

S. Pat Rymer Civil Engineer
R.C.E. 38709

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HYDRAULIC STUDY

LEMON CREST DRIVE
SUBDIVISION
TM 5582
LAKESIDE , CA 92040
APN 394-290-28

PDS2014-ER-14-14-005

By:
S. Pat Rymer, P.E.
Civil Engineer
1764 Bacon Street

February 12, 2019



DISCUSSION

Purpose

To determine surface flows for the design of drainage facilities and the development of a Storm Water Management Plan for a 24 unit residential subdivision.

Site Description

The site is located on a 17-acre lot in the rural community of Lakeside in an area that is essentially "built out" with all adjacent properties being residential single family dwellings. Except for an existing structure on the property that is to be removed as part of the proposed grading and construction, this lot is vacant and void of vegetation other than seasonal low lying weeds. The lot is slightly sloping with some trees and wild grasses and is located on the top of a hill (no offsite flow contributions).

Methodology

The "Modified Rational Method" was used to calculate surface flows in both before and after construction configurations.

Findings

As shown in the attached calculations sheets, there are 8 preconstruction drainage areas on this property that discharge at 8 different discharge points around the property. Of these, only two areas, Areas 4 and 5, do not discharge to an existing "hardened conveyance" systems. Areas 4 and 5 currently discharge as surface flows onto adjacent properties and eventually into hardened conveyances within public streets.

Summery/Conclusion

While proposed site modifications will modify existing on-site drainage patterns, no modifications to existing off site facilities are expected. All surface flows will be attenuated with tree wells with expanded basins placed throughout the project. Surface flows above and beyond the capacity of the tree wells be attenuated by the existing hardened conveyances in Lemon Crest Road, Janet Lane, Rockcrest Rd and Single Oak Dr.

The discharge of surface flows are not expected to significantly increase the flows in any of the hardened conveyance systems mentioned previously. Nor will it create any increased risk of flooding in any houses or other structures in the area. There is no housing in the 100 year flood hazard area, County of San Diego floodplain map or FEMA. There are no levees or dams in the area. The proposed project does not alter the existing drainage pattern in the area nor exceed the capacity of existing or planned storm water drainage systems. The proposed development project proposes drainage control elements that do not currently exist.

Declaration of Responsible Charge

I hereby declare that I am the Civil Engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in Section 6703 of the Business and Professions Code and that the design is consistent with current design.

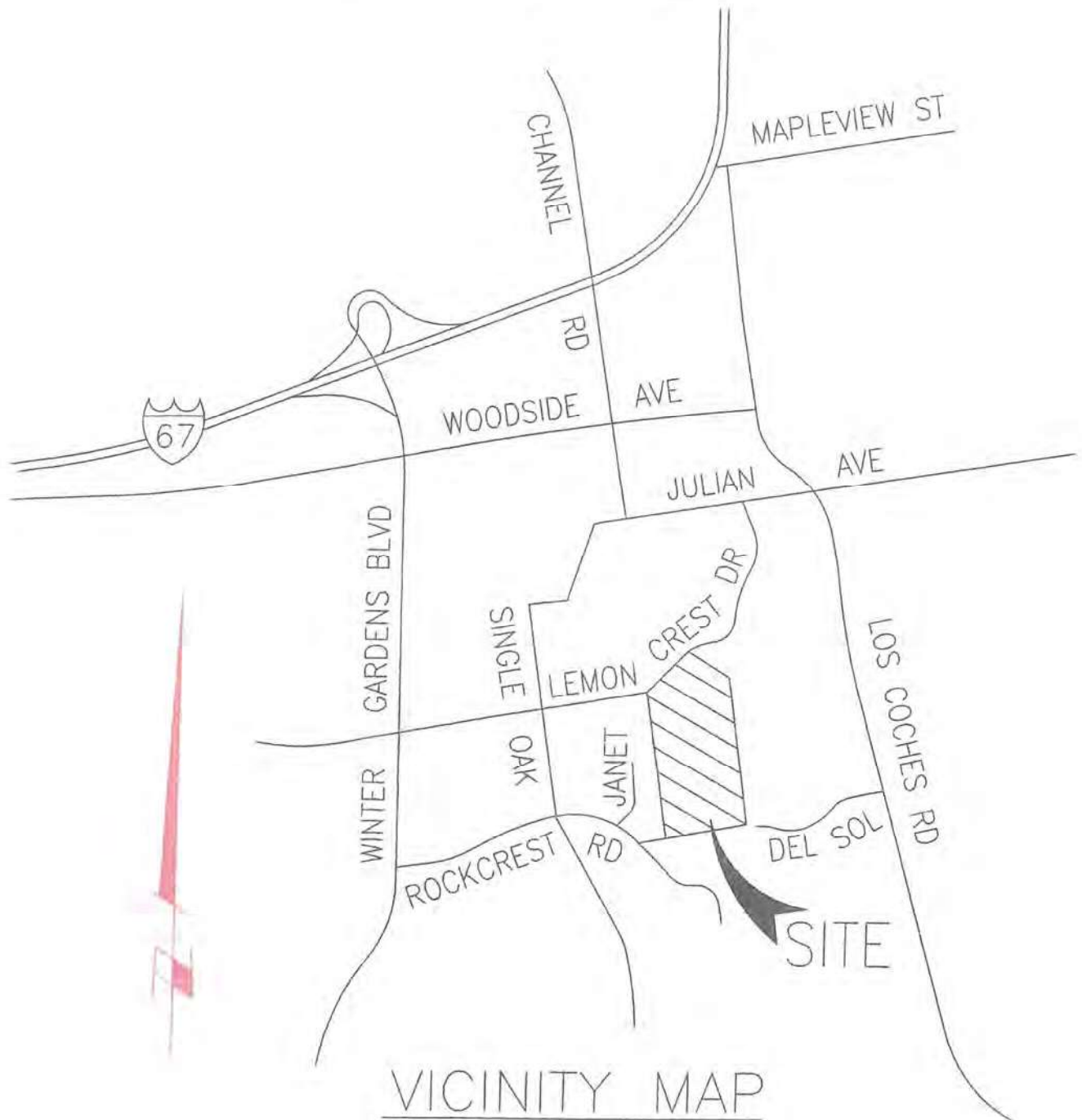
I understand that the check of the project drawing and specifications by the County of San Diego is confined to review only and does not relieve me, as the Engineer of work, of my responsibility for the project design.



S. Pat Rymer, P.E.
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3/12/20
Date

LAKE SIDE



VICINITY MAP

NOT TO SCALE

TB REF: PAGE 1232, B5

COUNTY OF SAN DIEGO TRACT NO. (LAKESIDE AREA)



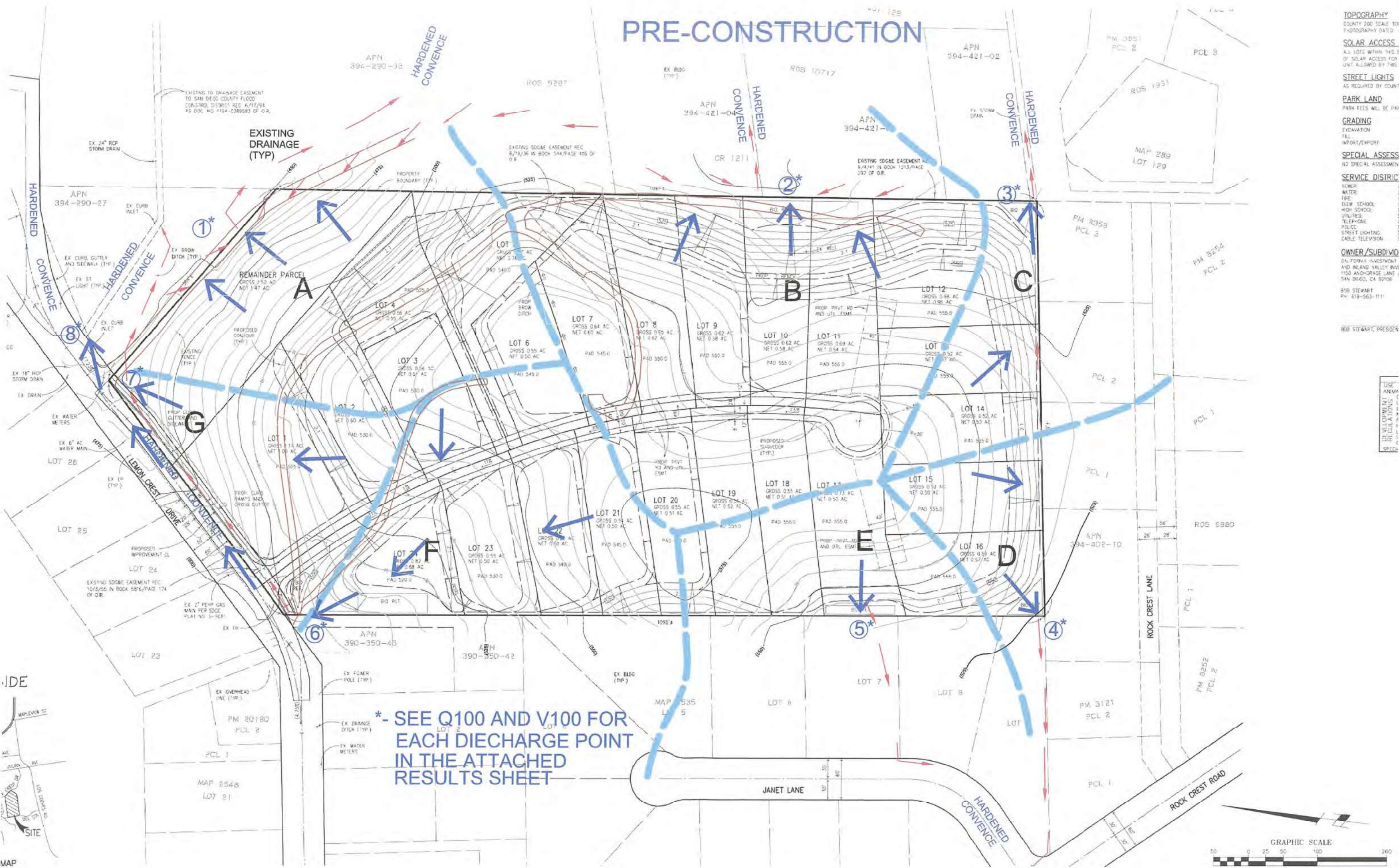
LEMON CREST DRIVE
TYPICAL SECTION

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 LAKESIDE TRACT NO. 3
 LAKESIDE TRACT NO. 4
 LAKESIDE TRACT NO. 5
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LEMON CREST

PRE-CONSTRUCTION



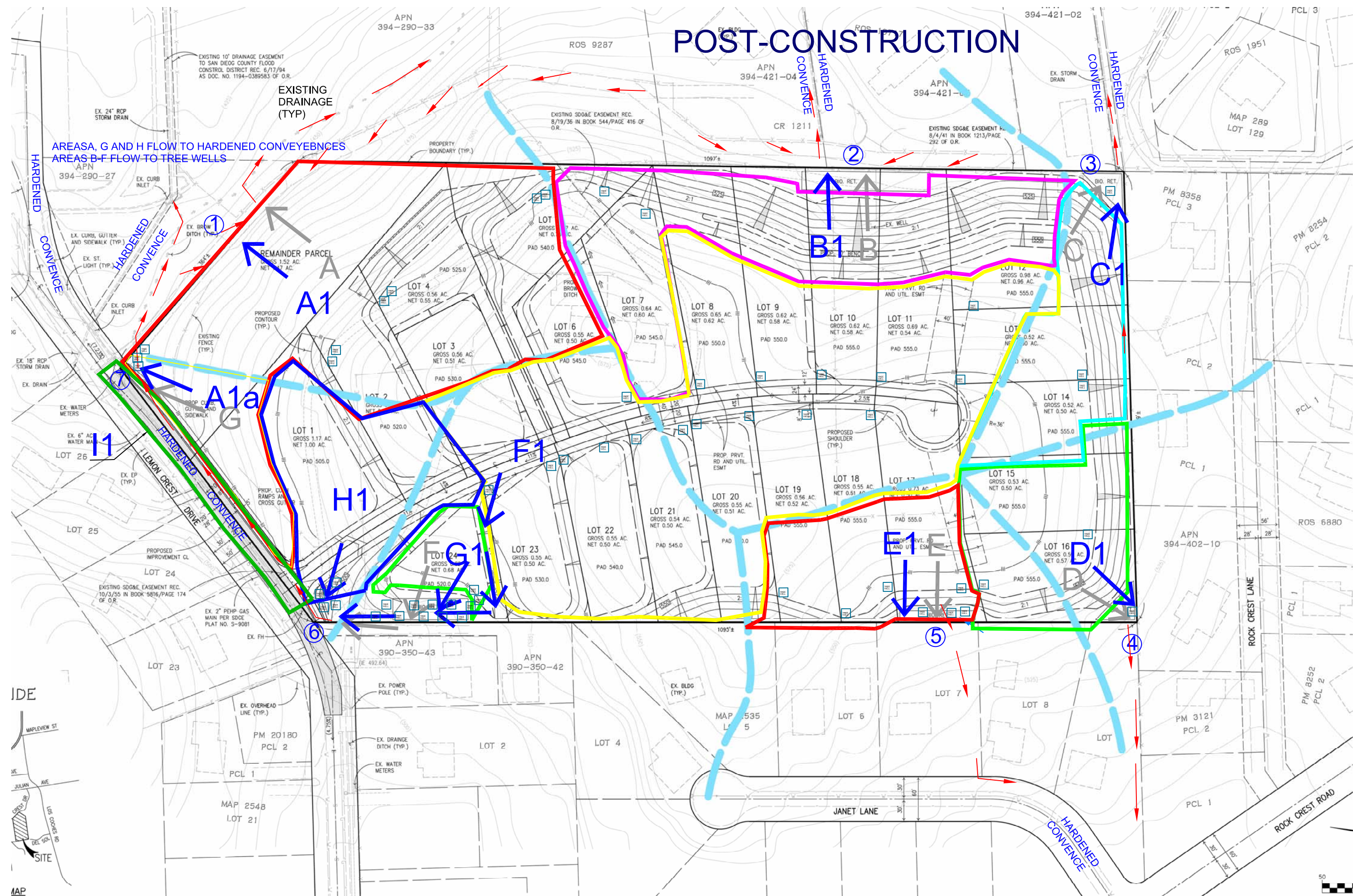
* - SEE Q100 AND V100 FOR EACH DIECHARGE POINT IN THE ATTACHED RESULTS SHEET

- TOPOGRAPHY
COUNTY 200 SCALE TOP
PHOTOGRAPHY DATED 11/11/94
- SOLAR ACCESS
ALL LOTS WITHIN THIS SITE
OF SOLAR ACCESS FOR 1
UNIT ALLOWED BY THIS SITE
- STREET LIGHTS
AS REQUIRED BY COUNTY
- PARK LAND
PARK FEES WILL BE PAID
- GRADING
EXCAVATION
FILL
IMPORT/EXPORT
- SPECIAL ASSESSMENT
NO SPECIAL ASSESSMENT
- SERVICE DISTRICT
SCHOOL
WATER
FIRE
ELEM. SCHOOL
HIGH SCHOOL
UTILITIES
TELEPHONE
POLICE
STREET LIGHTING
CABLE TELEVISION
- OWNER/SUBDIVIDOR
CALIFORNIA INVESTMENT
AND RECREATION TRUST
1150 ANCHORAGE LANE
SAN DIEGO, CA 92108
BOB STEWART
PR. 619-563-1111

USE
ANIMA
BLOCKS
SPEC



POST-CONSTRUCTION



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AS REQUIRED BY COUNTY E

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SERVICE DISTRICTS

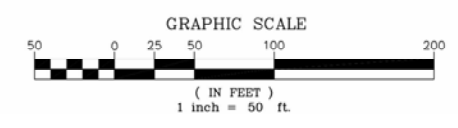
SEWER:	LAKI
WATER:	LAKI
FIRE:	LAKI
ELEM. SCHOOL:	LAKI
HIGH SCHOOL:	GRO
UTILITIES:	SAN
TELEPHONE:	AT&
STREET LIGHTING:	SAN
CABLE TELEVISION:	DEV

OWNER/SUBDIVIDER
CALIFORNIA INVESTMENT BAN
AND INLAND VALLEY INVEST
1150 ANCHORAGE LANE #101
SAN DIEGO, CA 92106

BOB STEWART
PH: 619-563-1111

BOB STEWART, PRESIDENT

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SPECIAL



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FORMULAS

Bob Stewart

Lemon Crest Rd.

Lakeside, CA 92040

DELT ELEV Change in elevation (ft).

D	Distance (ft).	
L	Distance (miles).	D/5280
s	Slope	DELT ELEV/D
Cp	Pervious Coefficient	Table 3-1
Impv	Percent Impervious	
C	Runoff Coefficient	.90x(% impervious)+Cp(1-% impervious)
Ti	Initial Time of concentra	$= 1.8(1.1-C)(\text{square root of D})/(\text{cube root of s})$ (see figure 3-3 Hydraulics Manual)
Tc	Time of Concentration	$= ((11.9L^3)/\text{DELT ELEV})^{0.385}$ (see figure 3-4 Hydraulics Manual)
I	Intensity	$= 7.44P6D^{0.645}$ (see figure 3-1 Hydraulics Manual)
A	Area	
Q	Flow	$= \quad \quad \quad \text{CIA}$

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RESULTS SHEET

Bob Stewart
Lemon Crest Rd.
Lakeside, CA 92040

RESULTS

Discharge Point	Pre Construction	Post Construction	Change	Mitigated Post Con	Basin/ TW	Comment
1	3.15	4.03	0.88	3.15	Tree Well	*
2	4.62	2.37	-2.25		Tree Well	Decreased Flows
3	0.89	1.23	0.34	0.89	Tree Well	*
4	0.88	1.41	0.53	0.88	Tree Well	*
5	1.25	2.71	1.46	1.25	Tree Well	*
6	2.53	13.20	10.67	2.53	Tree Well	*
7	1.67	0.58	-1.09		Tree Well	Decreased Flows
8	0.80	0.58	-0.22		Tree Well	Decreased Flows
	15.79	26.11	10.32	8.70		

*-See "Flow Retention" sheet for tree well retention details.

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2/4/2019

**PRE-CONSTRUCTION
CALCULATION SHEET- Q100
INPUT DATA**

Bob Stewart
Lemon Crest Rd.
Lakeside, CA 92040

SYSTEM	UP STREAM NODE	DOWN STREAM NODE	A (ac)	Imprv. (%)	RUNOFF COEF C	ELEV DIFF (ft)	D (ft)	s (ac)	T _i (min)	T _t (hr)	T _c (min)	I (in/hr)	Q 100 (cfs)	V 100 (fps)	DRAINAGE SYSTEM
1	8	1	3.41	0.05	0.25	125.00	500.00	25.00	13.03	0.03	14.62	3.43	2.92	1.95	UNDEVELOPED
2	9	2	5.50	0.15	0.25	73.00	505.87	14.43	15.45	0.03	17.44	3.06	4.21	2.81	UNDEVELOPED
3	10	3	1.08	0.05	0.25	57.00	465.91	12.23	15.58	0.03	17.57	3.05	0.82	0.55	UNDEVELOPED
4	10	4	0.70	0.05	0.25	50.00	308.32	16.22	11.65	0.02	12.94	3.71	0.65	0.43	UNDEVELOPED
5	9	5	1.30	0.05	0.25	32.00	294.88	10.85	12.85	0.02	14.31	3.48	1.13	0.75	UNDEVELOPED
6	8	6	3.30	0.05	0.25	70.00	579.29	12.08	17.44	0.04	19.80	2.82	2.33	1.55	UNDEVELOPED
7	11	7	1.70	0.05	0.25	102.00	454.53	22.44	12.83	0.03	14.37	3.47	1.47	0.98	UNDEVELOPED
8	6	7	0.17	0.05	0.80	24.50	408.38	6.00	6.38	0.04	8.74	4.78	0.65	0.43	PAVED STREET
													14.18		
													17.16		

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2/4/2019

POST-CONSTRUCTION**CALCULATION SHEET- Q100****SUMMARY OF MODIFIED RATIONAL METHOD**

Bob Stewart

Lemon Crest Rd.

Lakeside, CA 92040

AREA	C	A (ac)	CA	D (FT)	DELTA EL (FT)	D (Mi)	S (%)	Ti (FIG 3-3) (min)	Tt (FIG 3-4) (min)	Tc (min)	I (FIG 3-1)	Q100 (cfs)
A	0.25	2.31	0.58	176.73	55.00	0.03	31.12	12	0.01	12	3.80	2.19
A1	0.38	0.44	0.17	204.00	2.00	0.04	0.98	11	0.05	11	4.00	0.67
A2	0.38	0.46	0.17	187.66	2.00	0.04	1.07	11	0.04	11	4.00	0.70
A3	0.38	0.31	0.12	122.76	1.00	0.02	0.81	11	0.03	11	4.00	0.47
		3.52	1.04									4.03
B	0.25	1.41	0.35	318.29	50.00	0.06	15.71	11	0.02	11	4.00	1.41
B1	0.38	0.60	0.23	272.88	2.00	0.05	0.73	10	0.06	10	4.20	0.96
		2.01	0.58									2.37
C	0.25	0.48	0.12	309.16	40.00	0.06	12.94	11	0.02	11	4.00	0.48
C1	0.38	0.47	0.18	158.96	2.00	0.03	1.26	10	0.03	10	4.20	0.75
		0.95	0.30									1.23
D	0.25	0.44	0.11	244.90	10.00	0.05	4.08	11	0.03	11	4.00	0.44
D1	0.38	0.61	0.23	174.48	1.00	0.03	0.57	10	0.05	10	4.20	0.97
		1.05	0.34									1.41
E	0.25	0.16	0.04	84.88	15.00	0.02	17.67	11	0.01	11	4.00	0.16
E1	0.38	0.28	0.11	152.84	1.00	0.03	0.65	11	0.04	11	4.00	0.43
E2	0.38	0.47	0.18	165.33	1.00	0.03	0.60	11	0.05	11	4.00	0.71
		1.96	0.67									2.71
F1	0.38	0.22	0.08	113.21	1.00	0.02	0.88	10	0.03	10	4.20	0.35
F2	0.38	0.21	0.08	130.14	1.00	0.02	0.77	10	0.04	10	4.20	0.34
F3	0.38	0.64	0.24	214.76	2.00	0.04	0.93	10	0.05	10	4.20	1.02
F4	0.38	0.50	0.19	202.60	2.00	0.04	0.99	10	0.05	10	4.20	0.80
F5	0.38	0.47	0.18	207.92	2.00	0.04	0.96	10	0.05	10	4.20	0.75
F6	0.38	0.66	0.25	205.33	2.00	0.04	0.97	10	0.05	10	4.20	1.05
F7	0.38	0.42	0.16	221.03	2.00	0.04	0.90	10	0.05	10	4.20	0.67
F8	0.38	0.41	0.16	233.88	2.00	0.04	0.86	10	0.05	10	4.20	0.65
F9	0.38	0.44	0.17	227.15	2.00	0.04	0.88	10	0.05	10	4.20	0.70
F10	0.38	0.45	0.17	201.51	2.00	0.04	0.99	10	0.05	10	4.20	0.72
F11	0.80	0.40	0.32	808.00	41.00	0.15	5.07	10	0.07	10	4.20	1.34
		6.78	2.67									11.11
G1	0.38	0.25	0.10	117.16	1.00	0.02	0.85	10	0.03	10	4.20	0.40
												0.40
H1	0.38	0.80	0.30	298.27	10.00	0.06	3.35	11	0.04	11	4.00	1.22
H2	0.38	0.30	0.11	164.05	10.00	0.03	6.10	10	0.02	10	4.20	0.48
		1.1	0.42									1.69
I1	0.86	0.16	0.14	408.38	24.00	0.08	5.88	10	0.04	10	4.20	0.58
												0.58

TOTAL FLOW= **25.54**

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DISCHARGE PT 4- GRASS LINED CHANNEL

SHAPE- Roughly Parabolic

W(T)= 10.00 L= 300.00 DELT H= 45.00 n= 0.125 (weedy channel)

$Q = K'/n * T^{2.67} * s^{0.5}$ (Kings table 7-16) s=0.13

PRE CON

Q100= 0.88 cfs (hyd study)

K'= 0.0060

D/T= 0.055 D= 0.55

POST CON

Q100= 1.41 cfs (hyd study)

K'= 0.0096

D/T= 0.07 D= 0.7

CHANGE IN DEPTH= 0.15' (1.8")

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DISCHARGE PT 5- GRASS LINED CHANNEL

SHAPE- Roughly Parabolic

W(T)= 10.00 L= 150.00 DELT H= 45.00 n= 0.125 (weedy channel)

$Q = K'/n * T^{2.67} * s^{0.5}$ (Kings table 7-16) s=0.13

PRE CON

Q100= 1.29 cfs (hyd study)

K'= 0.0088

D/T= 0.07 D= 0.7

POST CON

Q100= 2.91 cfs (hyd study)

K'= 0.0199

D/T= 0.08 D= 0.8

CHANGE IN DEPTH= 0.1' (1.2")

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LEMONCREST HARDENED CONVEYENCE CAPACITY CALCS

Area 1- Curbeand gutter along Lemoncrest Dr.

Discharge Pt.7 (pre con)

$$Q_{6\&7} = 4.03 \text{ CFS} \quad s = 5.88 \%$$

(per Fig 3-6)

$$\text{Depth} = 0.28 \text{ ft} \quad v = 5.30 \text{ fps}$$

Discharge Pt.7 (post con)

$$Q_{6\&7} = 14.75 \text{ CFS} \quad s = 5.88 \%$$

(per Fig 3-6)

$$\text{Depth} = 0.38 \text{ ft}^* \quad v = 6.50 \text{ fps}$$

*- Less than 6"- OK

Downstream Hardned Conveyence (culvert)

PRE CON

$$Q = \text{Area1} + \text{Area7} + \text{Area6} + \text{Area8} = 6.47 \text{ cfs}$$

POST CON

$$Q = \text{Area A} + \text{Area F} + \text{Area G} + \text{Area H} + \text{Area I} = 19.07 \text{ cfs}$$

$$\text{Culvert Acpacity} = 28.30 \text{ cfs}^{**}$$

** - per County improvement plans

Janet Ln/Rockcrest Hardented Conveyence

$$Q_{4\&5} = 1.88 \text{ CFS} \quad s = 6.00 \%$$

(per Fig 3-6)

$$\text{Depth} = 0.23 \text{ ft}^{***} \quad v = 5.00 \text{ fps}$$

*** - Less than 6"- OK)

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4/18/20
Flow Retention

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Post Construction Retention

AREA	DIS. POINT	TREES WELLS (#)	PRE Q100 (CFS)	POST Q100 (CFS)	POST CON INCREASE (CFS)*	RELEASE PER BASIN (CFS)	RELEASE PIPE (IN)	RELEASE V (FPS)	6 HR VOL PER AREA (CUFT)	VOL PER BASIN (CUFT)	CAPTURE NEEDED (CUFT)**	BASIN DEPTH H (FT)**
A	1	6	3.15	4.03	0.88	0.53	2.50	4.03	19,008	3,168	648	1.50
B	2	2	4.62	2.37	-2.25							
C	3	3	0.89	1.23	0.34	0.30	2.00	3.56	7,344	2,448	1,188	3.00
D	4	4	0.88	1.41	0.53	0.22	2.00	2.64	11,448	2,862	1,182	3.00
E	5	7	1.25	2.71	1.46	0.18	2.00	2.14	31,536	4,505	1,565	3.50
F,G&H	6	34	2.52	13.20	10.68	0.07	1.50	1.58	230,688	6,785	-7,495	0.50
I	7	3	1.67	0.58	-1.09							
TOTAL		59	14.98	25.53	10.55				227,880			

TREE WELL= 420 CUFT

*- Negative values indicate decreased post construction flows.

BASIN VOLUMES

1'= 298 CUFT
2'= 739 CUFT
3'= 1364 CUFT
4'= 2205 CUFT

** - Volume and depth shown here are in addition to the soil volume provided in the tree well for storm water management purposes.

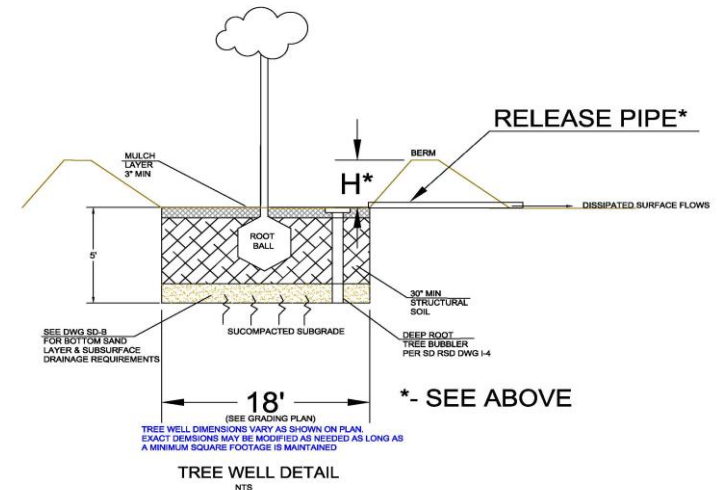


Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
NRCS Elements	County Elements	% IMPER.	Soil Type			
			A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% are:

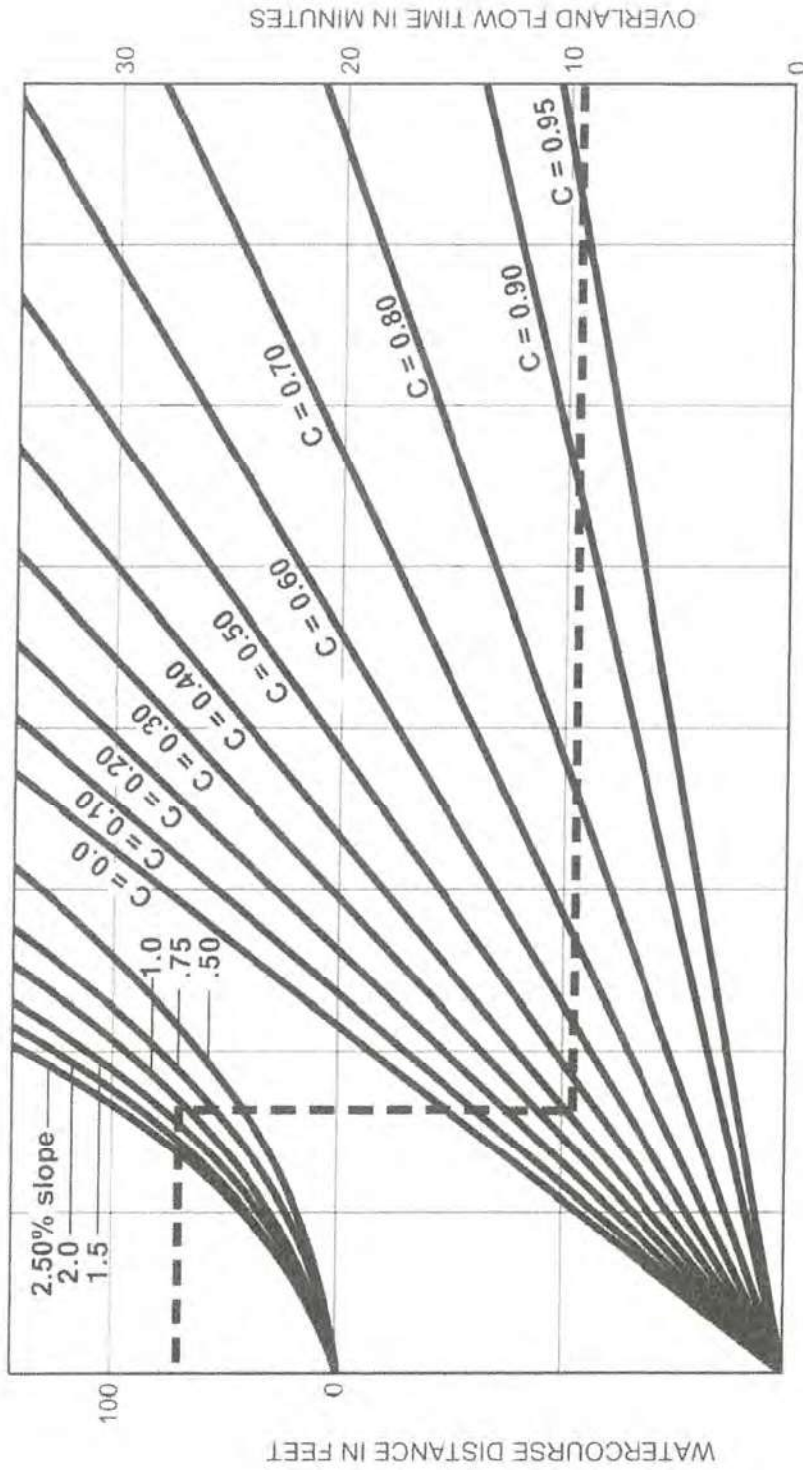
*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

FIGURE

3-3

Rational Formula - Overland Time of Flow Nomograph



EXAMPLE

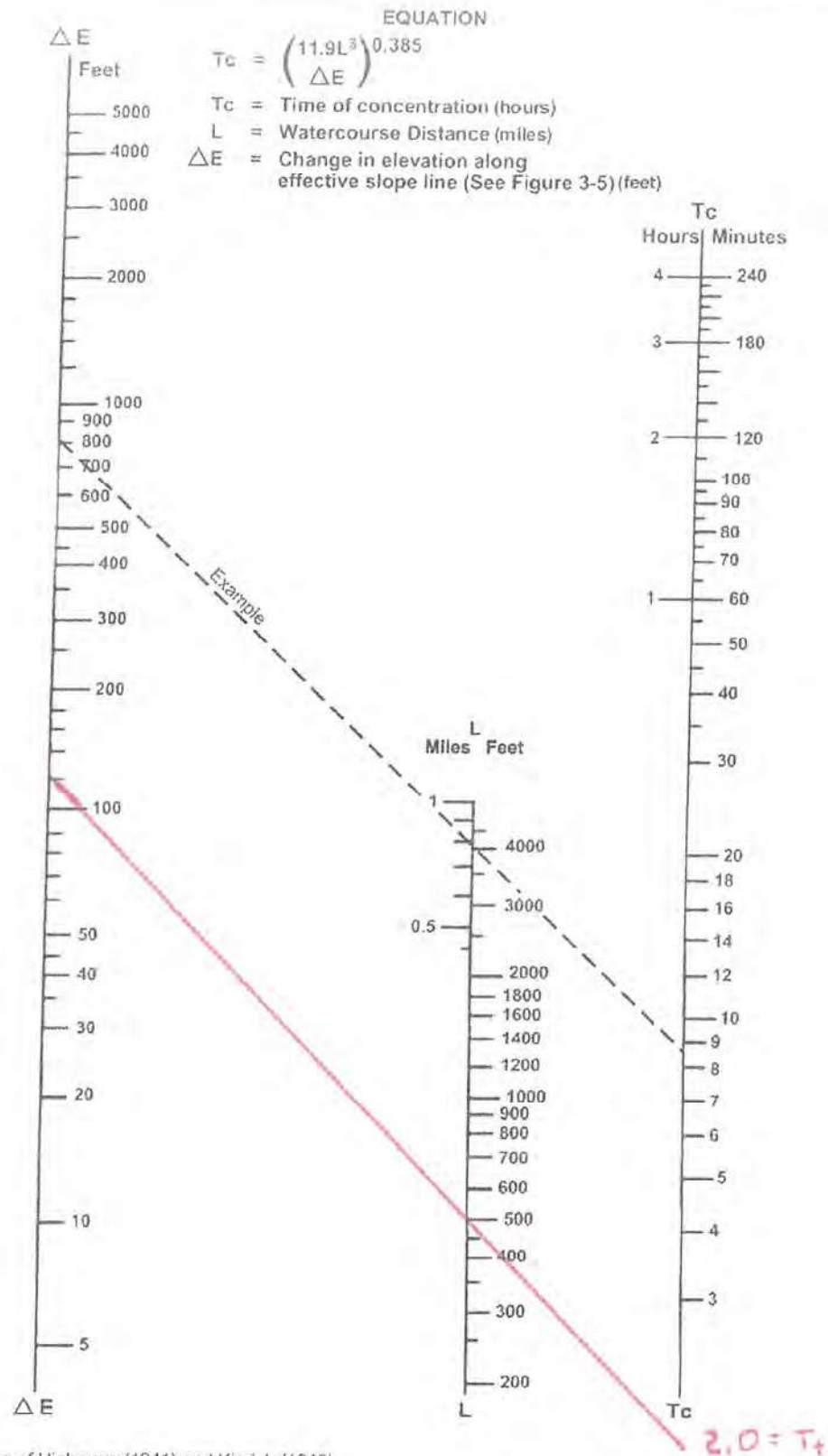
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

SLOPES > 10%
USE FORMULA
AREA 5 1-8

$$T = \frac{1.8 (1.1-C) \sqrt{D}}{s}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

AREA 1



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

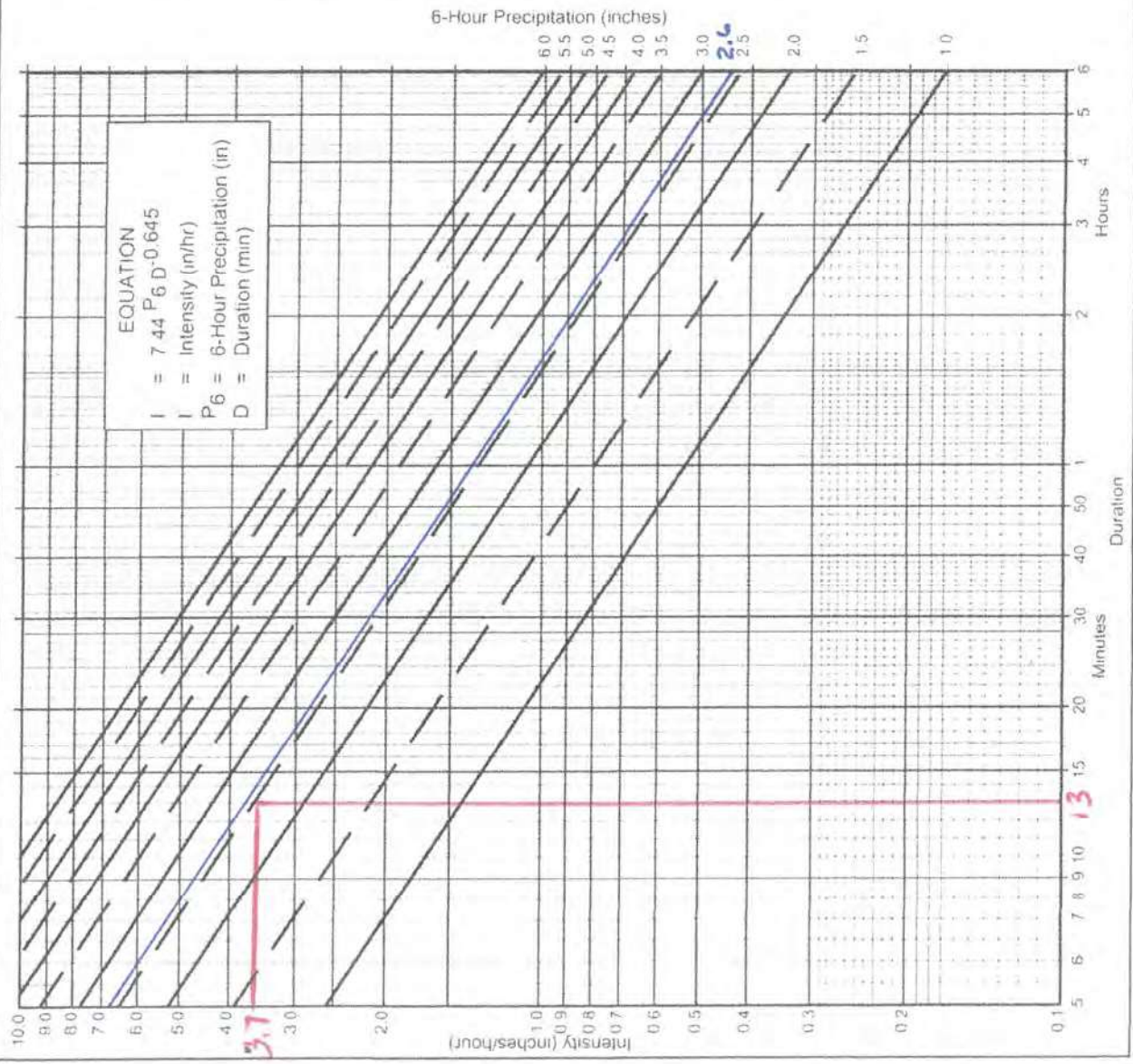
Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed

Application Form:

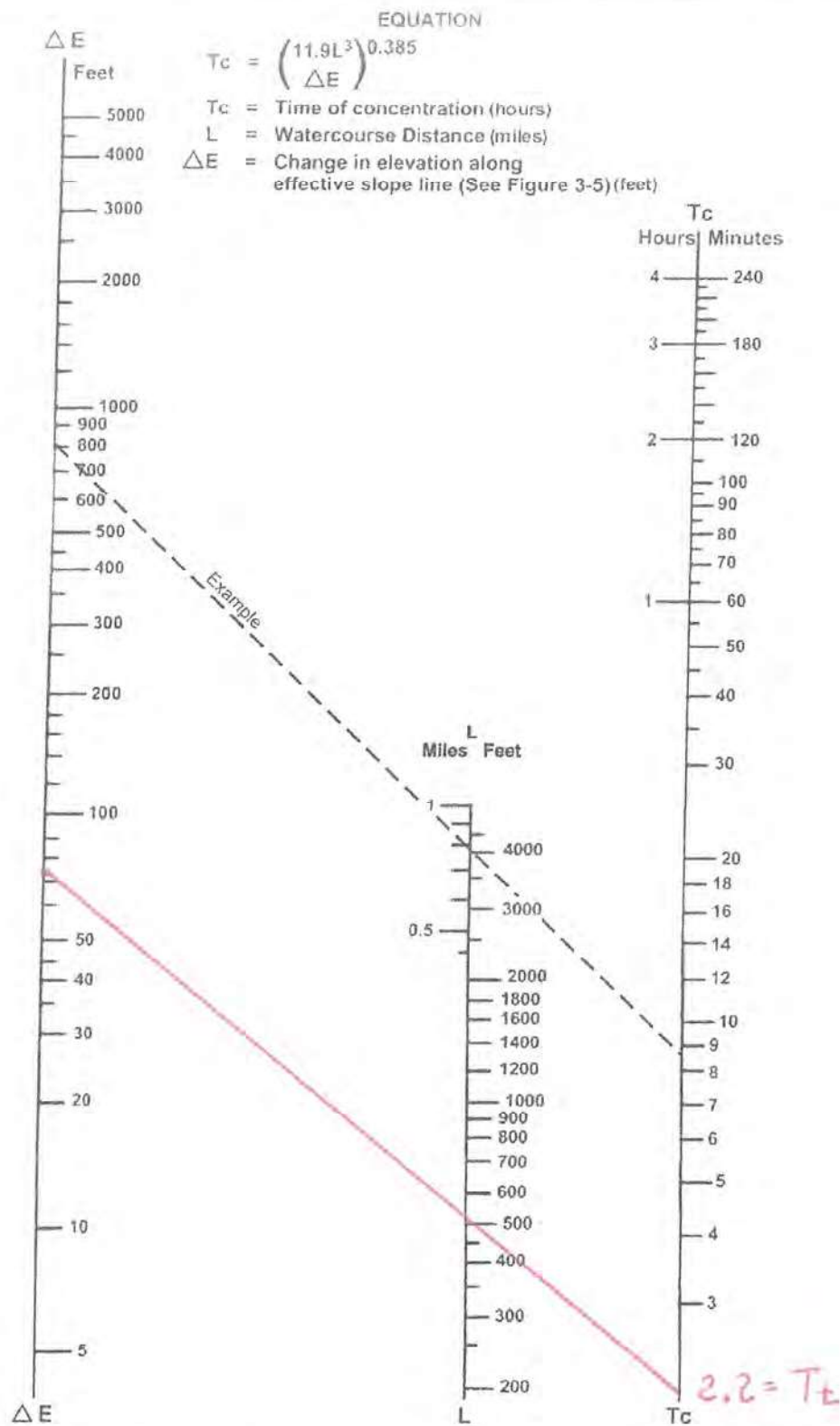
- (a) Selected frequency 100 year
- (b) $P_6 = 2.6$ in., $P_{24} = 5.5$, $\frac{P_6}{P_{24}} = 47\%$
- (c) Adjusted $P_6^{(2)} = 2.6$ in.
- (d) $t_x = 13$ min. (eq Fig 3-3)
- (e) $I = 3.69$ in./hr. (eq Fig 3-1)

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.



P ₆	Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.85	13.17	14.49	15.81	
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72	
10	1.58	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11	
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78	
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46	
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60	
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98	
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13	
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58	
60	0.53	0.80	1.06	1.33	1.59	1.85	2.12	2.39	2.65	2.92	3.18	
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45	
120	0.34	0.51	0.68	0.85	1.02	1.19	1.35	1.53	1.70	1.87	2.04	
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76	
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57	
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30	
300	0.19	0.28	0.38	0.47	0.56	0.65	0.75	0.85	0.94	1.03	1.13	
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00	

Intensity-Duration Design Chart - Template



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50 and 100 yr maps included in the Design and Procedure Manual)
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed

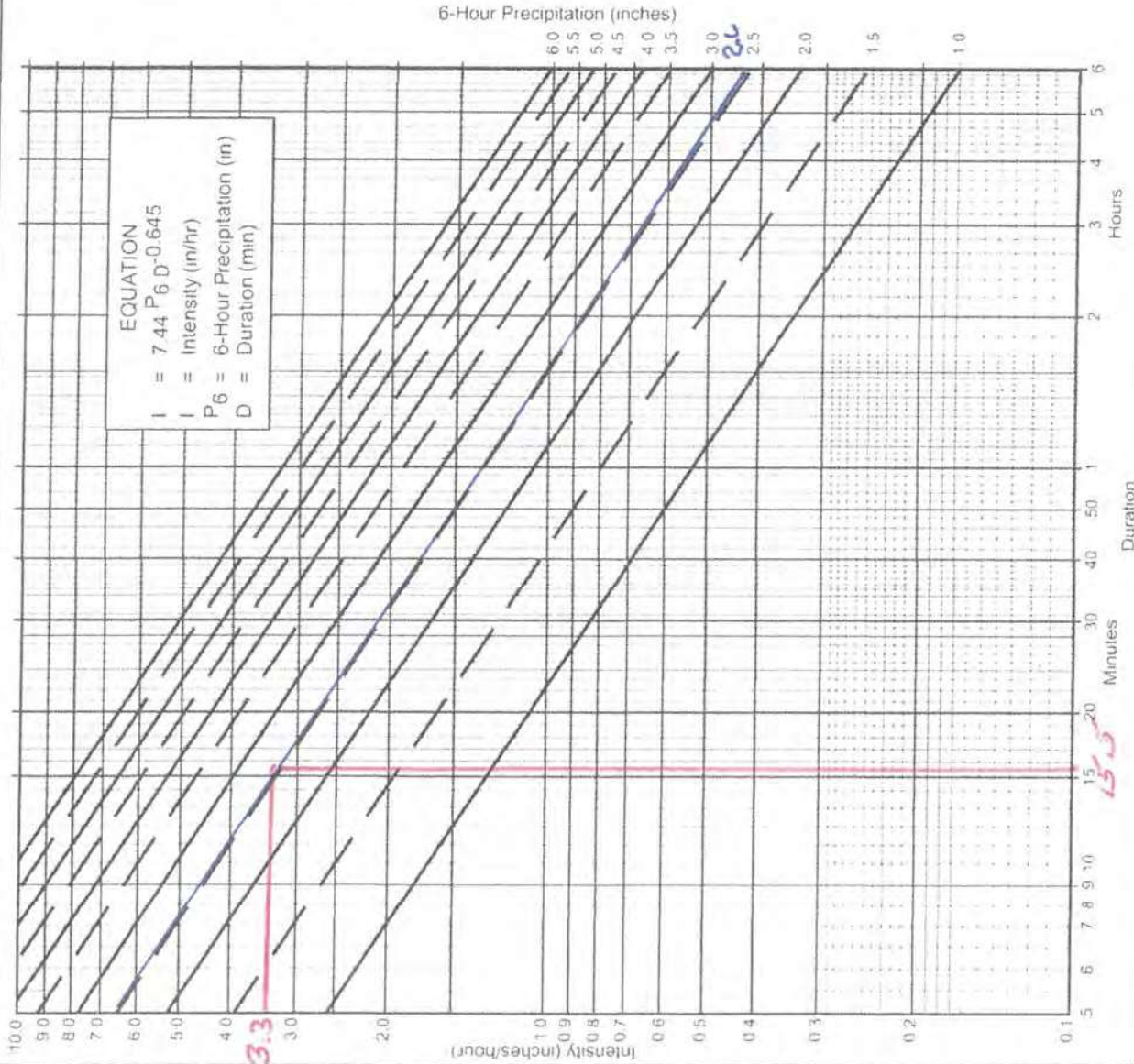
Application Form:

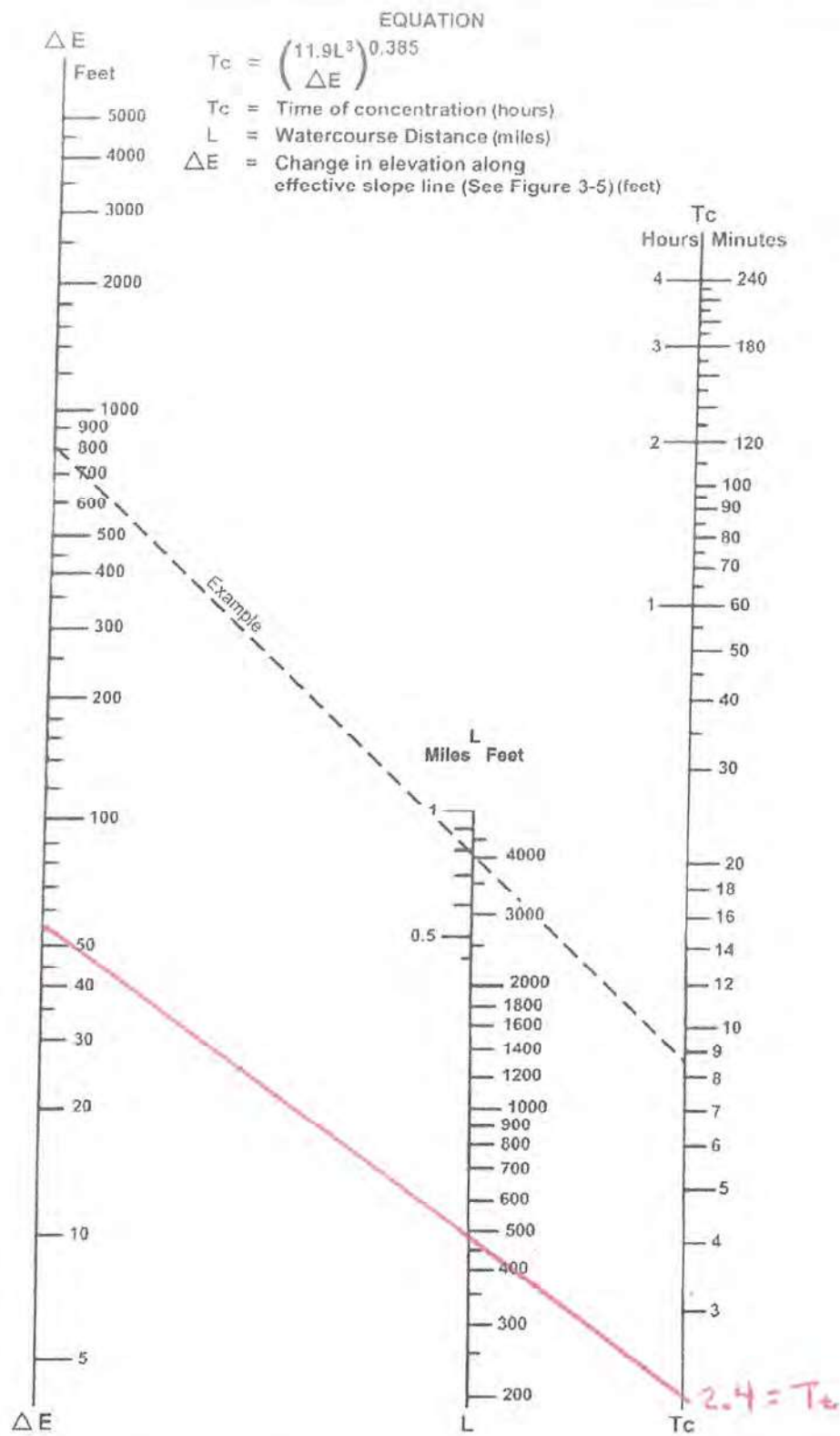
- Selected frequency 100 year
- $P_6 = \underline{2.6}$ in., $P_{24} = \underline{5.5}$, $\frac{P_6}{P_{24}} = \underline{47\%}$
- Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- $t_x = \underline{15.4}$ min. (eq Fig 3-3)
- $I = \underline{3.31}$ in./hr. (eq Fig 3-1)

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	
Duration	5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.85	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72	
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11	
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78	
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46	
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60	
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98	
40	0.69	1.03	1.38	1.72	2.07	2.41	2.75	3.10	3.45	3.79	4.13	
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58	
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18	
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45	
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04	
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76	
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57	
240	0.22	0.33	0.43	0.54	0.65	0.75	0.87	0.98	1.09	1.19	1.30	
300	0.19	0.28	0.38	0.47	0.56	0.65	0.75	0.85	0.94	1.03	1.13	
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00	

Intensity-Duration Design Chart - Template





SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

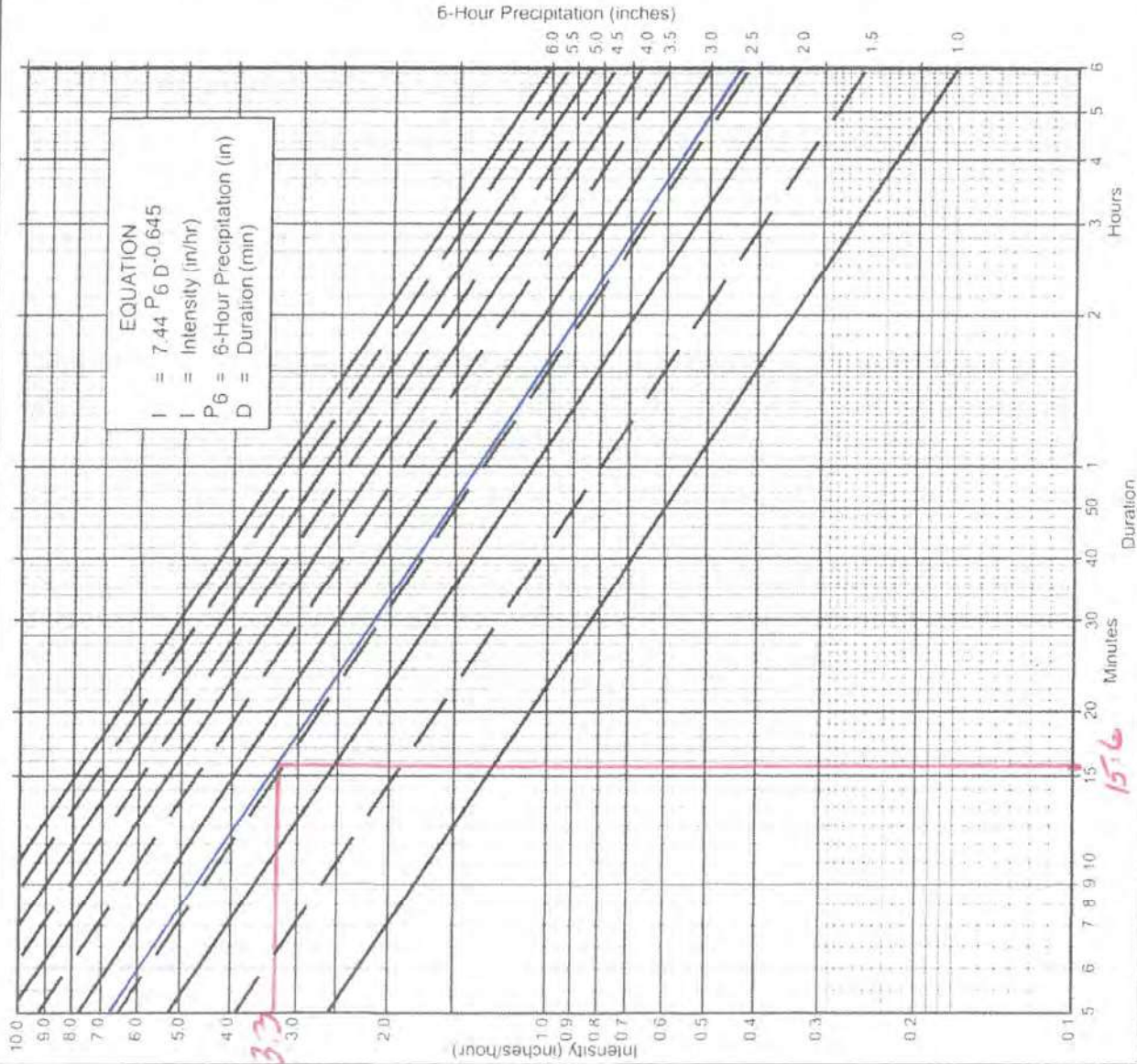
Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- Selected frequency 100 year
- $P_6 = \underline{2.6}$ in., $P_{24} = \underline{5.5}$, $\frac{P_6}{P_{24}} = \underline{47\%}$
- Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- $t_x = \underline{15.58}$ min (eq. Fig 3-3)
- $I = \underline{3.29}$ in./hr. (eq. Fig 3-1)

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

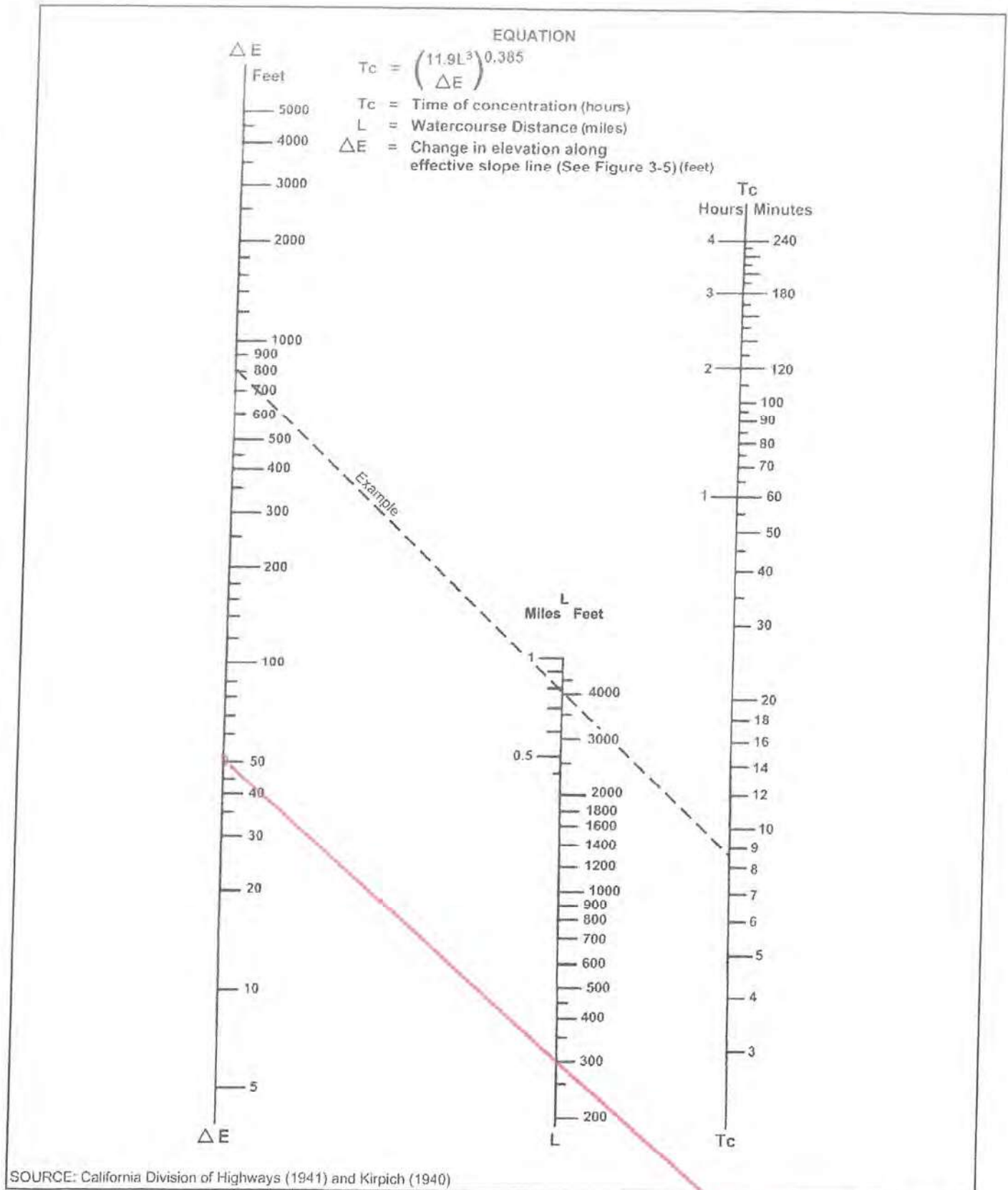


P_6 Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.85	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.75
180	0.25	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.65	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

FIGURE

3-1

Intensity-Duration Design Chart - Template



Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

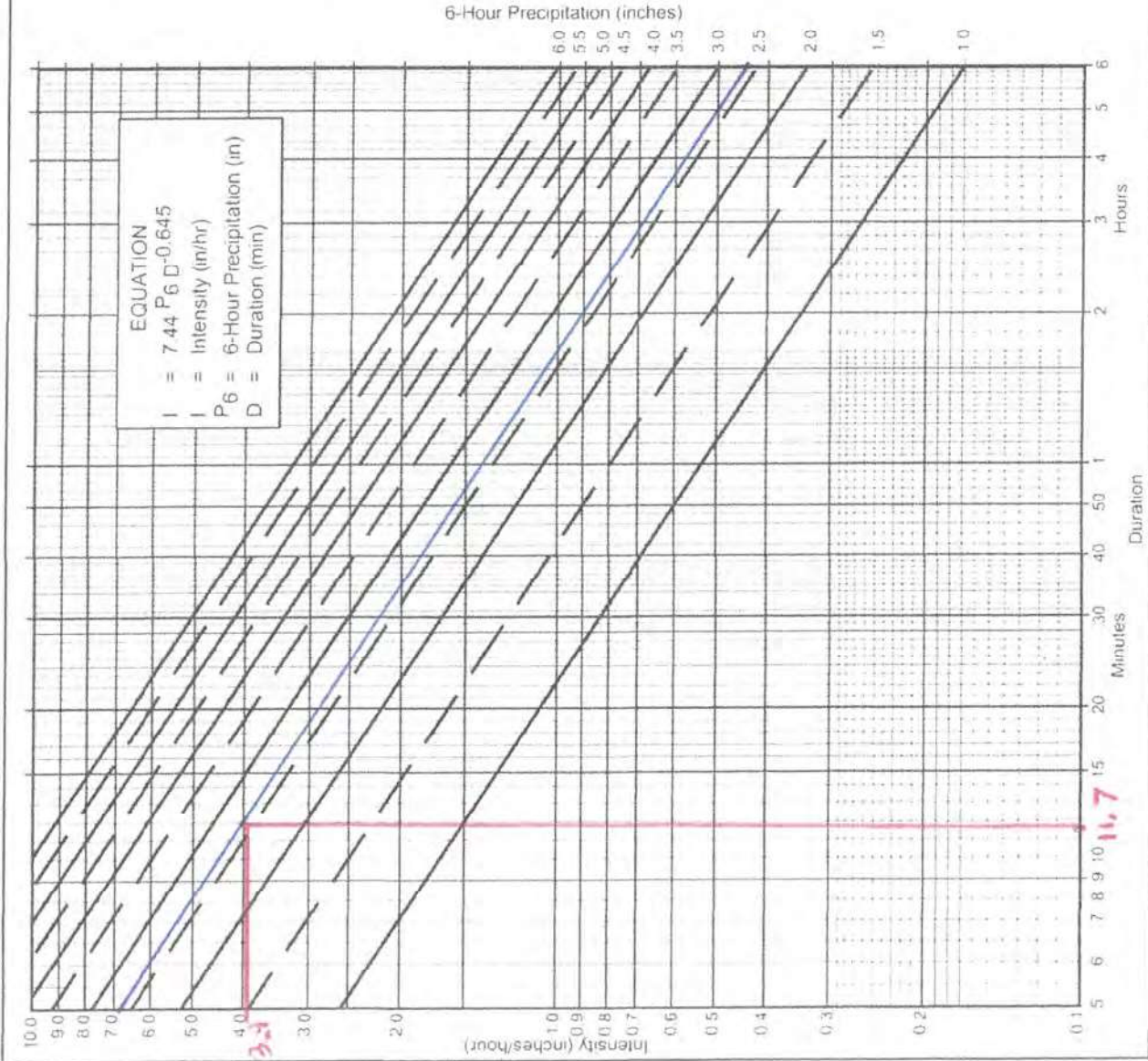
Application Form:

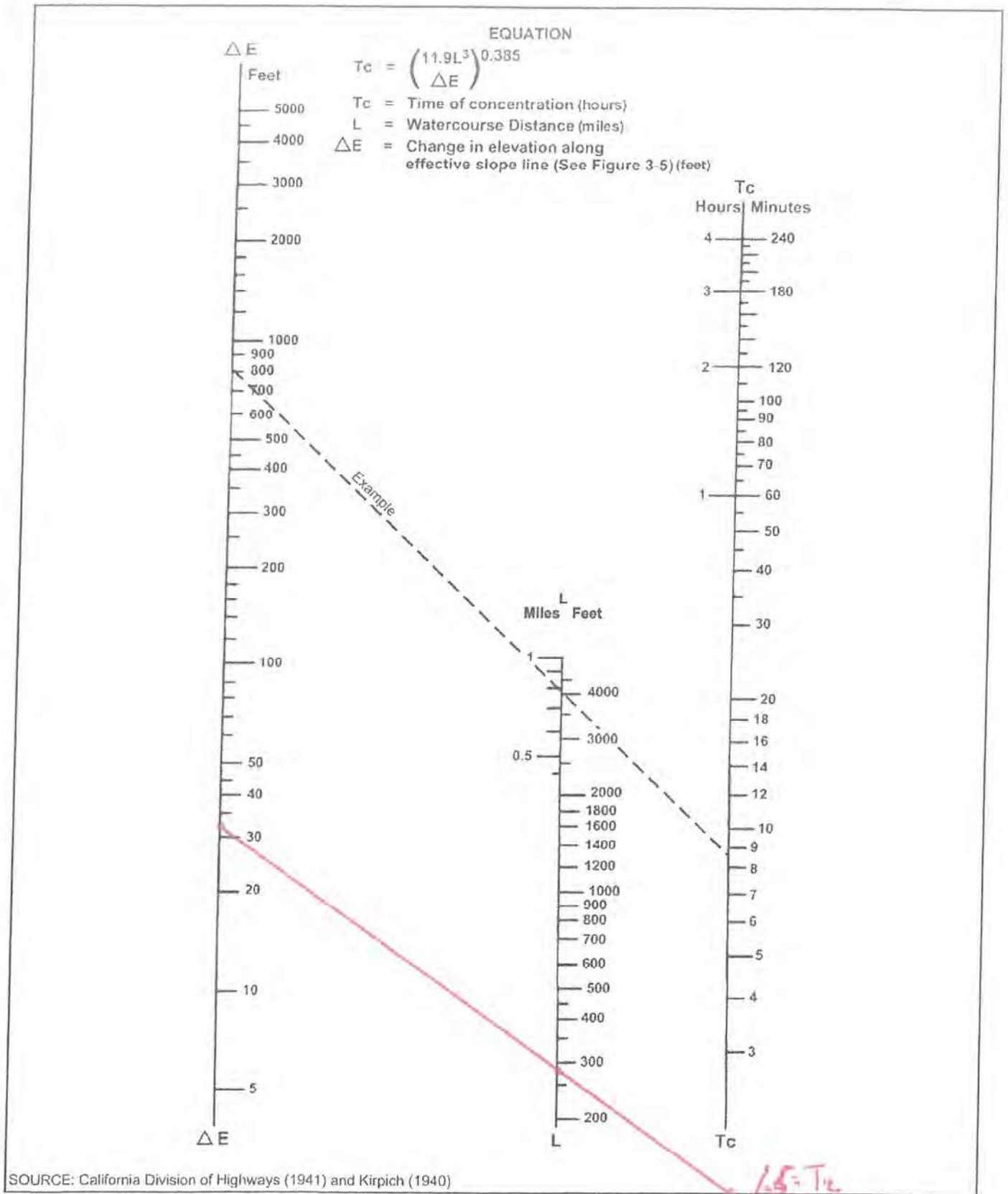
- (a) Selected frequency 100 year
- (b) $P_6 = \underline{2.6}$ in., $P_{24} = \underline{5.5}$ $\frac{P_6}{P_{24}} = \underline{47\%}$ (2)
- (c) Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- (d) $t_x = \underline{11.65}$ min. (eq. Fig 3-3)
- (e) $I = \underline{3.97}$ in./hr (eq. fig 3-1)

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P ₆ Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.85	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.85	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.76	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template



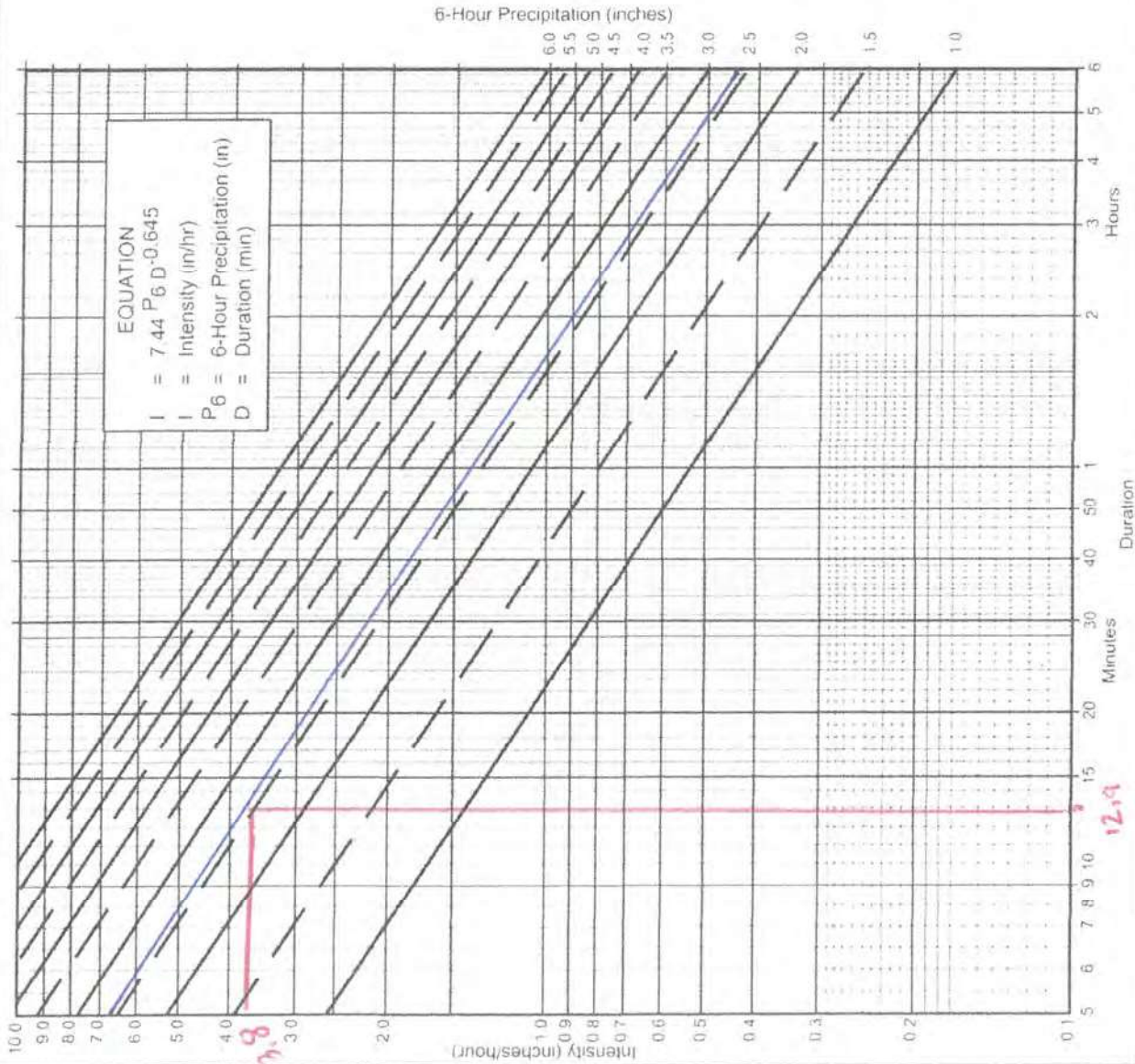


Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

Intensity-Duration Design Chart - Template



Directions for Application:

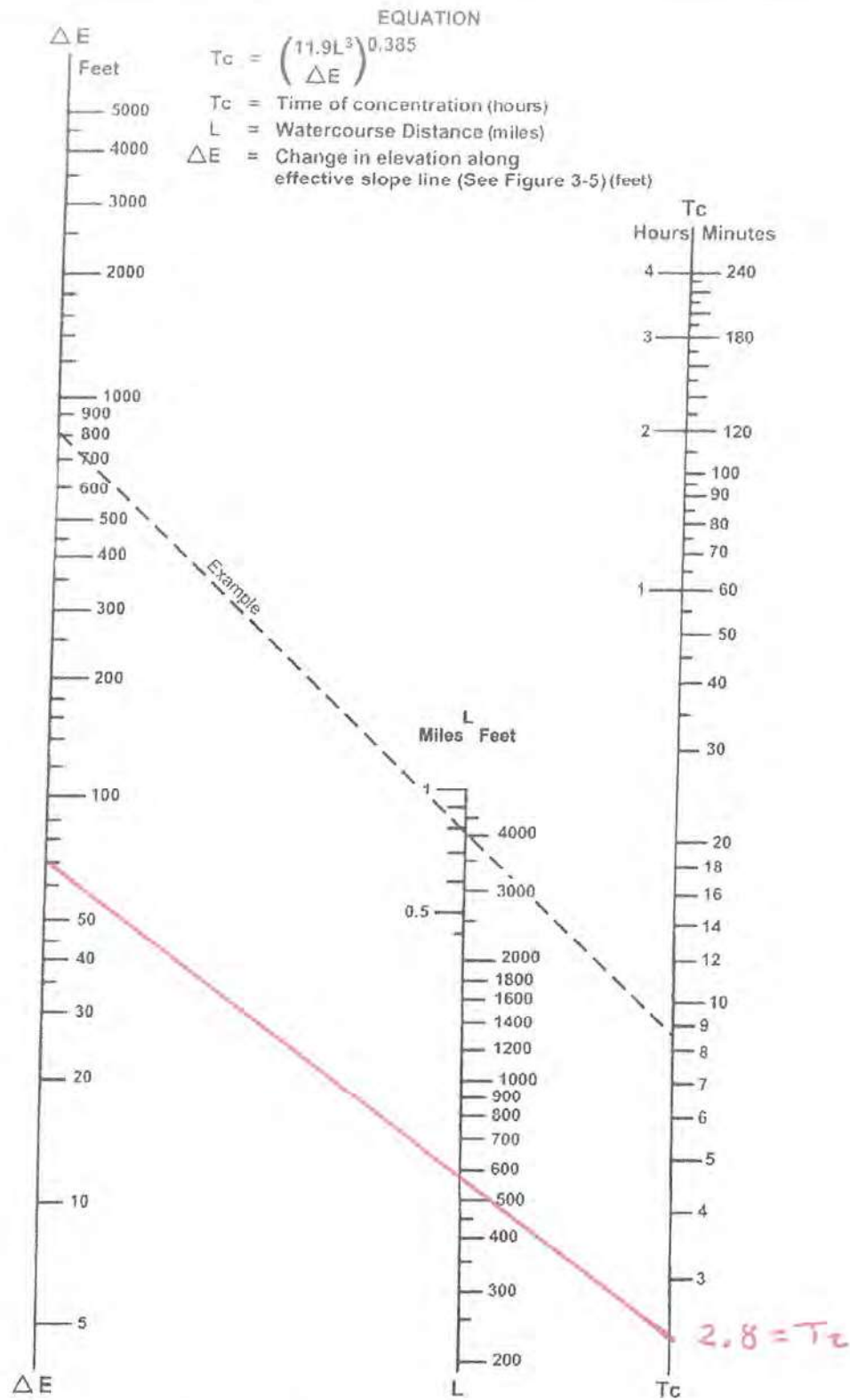
- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 100 year
- (b) $P_6 = \underline{2.6}$ in., $P_{24} = \underline{5.5}$, $\frac{P_6}{P_{24}} = \underline{47\%}^{(2)}$
- (c) Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- (d) $I_x = \underline{12.85}$ min. (eq 3-3)
- (e) $I = \underline{3.73}$ in./hr. (eq 3-1)

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P_6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49
7	2.12	3.18	4.24	5.30	6.35	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.75	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.85	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.09	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

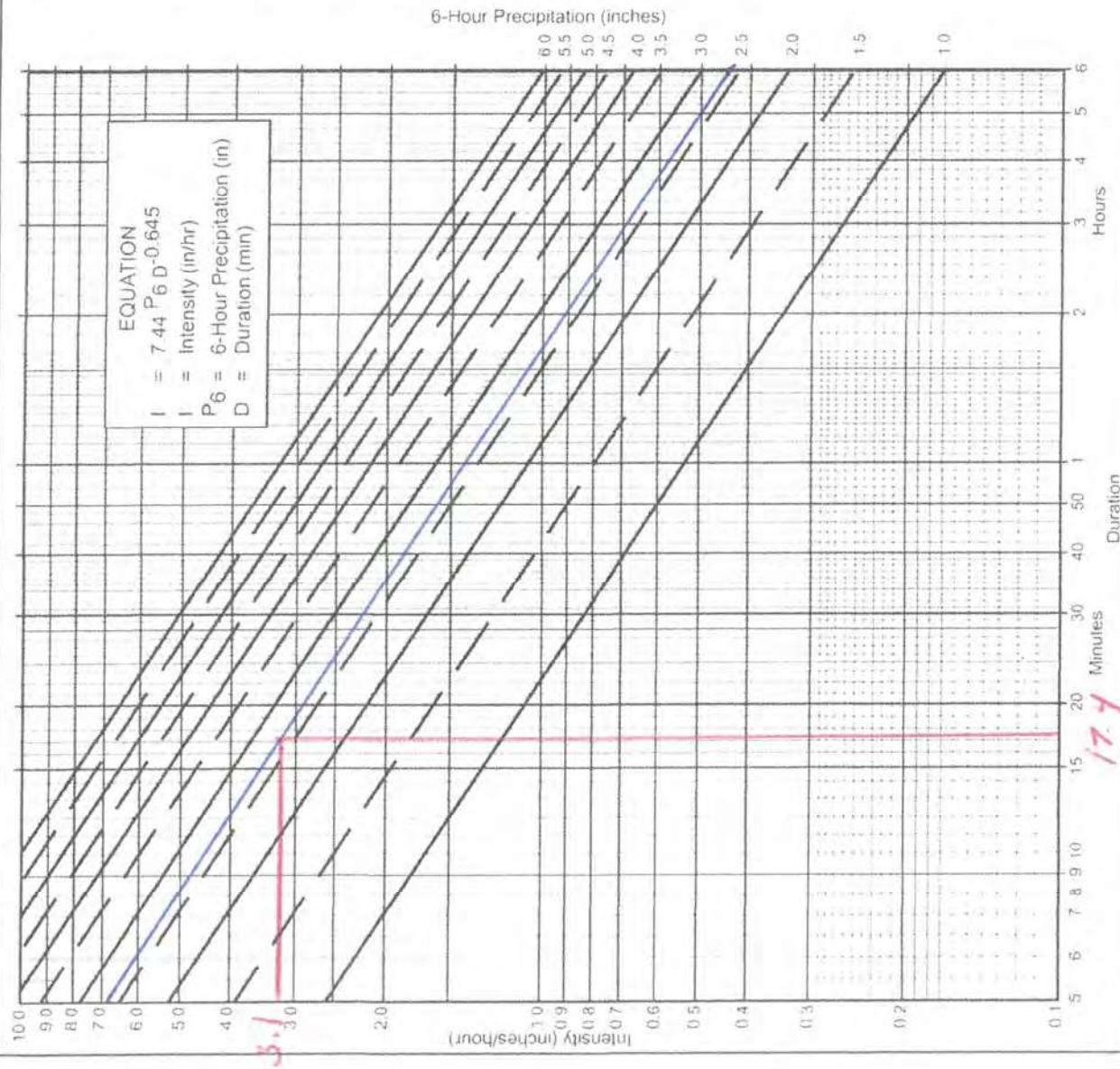
Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50 and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 100 year
- (b) $P_6 = \underline{2.6}$ in., $P_{24} = \underline{5.5}$, $\frac{P_6}{P_{24}} = \underline{47\%}$ (2)
- (c) Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- (d) $t_x = \underline{17.4}$ min (eq 3-3)
- (e) $I = \underline{3.1}$ in./hr. (eq 3-1)

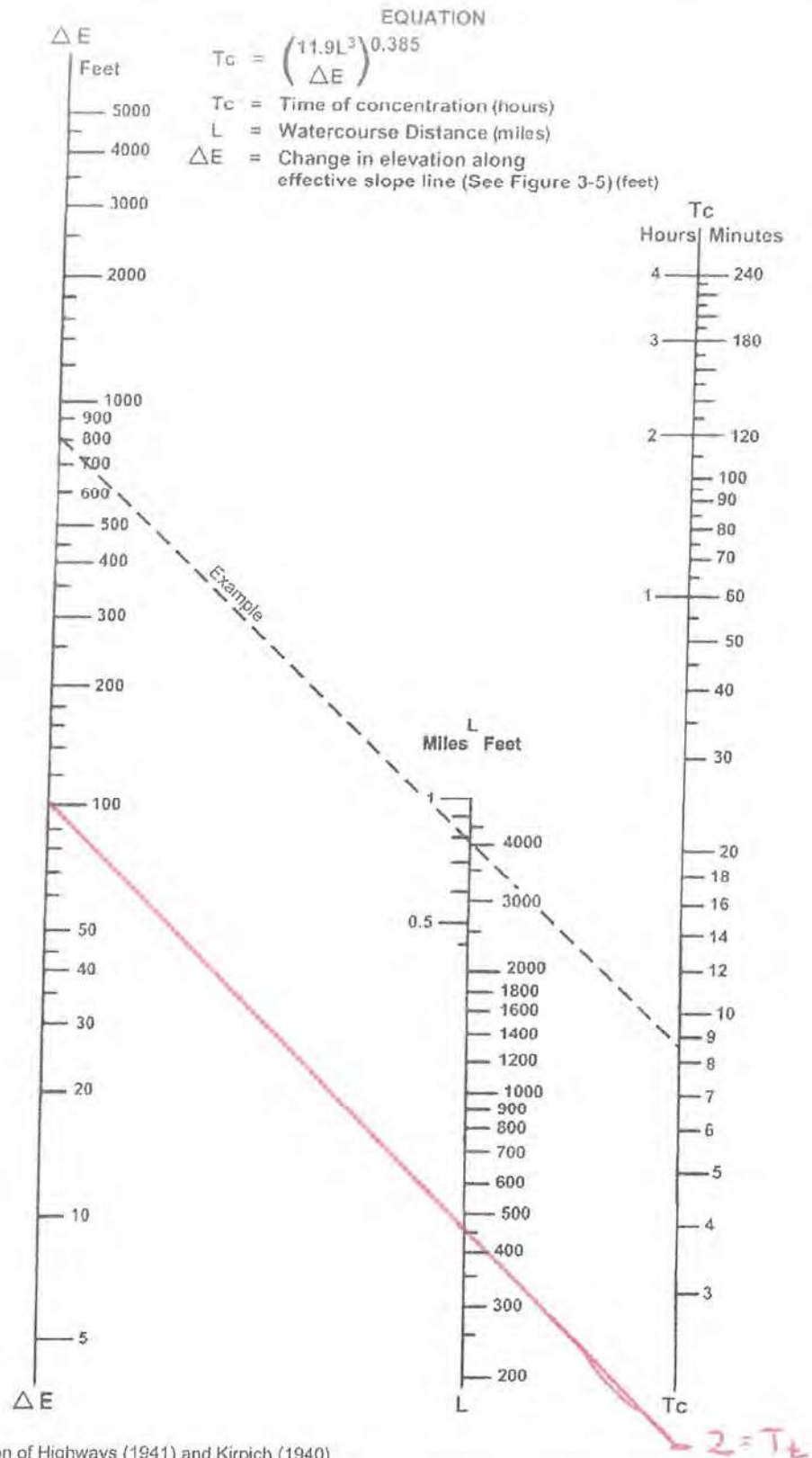
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.



P_6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	5	2.53	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49
	7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66
	10	1.68	2.53	3.37	4.21	5.05	5.89	6.74	7.58	8.42	9.27
	15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13
	20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93
	25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13
	30	0.83	1.24	1.65	2.07	2.49	2.90	3.32	3.73	4.15	4.56
	40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79
	50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28
	60	0.53	0.80	1.05	1.33	1.59	1.85	2.12	2.39	2.65	2.92
	90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25
	120	0.34	0.51	0.65	0.85	1.02	1.19	1.36	1.53	1.70	1.87
	150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62
	180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44
	240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19
	300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03
	360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92

Intensity-Duration Design Chart - Template

AREA 7



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

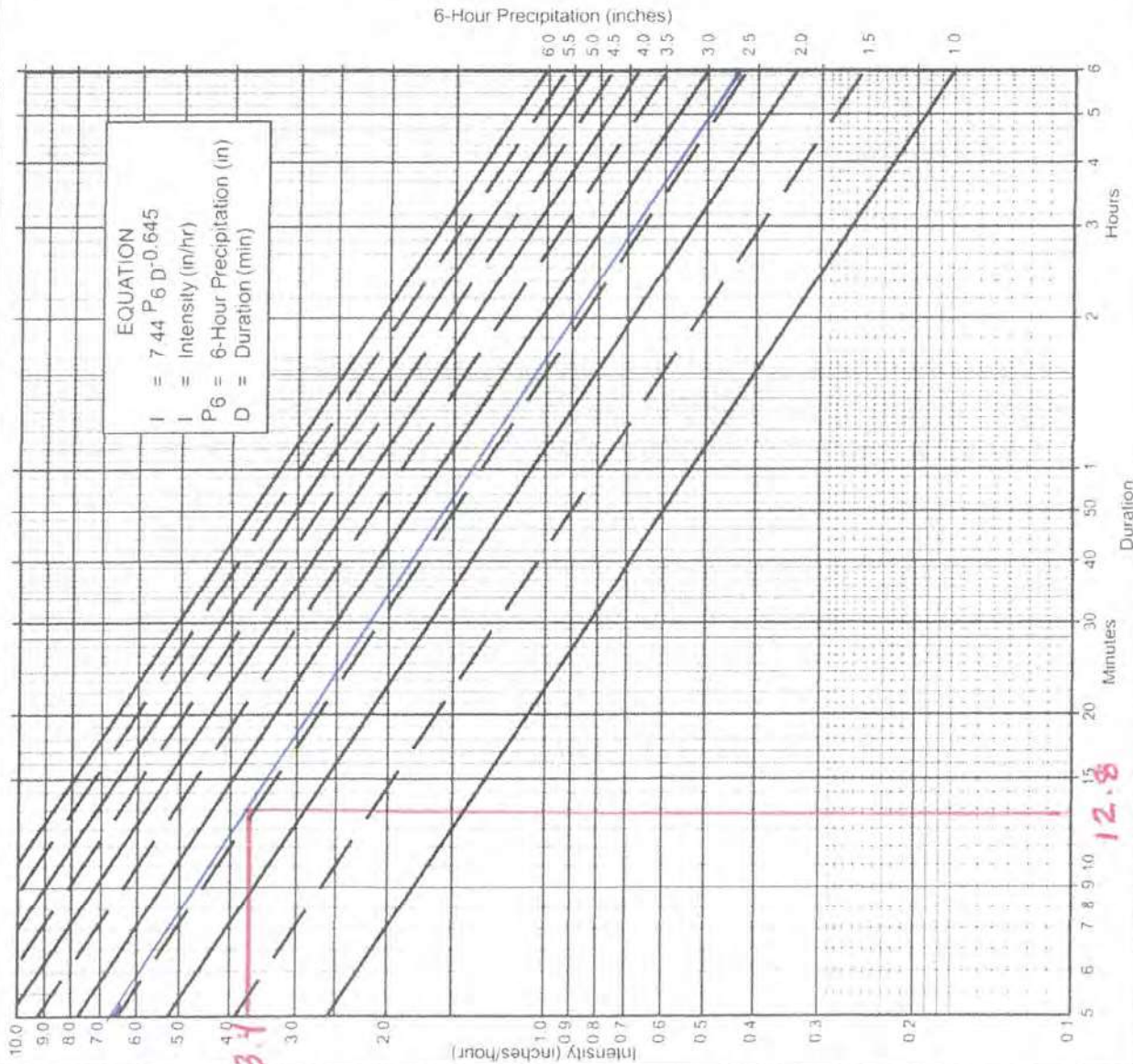
Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50 and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed

Application Form:

- Selected frequency 100 year
- $P_6 = \underline{2.6}$ in., $P_{24} = \underline{5.5}$ $\frac{P_6}{P_{24}} = \underline{47\%}^{(2)}$
- Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- $t_x = \underline{12.8}$ min.
- $I = \underline{3.4}$ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

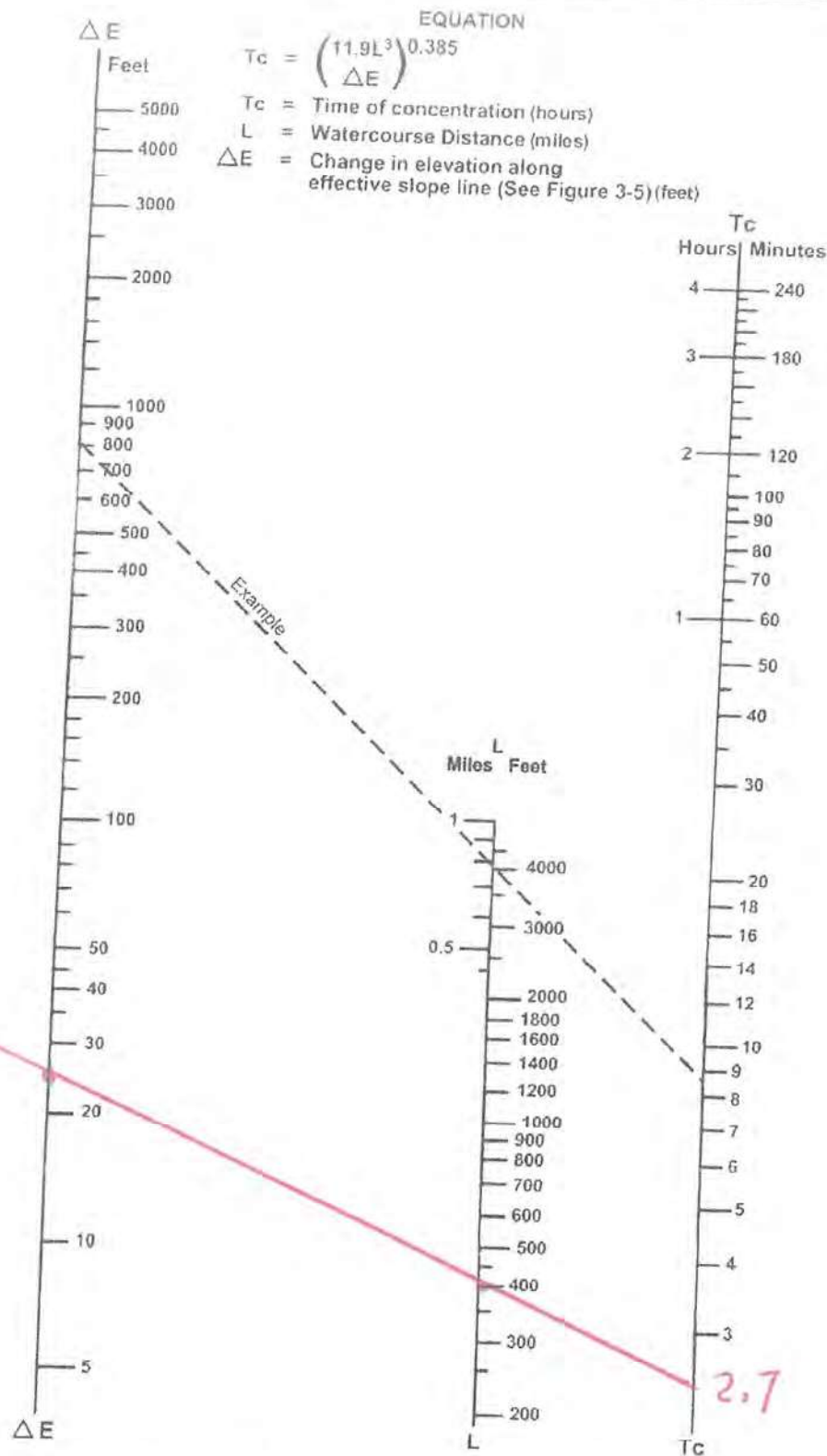


Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.85	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.88	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.36	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.85	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.35	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.75	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.65	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

FIGURE

3-1

Intensity-Duration Design Chart - Template



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

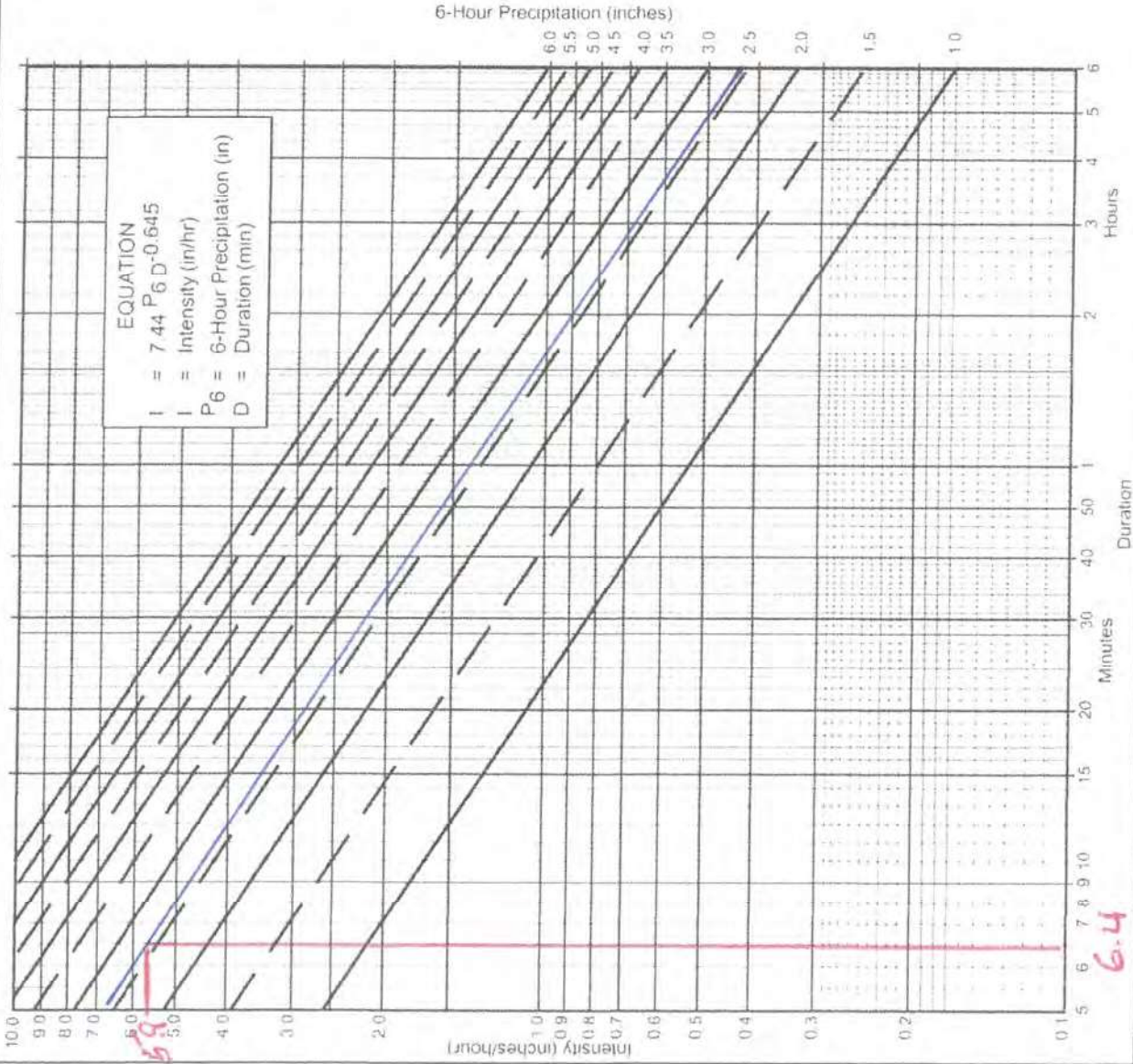
Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

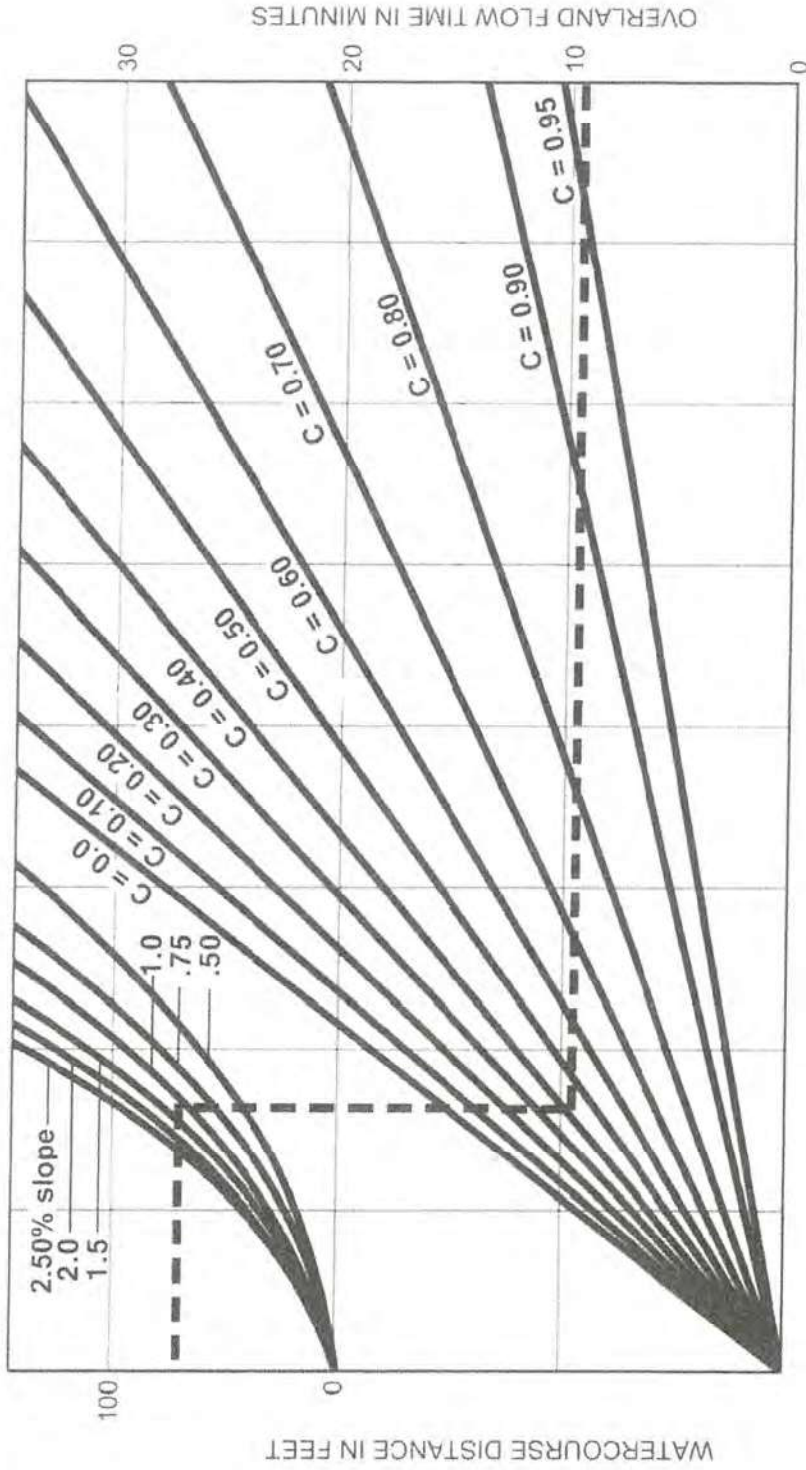
- (a) Selected frequency 100 year
- (b) $P_6 = \underline{2.6}$ in., $P_{24} = \underline{5.5}$ $\frac{P_6}{P_{24}} = \underline{47\%}$ (2)
- (c) Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- (d) $t_x = \underline{6.38}$ min (eq 3-3)
- (e) $I = \underline{5.86}$ in./hr. (eq 3-1)

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.



P_6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.49	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.85	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.25	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.65	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

USE FORMULA
AREAS A-I

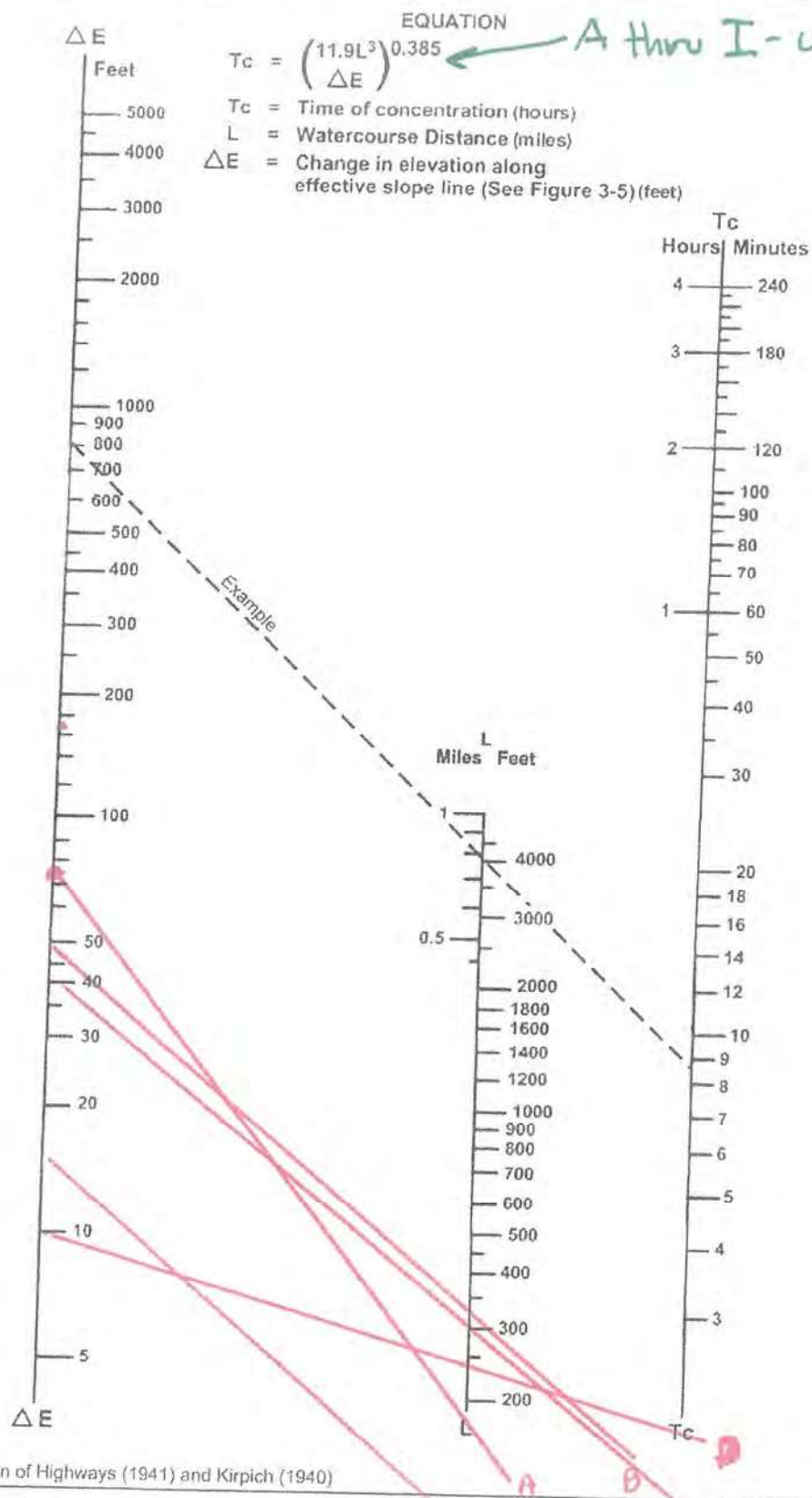
$$T = \frac{1.8 (1.1-C) \sqrt{D}}{s \sqrt{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

Rational Formula - Overland Time of Flow Nomograph

3-3



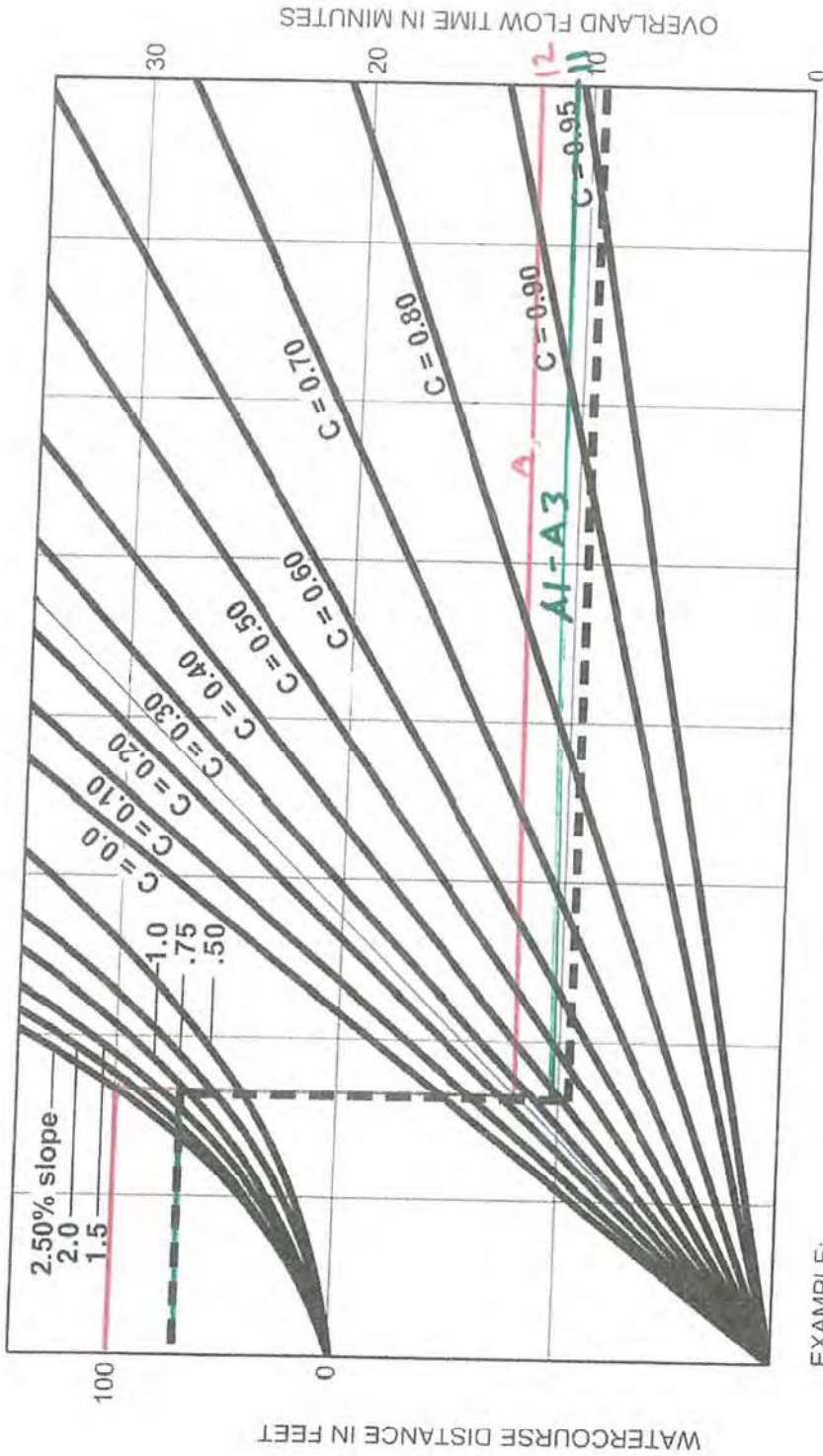
SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of
Time of Concentration (T_c) or Travel Time (T_t) for Natural Watersheds

FIGURE

3-4

Post Construction



EXAMPLE:

Given: Watercourse Distance (D) = 70 Feet
 Slope (s) = 1.3 %
 Runoff Coefficient (C) = 0.41
 Overland Flow Time (T) = 9.5 Minutes

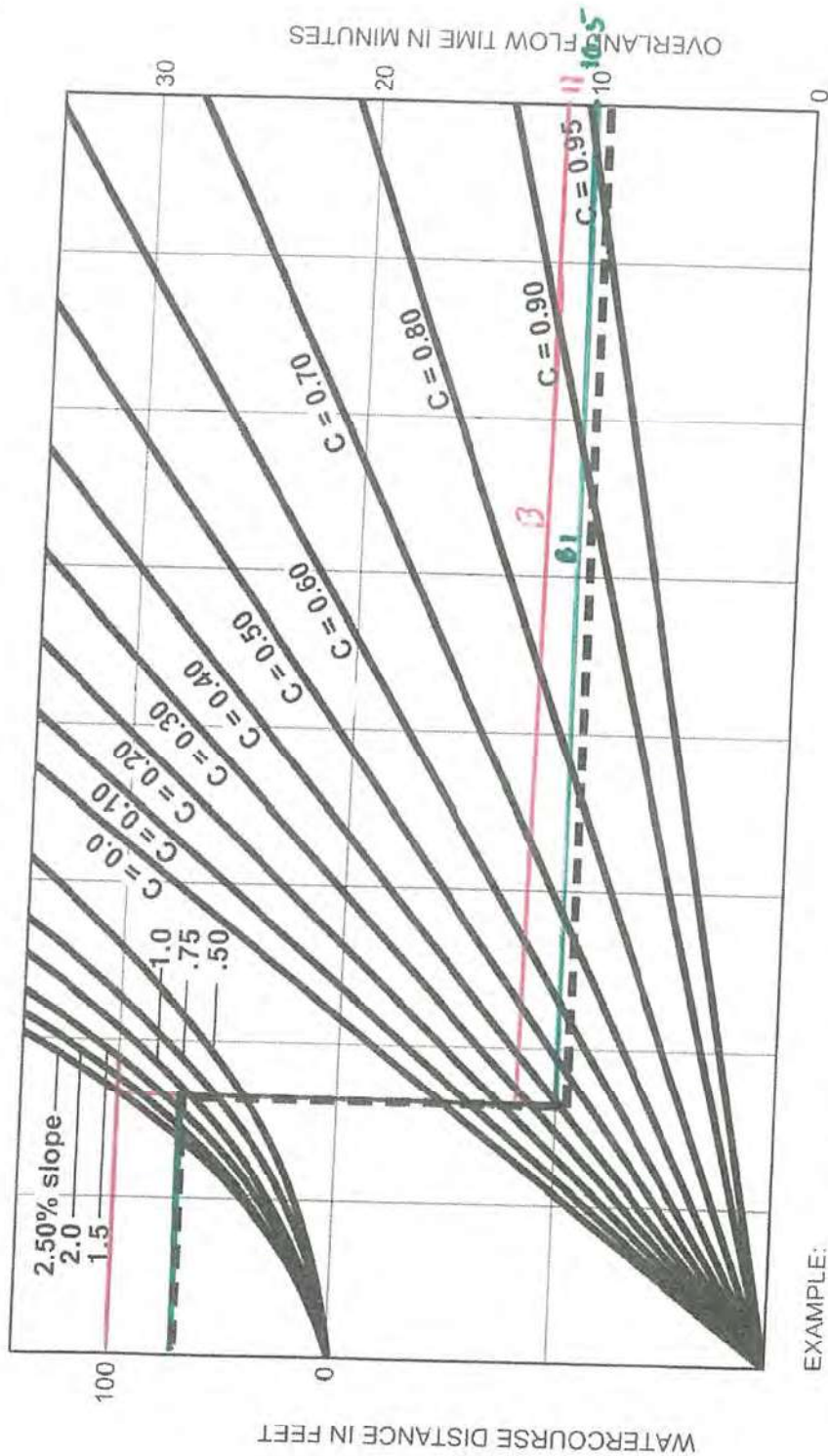
$$T = \frac{1.8 (1.1-C) \sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

Rational Formula - Overland Time of Flow Nomograph

3-3



SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

3-3

Rational Formula - Overland Time of Flow Nomograph

Directions for Application:

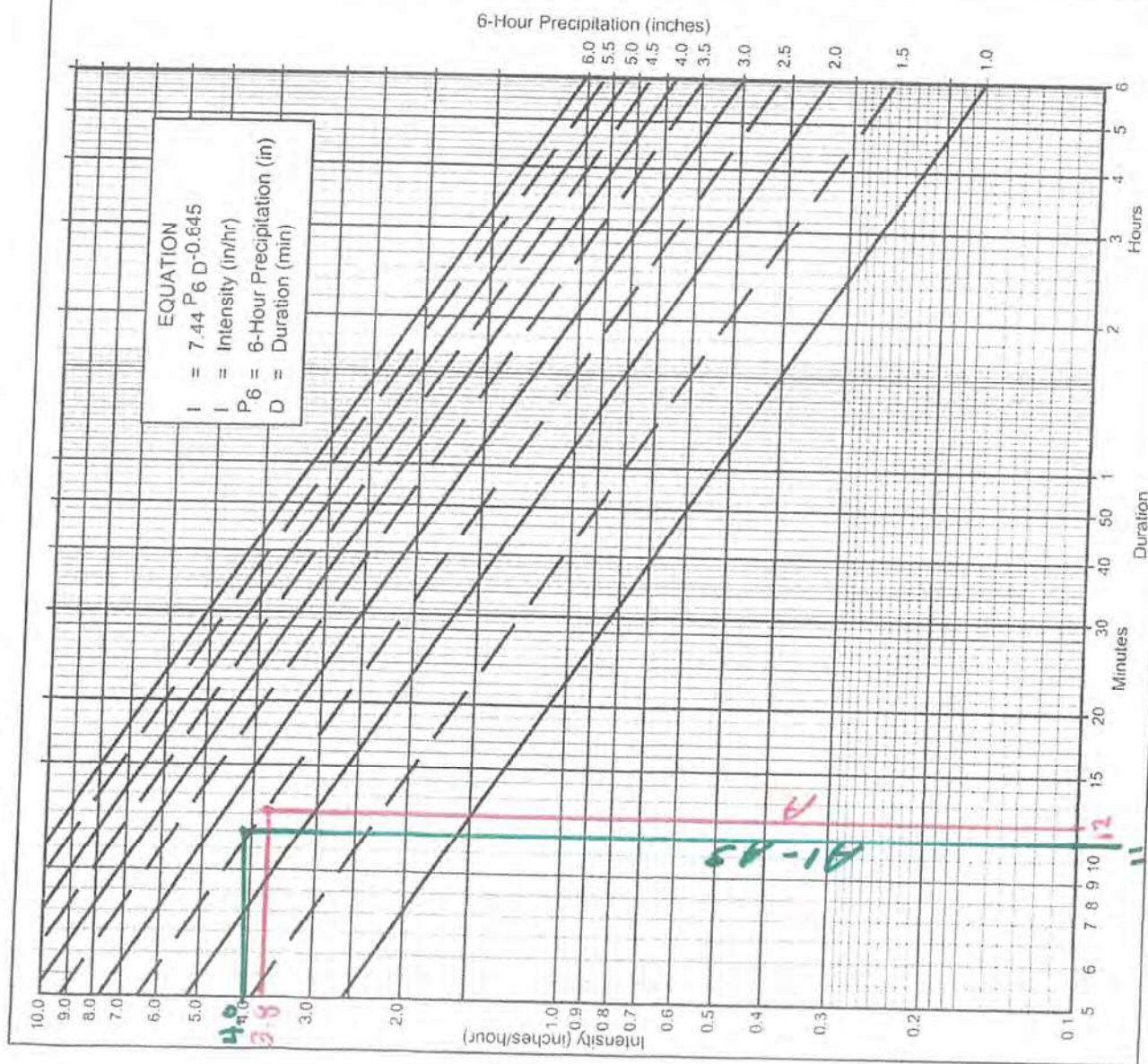
- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 100 year
- (b) $P_6 = \underline{2.6}$ in., $P_{24} = \underline{35}$ in. $\frac{P_6}{P_{24}} = \underline{47} \%^{(2)}$
- (c) Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- (d) $t_x = \underline{\quad}$ min. $A: T_t = \underline{12}$ $A1-A3: T_t = \underline{11}$
- (e) $I = \underline{\quad}$ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

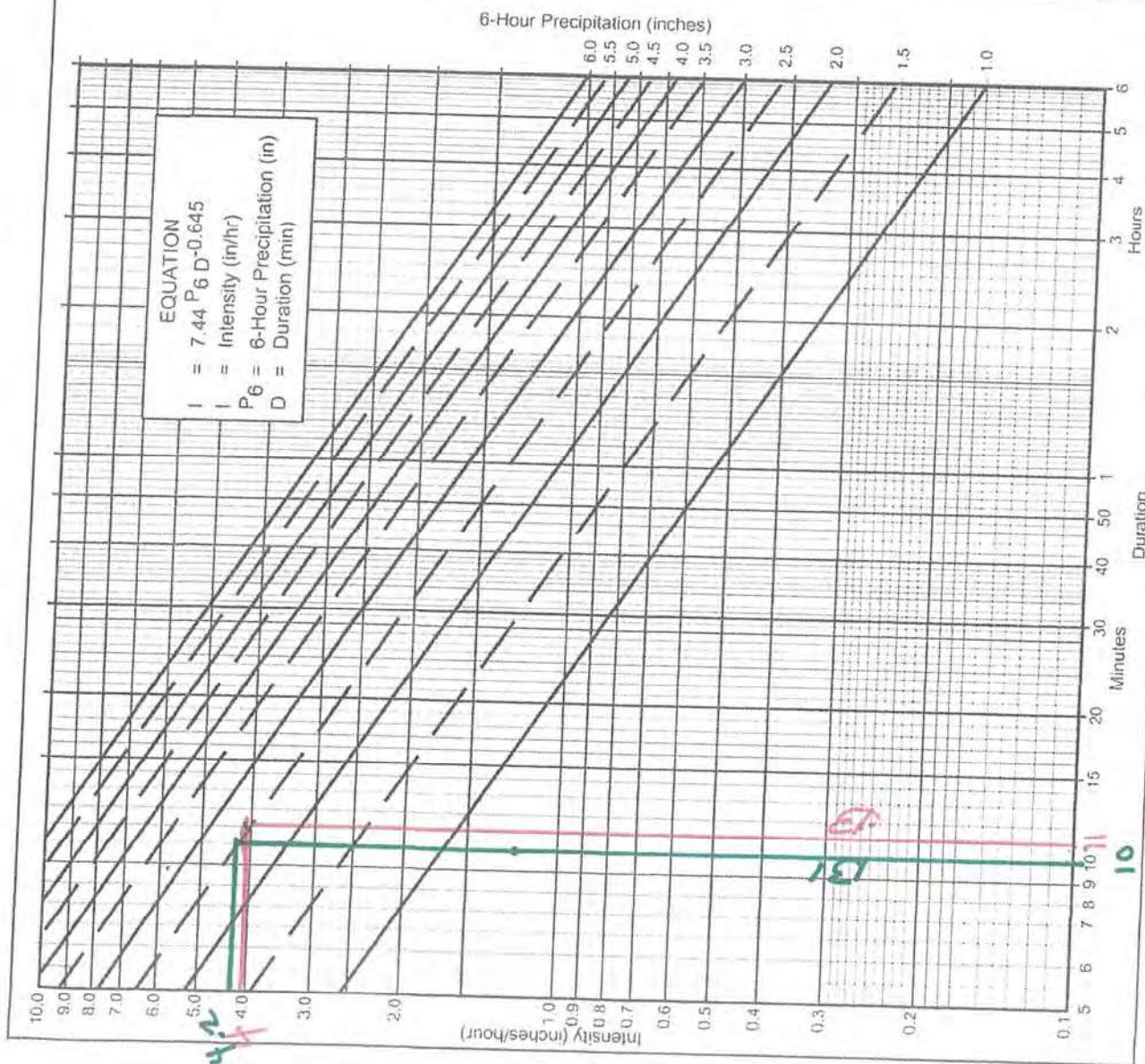
P6 Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.35	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.45
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.55
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.89	1.03	1.18	1.32	1.47	1.62	1.75
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.29
300	0.19	0.28	0.38	0.47	0.56	0.65	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00



Intensity-Duration Design Chart - Template

FIGURE

3-1



Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency 100 year
- (b) $P_6 = \underline{2.6}$ in., $P_{24} = \underline{5.5}$, $\frac{P_6}{P_{24}} = \underline{47} \%^{(2)}$
- (c) Adjusted $P_6^{(2)} = \underline{2.6}$ in.
- (d) $t_x = \underline{\quad}$ min. $B = 11$ $B_1 = 10$
- (e) $I = \underline{\quad}$ in./hr. $B = 4.0$ $B_1 = 4.2$

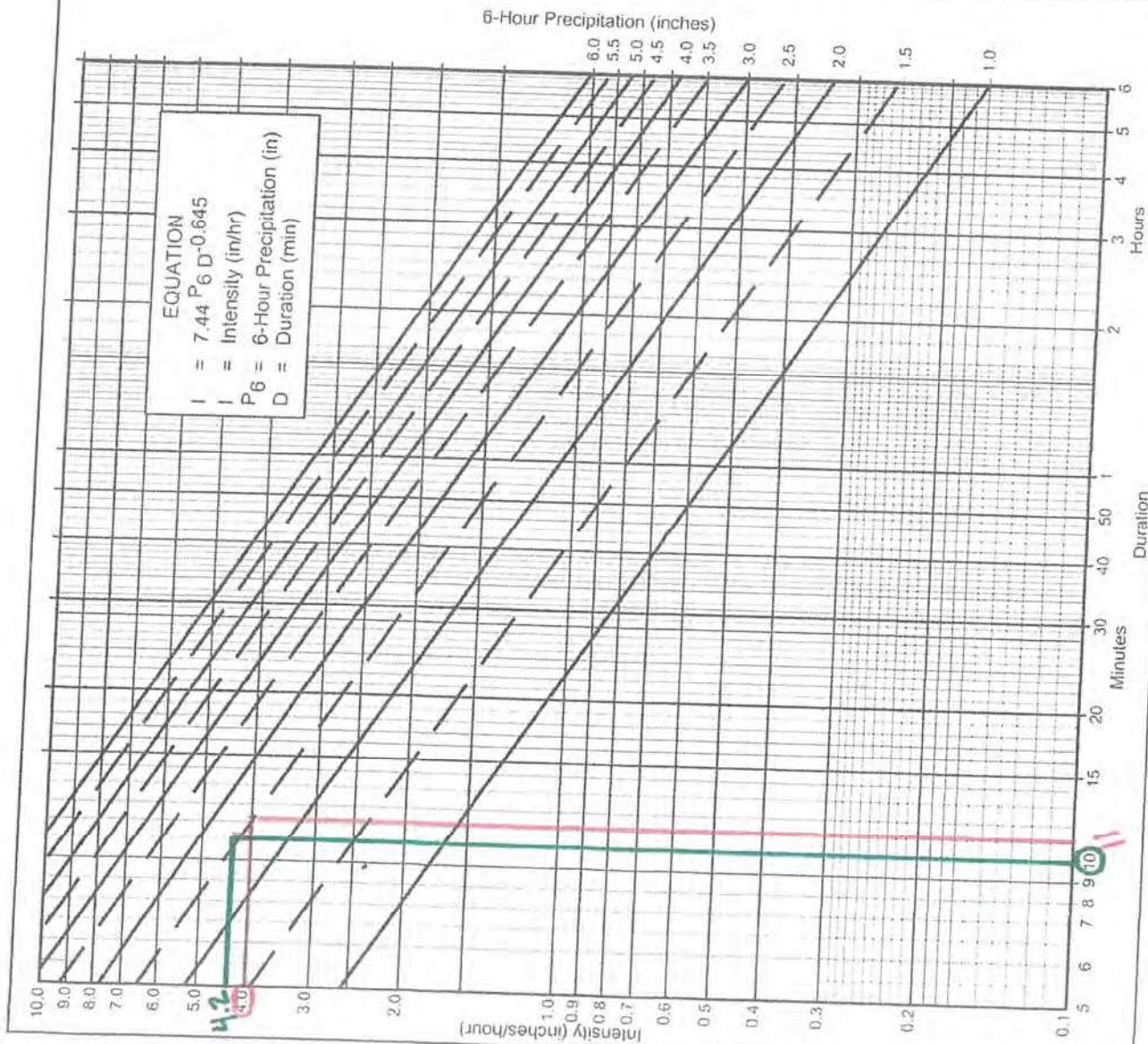
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.39	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.45	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.85	2.12	2.39	2.65	2.92	3.18
80	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
100	0.34	0.51	0.68	0.85	1.02	1.19	1.35	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.55	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



Directions for Application:

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

- (a) Selected frequency _____ year
 (b) $P_6 =$ _____ in., $P_{24} =$ _____ $\frac{P_6}{P_{24}} =$ _____ %⁽²⁾
 (c) Adjusted $P_6^{(2)} =$ _____ in.
 (d) $t_x =$ _____ min. $C_{thrs} I \rightarrow 10 \rightarrow 11$
 (e) $I =$ _____ in./hr. $C_{thrs} I \rightarrow 4.0 \rightarrow 4.2$

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.48
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.58	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.99	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
80	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.65	0.75	0.86	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1

County of San Diego Hydrology Manual



Soil Hydrologic Groups

Legend

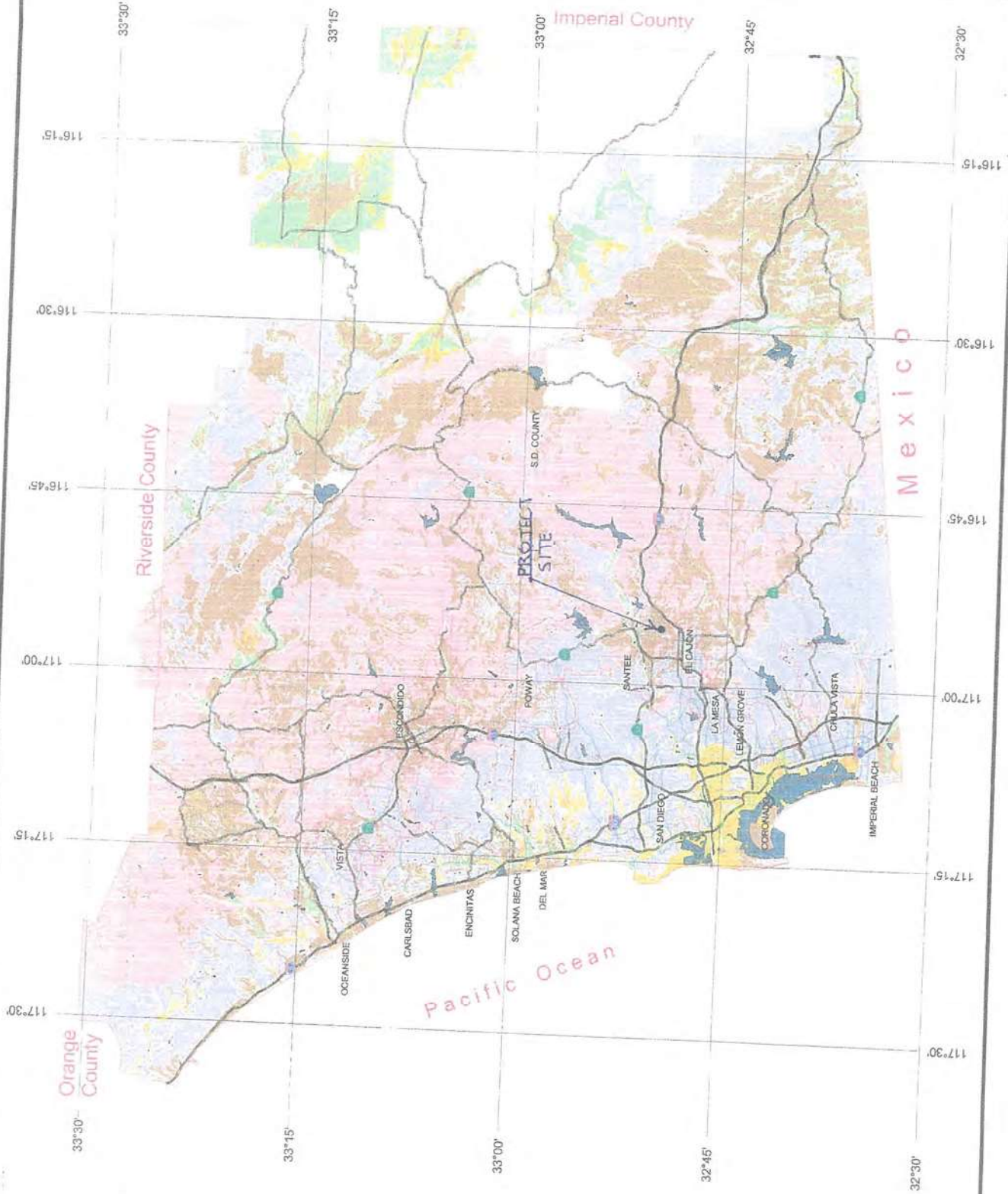
Soil Groups



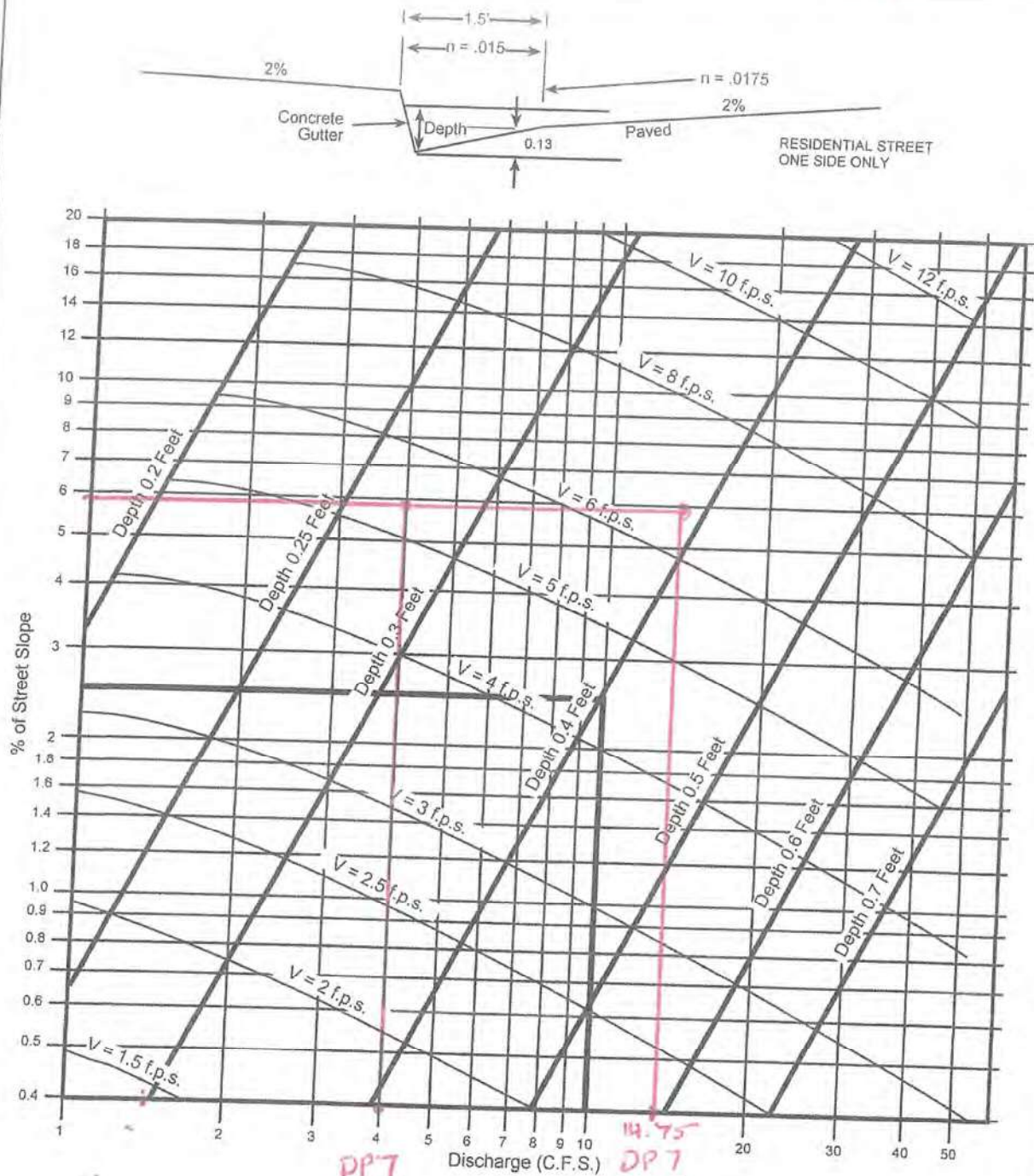
Data Unavailable



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Leavitt Rd



EXAMPLE:
 Given: $Q = 10$ $S = 2.5\%$
 Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

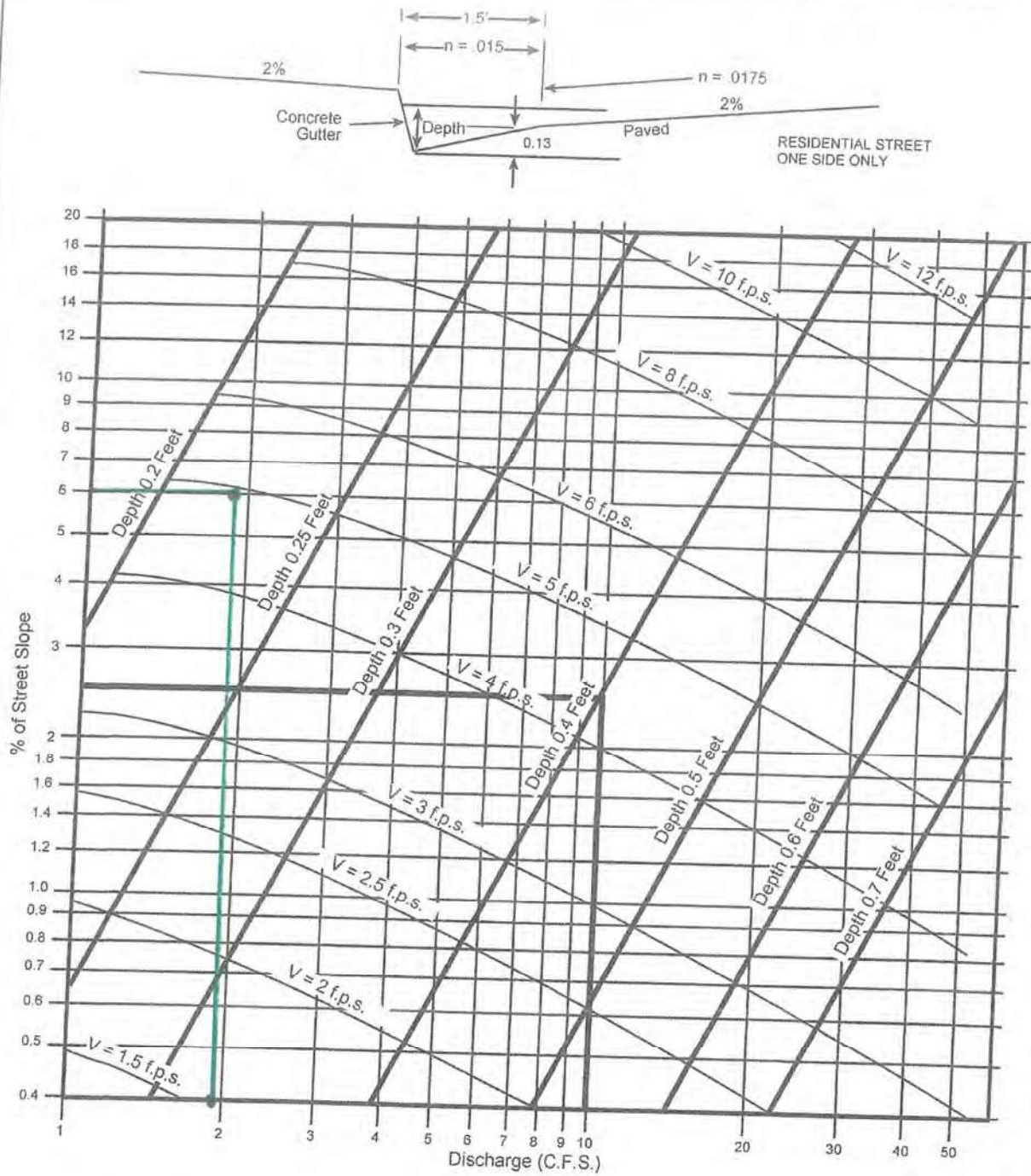
SOURCE: San Diego County Department of Special District Services Design Manual

Gutter and Roadway Discharge - Velocity Chart

FIGURE

3-6

Janelln / Rockcrot



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Gutter and Roadway Discharge - Velocity Chart

FIGURE

3-6