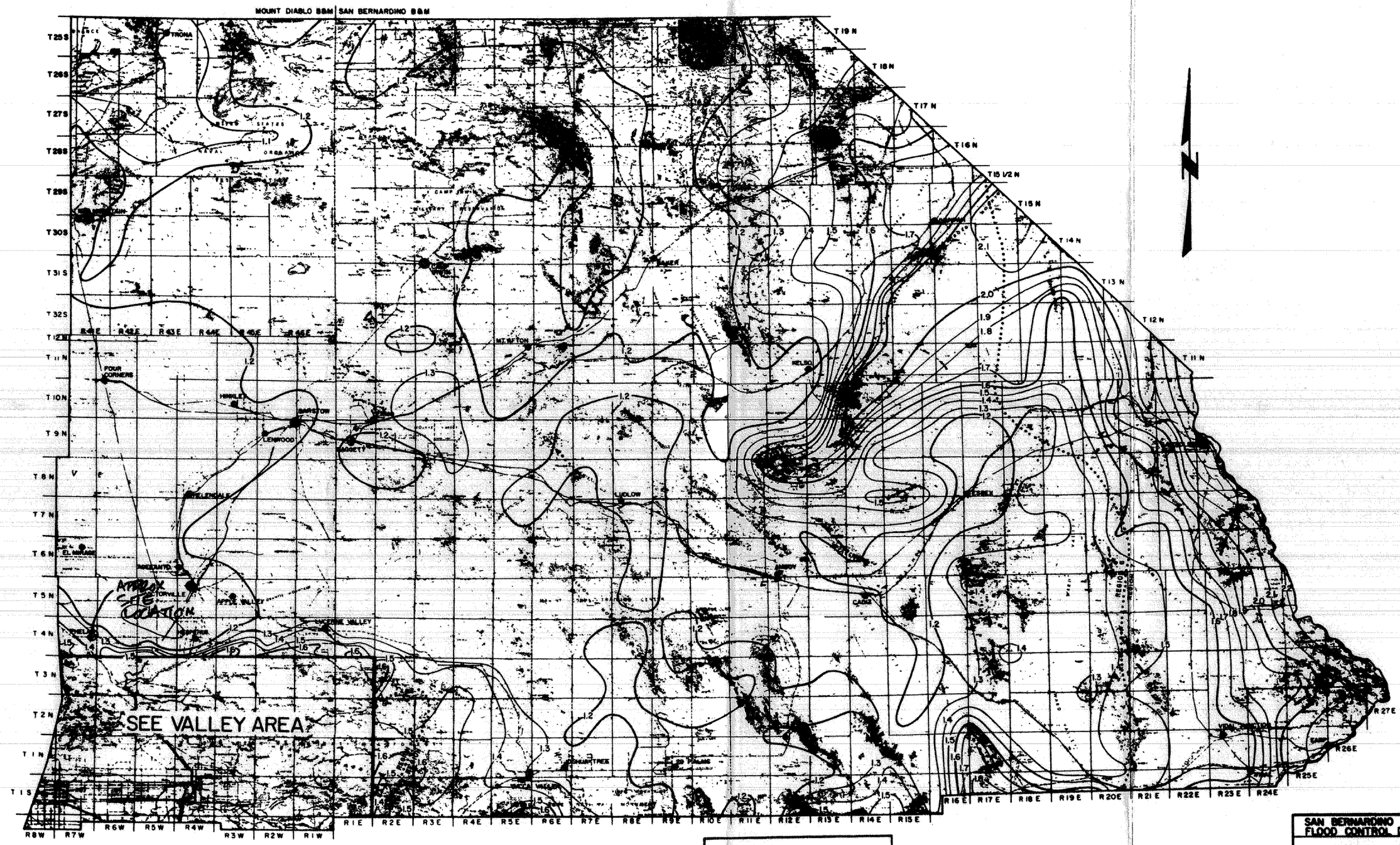
APPROVED BY _____ FLOOD CONTROL ENGINEER

DATE	SCALE	FILE NO.	DRWG. NO.
1982	1" = 6 MI.	WRD-1	9 of 12

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

FIGURE B-9



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., NOAA ATLAS 2, 1973

APPROVED BY

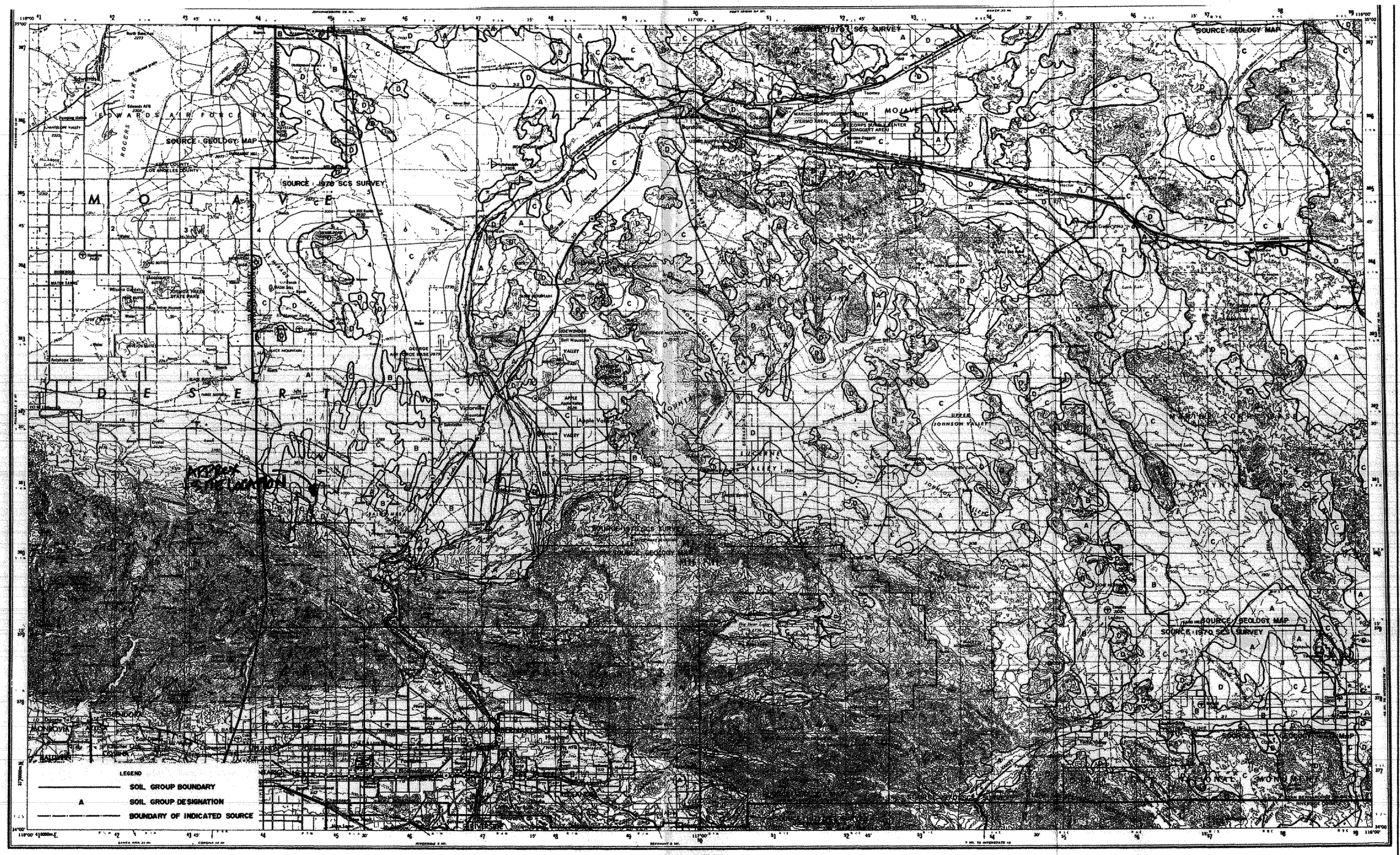
FLOOD CONTROL ENGINEER

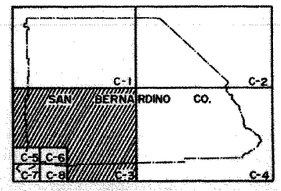
DATE	SCALE	FILE NO.	DRAWING NO.
1982	1" = [illegible]	[illegible]	[illegible]

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

FIGURE B-10





INDEX MAP

Scale 1:250,000

5 0 5 10 15 20 Statute Miles

5 0 5 10 15 20 25 30 Kilometers

5 0 5 10 15 Nautical Miles

CONTOUR INTERVAL 200 FEET
WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS
TRANSVERSE MERCATOR PROJECTION

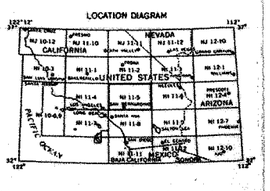
BLACK NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 11

1965 MAGNETIC DECLINATION FROM TRUE NORTH VARIES FROM 15½° (280 MILS) EASTERLY FOR THE CENTER OF THE WEST EDGE TO 15° (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

RATIONAL METHOD STUDY FORM APN 3066-26410

SAN BERNARDINO COUNTY HYDROLOGY MANUAL

STUDY NAME: PPH CSD ADMIN SITE: ONSITE

100 -YEAR STORM 1-HOUR RAINFALL (INCH) = 1.3 ; SLOPE = 0.70

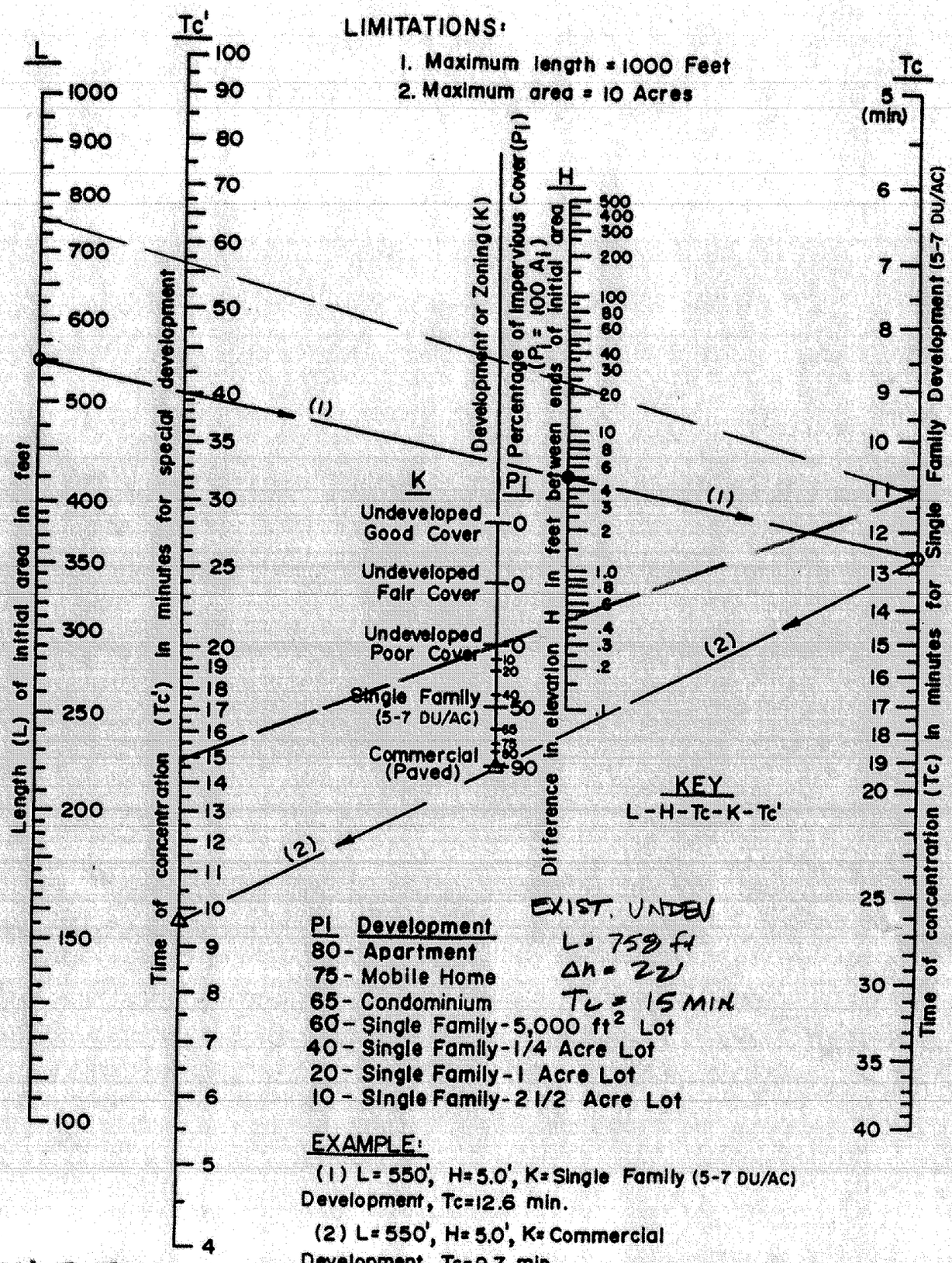
Calculated by JLM Date 2-1-13

Checked by _____ Date _____

Page ____ of ____

Concentration Point	Area (Acres) Subarea	Area (Acres) Total	Soil Type	Dev. Type	T_i min.	T_c min.	I in/hr	Fm in/hr	Fm avg.	Q Total	Flow Path Length ft.	Slope ft./ft.	V ft./sec.	Hydraulics and Notes
EXIST (E)	4.41	4.41	B	UN DEV		15	3.4	0.14	0.14	12.94cfs	758	0.029	—	INITIAL SUB-AREA
PROPOSED (1)	0.67	0.67	B	COMM		7	5.7	0.04	0.04	3.41cfs	382	0.031	—	INITIAL SUB-AREA
PROPOSED (2)	2.31	2.31	B	COMM		8	5.3	0.04	0.04	6.94cfs	591	0.026	—	INITIAL SUB-AREA
PROPOSED (3)	1.35	1.35	B	COM		10	4.5	0.04	0.04	5.42cfs	355	0.014	—	INITAL SUB-AREA
COMB (2) & (3)	3.36	3.36	B	COM		9	4.9	0.04	0.04	11.98cfs	—	—	—	COMBINED AREAS

Figure D-6



LIMITATIONS:

1. Maximum length = 1000 Feet
2. Maximum area = 10 Acres

KEY
L - H - Tc - K - Tc'

PI	Development
80	Apartment
75	Mobile Home
65	Condominium
60	Single Family - 5,000 ft² Lot
40	Single Family - 1/4 Acre Lot
20	Single Family - 1 Acre Lot
10	Single Family - 2 1/2 Acre Lot

EXIST. UNDEV
L = 759 ft
Δh = 22
Tc = 15 MIN

EXAMPLE:

(1) L = 550', H = 5.0', K = Single Family (5-7 DU/AC) Development, Tc = 12.6 min.

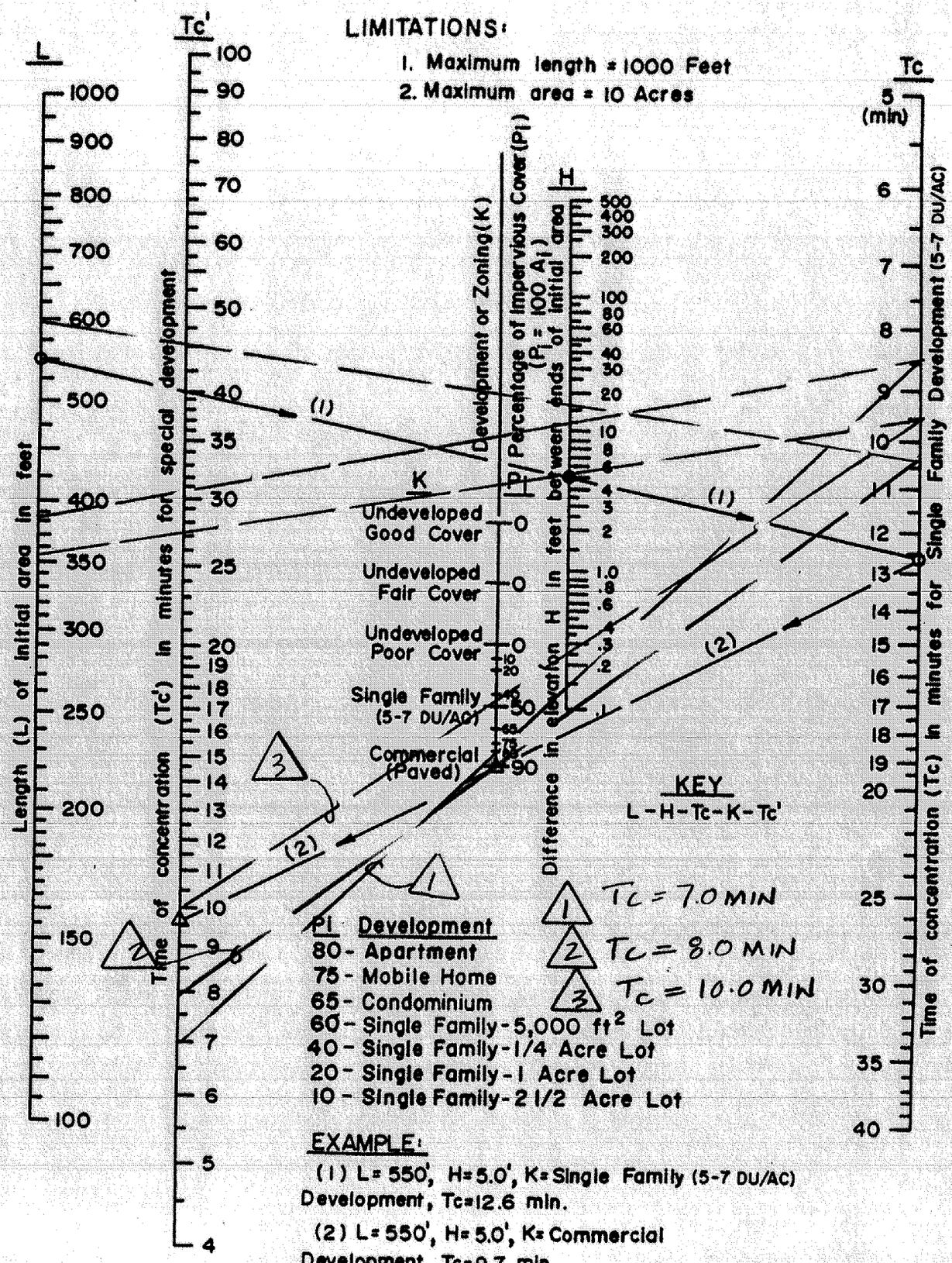
(2) L = 550', H = 5.0', K = Commercial Development, Tc = 9.7 min.

ON-SITE

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1



ON-SITE

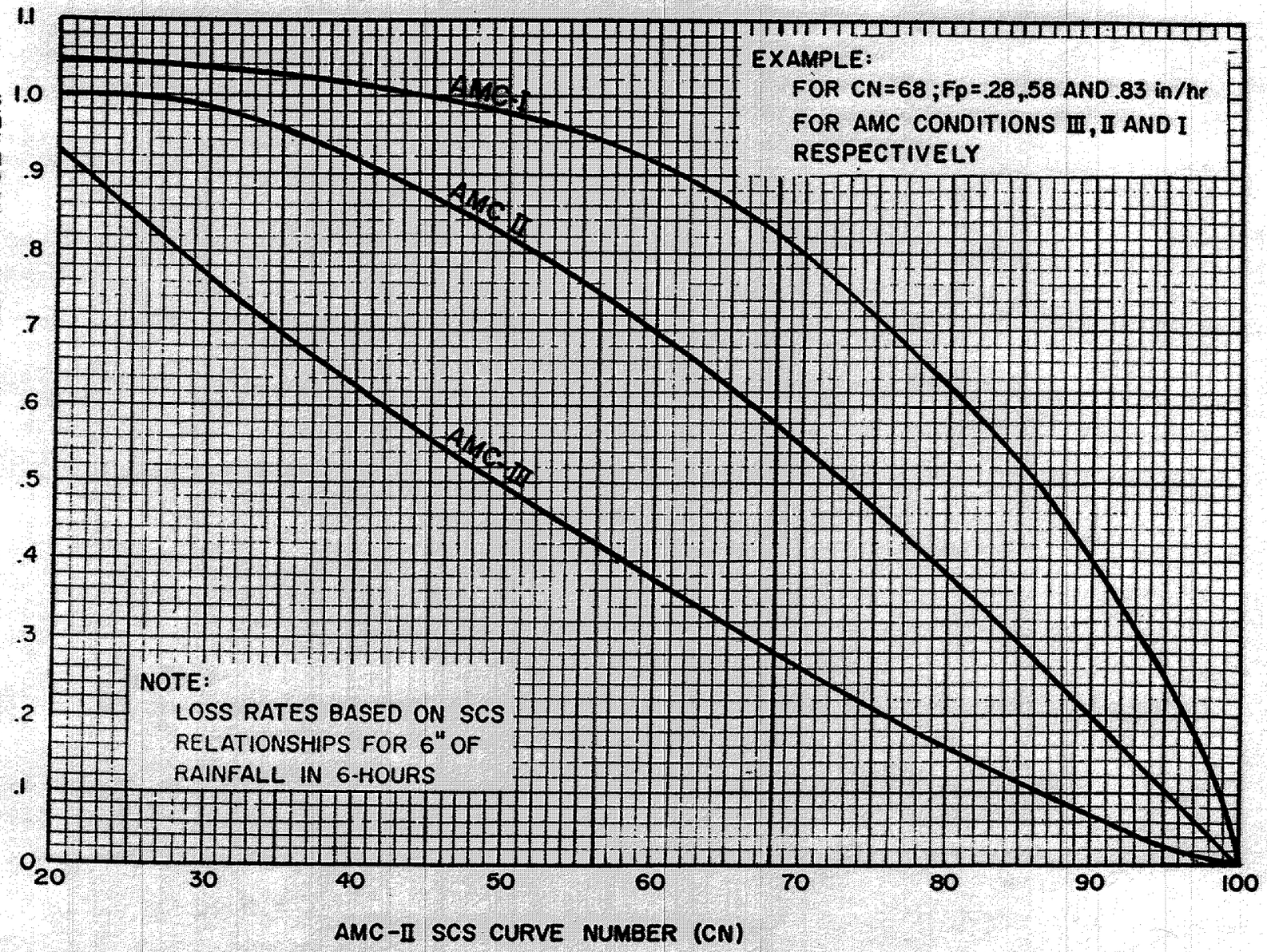
SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

⚠: 10YR - $F_m = 0.72 \times 0.1 = 0.07$ 100YR - $F_m = 0.42 \times 0.1 = 0.04$



$a_p = 1.0$

CN=56

PROPOSED ON-SITE

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

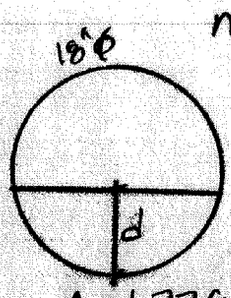
INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6

HYDRAULIC CALCULATIONS

18"Φ FOR FLOWS @ △1

$Q_{100} = 3.41$ cfs
$S = 0.6\%$
$n = 0.013$



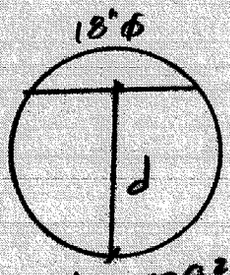
$A = 1.77 ft^2$
$R = 0.375 ft$

$Q_{MAX} = 8.14$ cfs
$v = 4.6$ fps

$d = 0.763$ ft
$v = 3.8$ fps

18"Φ FOR FLOWS @ △2

$Q_{100} = 10.94$ cfs
$S = 1.2\%$
$n = 0.013$



$A = 1.77 ft^2$
$S = 0.375$ ft

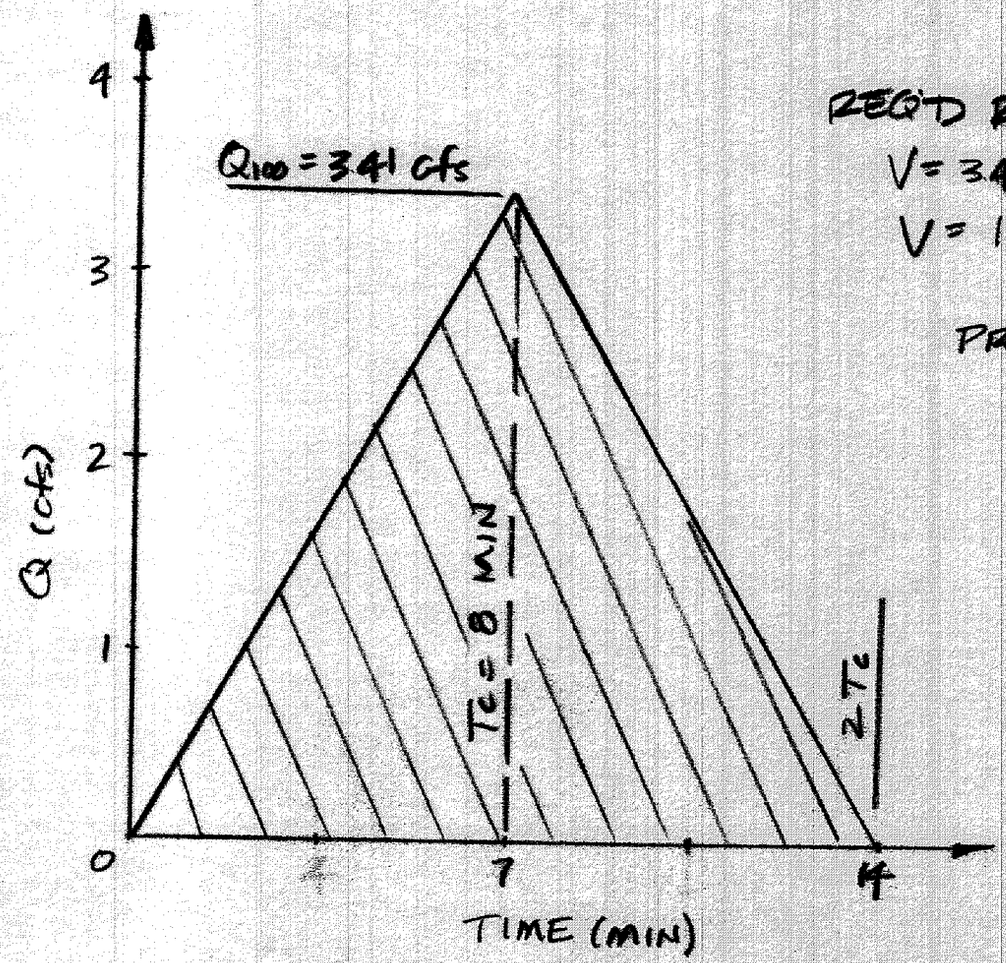
$Q_{MAX} = 11.51$ cfs
$v = 6.51$ fps

$d = 1.21'$
$v = 7.17$ fps

AMPAD

SIMPLIFIED UNIT HYDROGRAPH

RETAIN 100% OF 100-YR STORM FLOWS ON-SITE (1) Q_{100} = 3.41 cfs Tc = 7 MIN



REQ'D RETENTION VOLUME

$V = 3.41 cfs \times 14 MIN \times 1/2 \times 60 sec/MIN$

$V = 1{,}432$ cf

PROVIDED RETENTION VOLUME = 4,700 cf.

AMPAD

SIMPLIFIED UNIT HYDROGRAPH

RETAIN 100% OF 100YR STORM FLOWS

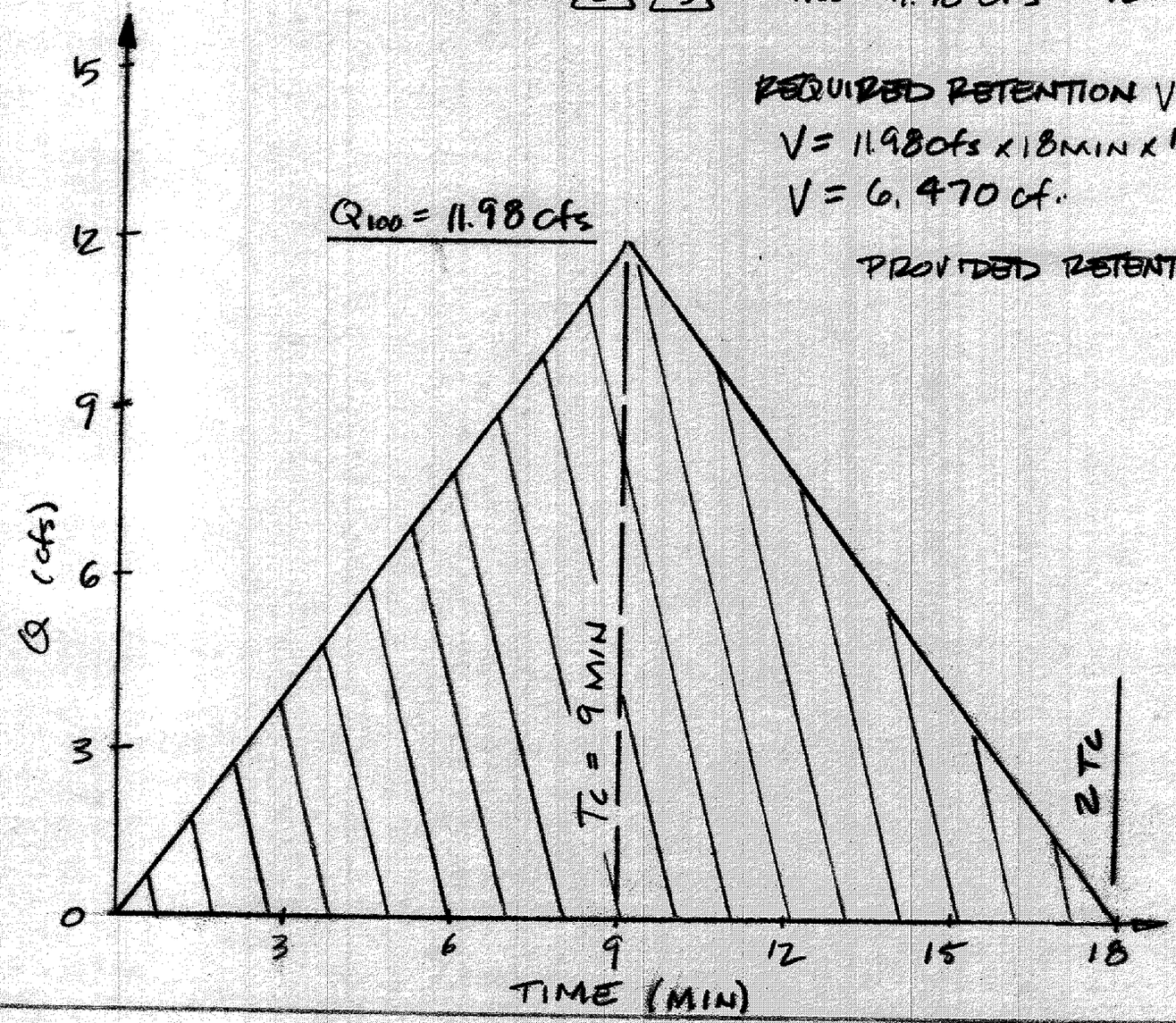
COMB. ON-SITE 2 & 3 : Q_{100} = 11.98 cfs Tc = 9 MIN

REQUIRED RETENTION VOLUME

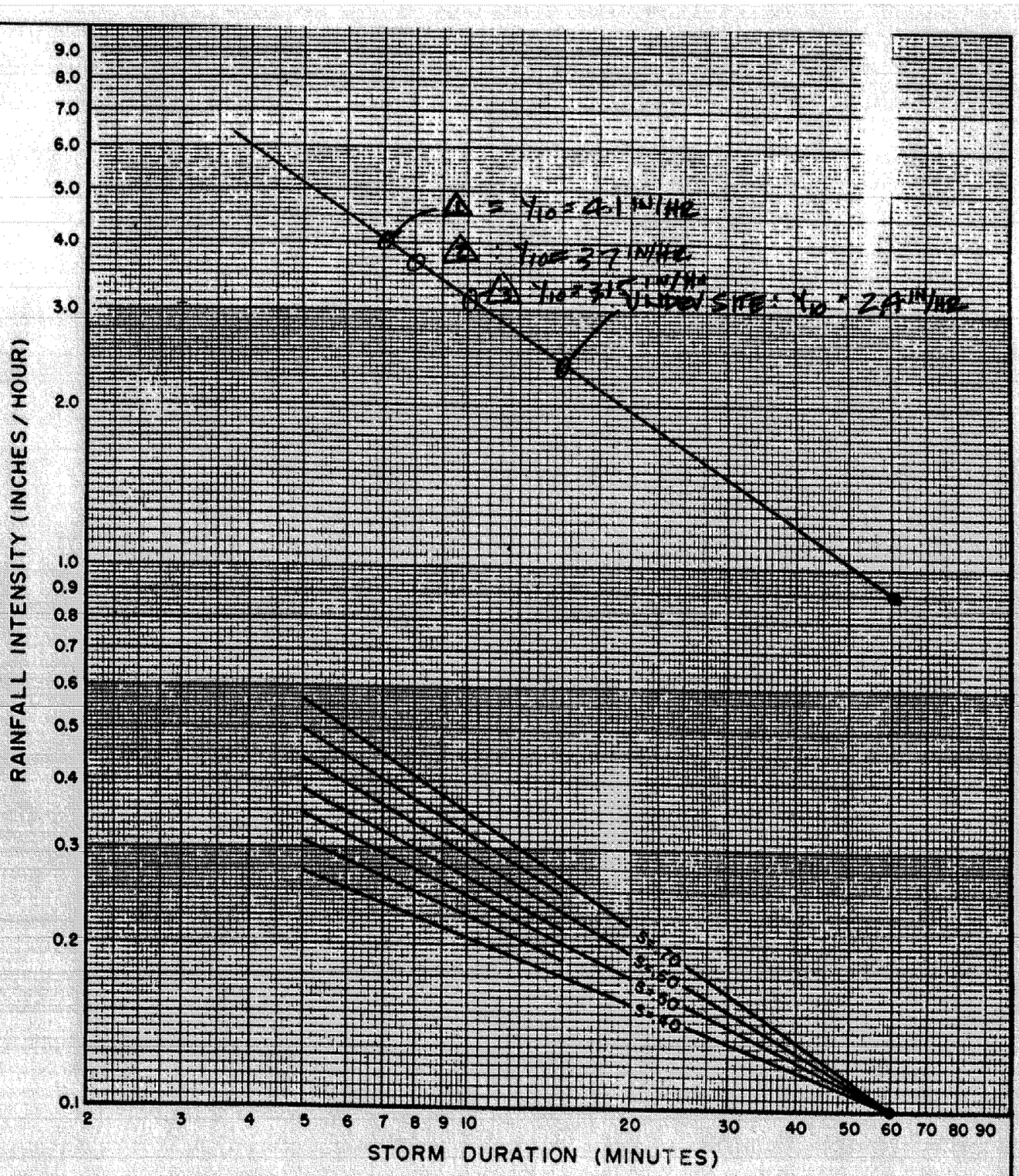
V = 11.98cfs x 18MIN x 1/2 x 60SEC/MIN

V = 6,470 cf.

PROVIDED RETENTION VOL = 9,583 cf.



SAN BERNARDINO DRAINAGE MANUAL
FIGURES & CHARTS



DESIGN STORM FREQUENCY = 10 YEARS

ONE HOUR POINT RAINFALL = 0.90 INCHES

LOG-LOG SLOPE = 0.70

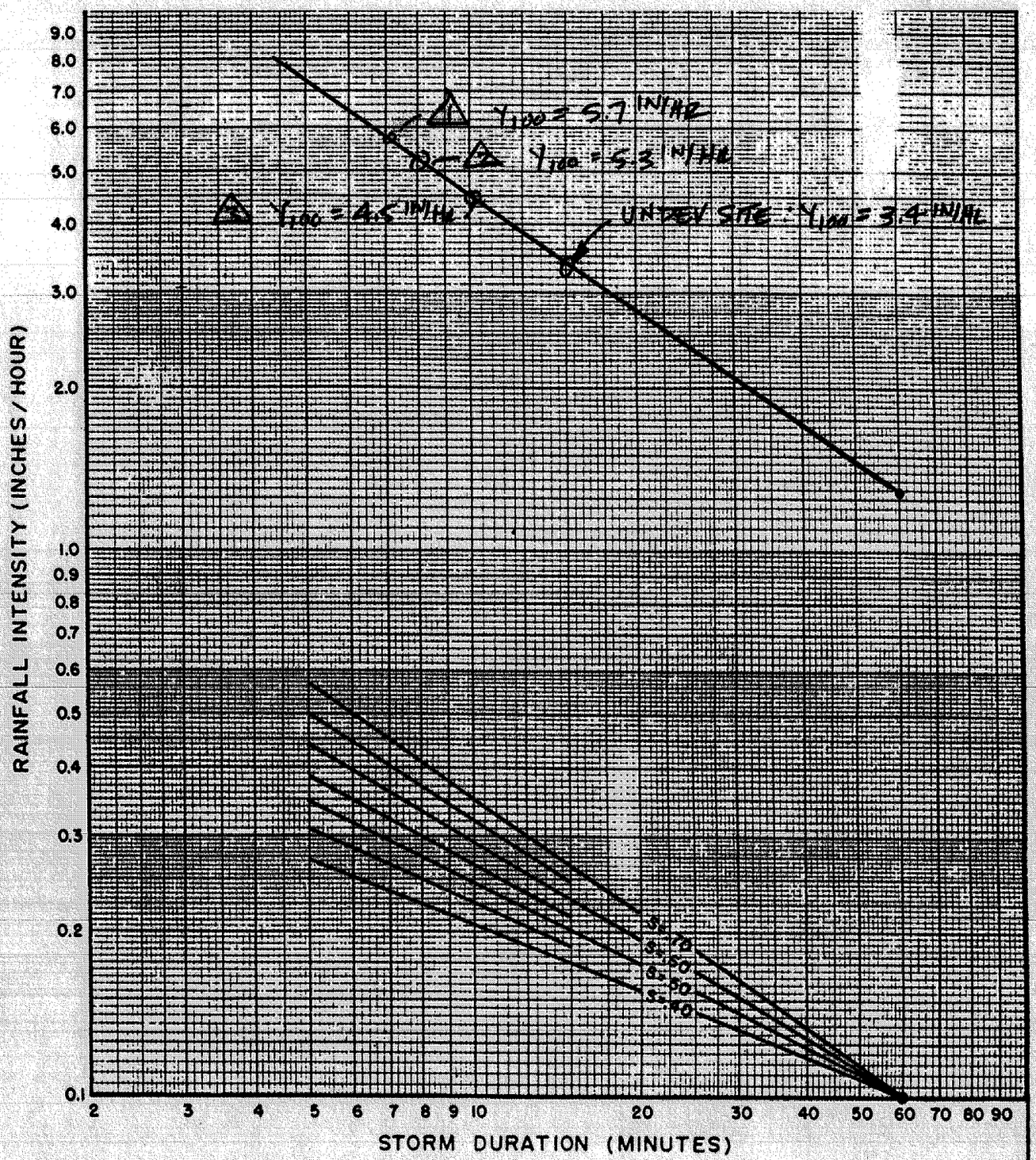
PROJECT LOCATION = PHELAN, CA

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

INTENSITY - DURATION CURVES CALCULATION SHEET

FIGURE D-3



DESIGN STORM FREQUENCY = 100 YEARS

ONE HOUR POINT RAINFALL = 1.3 INCHES

LOG-LOG SLOPE = 0.70

PROJECT LOCATION = PHELAN, CA

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

INTENSITY - DURATION CURVES CALCULATION SHEET

FIGURE D-3

TABLE C.2. Fm (in/hr) VALUES FOR TYPICAL COVER TYPES

COVER TYPE	A_p(1)	SOIL GROUP A	B	C	D
NATURAL:					
Barren	1.0	0.41	0.27	0.18	0.14
Row Crops (good)	1.0	0.59	0.41	0.29	0.22
Grass (fair)	1.0	0.82	0.56	0.40	0.31
Orchards (fair)	1.0	0.88	0.62	0.43	0.34
Woodland (fair)	1.0	0.95	0.69	0.50	0.40
URBAN:					
Residential (1 DU/AC)	0.80	0.78	0.60	0.45	0.37
Residential (2 DU/AC)	0.70	0.68	0.53	0.39	0.32
Residential (4 DU/AC)	0.60	0.58	0.45	0.34	0.28
Residential (10 DU/AC)	0.40	0.39	0.30	0.22	0.18
Condominium	0.35	0.34	0.26	0.20	0.16
Mobile Home Park	0.25	0.24	0.19	0.14	0.12
Apartments	0.20	0.19	0.15	0.11	0.09
Commercial/Industrial	0.10	0.10	0.08	0.06	0.05

NOTES:

(1) Recommended a_p values from Figure C-4

(2) AMC II assumed for all Fm values

(3) CN values obtained from Figure C-3

(4) DU/AC=dwelling unit per acre

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

Cover Type (3)	Quality of Cover (2)	Soil Group A	Soil Group B	Soil Group C	Soil Group 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

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CURVE NUMBERS FOR PERVIOUS AREAS

Figure C-3 (1 of 2)