CEQA Drainage Study

REPLACEMENT TENTATIVE PARCEL MAP
20975RPL2
ER# 0508028

Prepared For:

Anthony Lang & Kim Lang
P.O. Box 262014
San Diego, CA 92196

Nhon T. Ly & Terri H. Nguyen
2630 Del Mar Heights Road
Del Mar, CA 92014

Prepared By:

Nolte Associates, Inc.
15070 Avenue of Science
Suite 100
San Diego, CA 92128

Lin Lin, P.E. RCE 66513

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APPENDICES

1.0 INTRODUCTION

1.1 Purpose of Study

This Drainage Study provides preliminary hydrology analysis for the Preliminary Grading Plan submitted with the Lang T.P.M. 20975, 10.22 acre site identified as APN 267-142-09.

1.2 Scope

This analysis covers approximately 10.22 acres of undeveloped on-site watershed area and 144.11 acres of tributary off-site watershed area.

Within the project, Modified Rational Method hydrology calculations were performed for both existing and post development for 100-year storm frequency.

2.0 DESCRIPTION OF WATERSHED

2.1 Area Characteristics

The study area is an undeveloped 10.22 acre parcel covered with California adolphia, coastal sage, and grasslands. It is located in the Santa Fe Valley area, which is west of Black Mountain Road, east of Del Dios Highway, and south of Artesian Road. The project is within the unincorporated County, and San Dieguito Watershed. Runoffs from the site will discharge to three natural drainage channels. Those three channels eventually join each other to form a single watercourse, and drain southwesterly into the San Dieguito River and thence to the Pacific Ocean.

Existing Condition:
The existing imperious cover is 0%. Runoffs from 3.21 acre of the site drain southwesterly to an off-site natural drainage channel, which referred as natural drainage channel 1 (per Appendix A, existing drainage area map). Runoffs from 6.85 acre of the site drain southerly to a natural drainage channel across the site, which referred as natural drainage channel 2 (per Appendix A, existing drainage area map), and runoffs from 0.16 acre at the southeast corner of the site drain to a natural drainage channel called natural drainage channel 3 (per Appendix A, existing drainage area map).

Proposed Condition:
The project site is divided into 4 parcels. 4 single family houses with access roads are proposed. Each house pad is assumed to have 5,000 square feet impervious cover. The proposed imperious cover for this 10.22 acre site will be 10.53%. Runoffs from 3.92 acre of the site drain southwesterly to an off-site natural drainage channel, which referred as natural drainage channel 1 (per Appendix A, proposed drainage area map). Runoffs from 6.14 of the site drain southerly to a natural drainage channel across the site, which referred as natural drainage channel 2 (per Appendix A, proposed drainage

area map), and runoffs from 0.16 acre at the southeast corner of the site drain to a natural drainage channel called natural drainage channel 3 (per Appendix A, proposed drainage area map). Since drainage area P3 (per Appendix A, proposed drainage area map) will remain as open space, which means no impact due to development to natural drainage channel 3, this channel is not studied.

2.2 Soil Groups

Soil type "D" was used based on County of San Diego Hydrology Manual Soil Hydrologic Groups.

2.3 Land Uses

Existing Land designation is 21 specific plan amendment: SPA01-002. Existing zoning is RV9.

3.0 METHODOLOGY

3.1 Methodology-Modified Rational Method

Per the County of San Diego Hydrology Manual (dated June 2003) for watersheds less than 1 square mile with stream junctions, we used the modified rational formula, as excerpted below. 100 year rainfall isopluvials 6 hours and 24 hours were used for the existing and proposed condition. The calculations are included in Appendix A.

From the Hydrology Manual, this method is as follows:

MODIFIED RATIONAL METHOD

Watersheds Less than 1 Square Mile

Method of Computing Runoff

Use the Rational Formula Q = CIA where:

Q is the peak rate of flow in cubic feet per second.

C is a runoff coefficient expressed as that percentage of rainfall that becomes surface runoff.

I is the average rainfall intensity in inches per hour for a storm duration equal to the time of concentration (T_c) of the contributing drainage area.

A is the drainage area in acres tributary to design point.

1) Runoff Coefficient, C

Table 3-1 at Appendix B lists the estimated coefficient for each type of land use. Coefficient 0.35 is used for open space and residential landscape areas. Impervious cover for each residential lot is assumed as 5,000 square feet house pad. Coefficient for each drainage area is calculated by using following formula:

C = 0.90 x (% Impervious) + Cp x (1 - % Impervious)

Where:
Cp = Pervious Coefficient Runoff Value for the soil type (shown in Table 3-1 as Undisturbed Natural Terrain/Permanent Open Space, 0% Impervious)

2) Rainfall Intensity, I

I = 7.44 P_6 D^(-0.645)

Where:
P_6 = Adjusted 6-hour storm rainfall amount
D = Duration in minutes (use Tc)

3) Initial Time of Concentration, Tc

The initial time of concentration is the time required for runoff to sheet flow from the most remote part of the watershed to the outlet point of the first sub-basin.

Methods of calculation differ for natural watersheds (non-urbanized) and for urban drainage systems. However, when designing storm drain systems, it is assumed that the existing natural watershed would become fully urbanized during the useful life of the storm drain system.

Maximum sheet flow length from San Diego County Hydrology Manual Table 3-2 is used in this drainage study. Rational Formula – Overland Time of Flow Nomograph (San Diego County Hydrology Manual Figure 3-3) is utilized to calculate initial time of concentration.

T_i =1.8 (1.1-C) *(D^0.5)/(S^0.333)

Where,
T_i = Initial time of concentration (minute)
C = Runoff coefficient
D= Sheet flow length (feet)
S = Slope (percentage)

4) Time of Concentration, Tc

The time of concentration at any point within the drainage area is given by:

$$T_c = T_i + T_t \text{ where}$$

T_i is the initial time of concentration.

T_t is the travel time or the time required for the storm water to flow from the initial sub-basin to the point in question.

Travel Time, T_t, is computed by dividing the length of storm drain by the computed flow velocity. Since the velocity normally changes at each inlet because of changes in flow rate or slope, total travel time must be computed as the sum of the travel times for each section of the storm drain.

The overland flow component of travel time, T_t, may be estimated by the use of San Diego County Hydrology Manual Figure 3-4, Nomograph for Determination of Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds.

Tt=(11.9*(L^3)/ΔE)^0.385

Where
Tt = Time of concentration (hour)
L = Watercourse distance (miles)
ΔE = Change in elevation along effective slope line (feet, see San Diego County Hydrology Manual Figure 3-5)

5) Modified Rational Method (for Junction Analysis)

Junction Equation: when T1<T2
$Q_{T1}=Q1+(T1/T2)Q2$
$Q_{T2}=Q2+(I2/I1)Q1$

Where
Q_{T1}, Q_{T2} = Total peak rate at the junction (cfs)
Q1, Q2 = Peak rate for the tributary area (cfs)
I1, I2 = Rainfall intensity (inch/hour)
T1, T2 = Time of concentration (min)

Select the larger Q, and re-calculate Tc associate with that Q.

6) Total Volume

VOL = C(P6)A

Where
VOL = Volume of runoff (acre-inches)
P6 = 6-hour rainfall (inches)
C = Runoff coefficient
A = Area of the watershed (acres)

3.2 100-Year Storm

According to California Environmental Quality Act, the 100-year frequency storm was used as the basis for this study. The 100-year, six-hour rainfall amounts were derived from the County of San Diego Hydrology Manual dated June 2003. Isopluvial charts are shown in Appendix B.

4.0 SUMMARY

The proposed site will maintain the overall existing drainage patterns. Due to low density development, the impact of increase of impervious cover is insignificant. This study determined the 100-year peak flow under developed condition at junction of two existing natural channel 1 and 2 is 132.06 cfs, which is only 0.9% increasing from 130.93 cfs under existing condition. FlowMaster from Bentley Systems, Inc. Haestad Methods Solution Center is utilized to check the impact of the proposed condition at the junction of channel 1 and channel 2. The result shows that the normal depths of the existing and the post condition are the same, which indicates that there is no downstream impact caused by the post development condition. Per Appendix A for FlowMater output.

The following table summarizes the peak 100-year flows and volumes:

DRAINAGE CHANNEL	EX Q	POST Q	ΔQ=POST Q -EX Q	EX.C	POST C	EX. DRAINAGE AREA	POST DRAINAGE AREA	EX VOL	POST VOL	ΔVOL=POST VOL-EX VOL
	cfs	cfs	cfs			ac	ac	ac-inch	ac-inch	ac-inch
1	112.92	113.76	0.84	0.35	0.351	132.96	133.69	127.97	128.92	0.95
2	26.34	26.77	0.43	0.35	0.368	21.21	20.48	20.41	20.74	0.33
1 & 2	130.93	132.06	1.13	0.35	0.353	154.17	154.17	148.39	149.67	1.28

Erosion during construction is anticipated for the project site. Therefore, mitigation measures should be provided in order to reduce construction related impacts. A Storm Water Pollution Prevention Plan will be provided before construction phase.

According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) 06073C1331F, dated 06/19/1997, this site is not located in 100-year floodplain.

5.0 REFERENCES

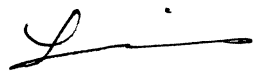
County of San Diego, Department of Public Works, Hydrology Manual, 2003.

Flood Insurance Rate Map 06073C1331F, 06/19/1997

6.0 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 Professional Code, and that the design is consistent with current design.

I understand that the check of project drawings by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.



12/6/07

Lin Lin
RCE 66513

Date

APPENDIX A

Rational Method Calculations
Existing Drainage Area Map
Proposed Drainage Area Map
FlowMaster Output

LANG TPM 20975
EXISTING 100-YEAR Q

100-YEAR STORM EVENT

P6	2.75
P24	4.75
P6/P24	57.89%
P6 USED	2.75

NOTE: ADJUST 6 HR PRECIPITATION SO THAT IT IS WITHIN THE RANGE OF 45% TO 65% OF 24 HR PRECIPITATION (NOT APPLICABLE TO DESERT)

$I=7.44(P6)(D^{-0.645})$

P6 = Adjusted 6-hour storm rainfall amount

D = Duration in minutes (use Tc)

DRAINAGE AREA	IC	IC %	C	AREA	Tc	I	Q	COM. AREA	AREA	COM. C	Tc	I	Q	Q_{T1}	Q_{T2}	REMARK
	ac			ac	min	inch/hr	cfs		ac		min	inch/hr	cfs	cfs	cfs	
E1	0	0.00%	0.35	76.90	16.43	3.36	90.52									
E2	0	0.00%	0.35	56.05	10.83	4.40	86.36	E1, E2	132.96	0.3500	27.26	2.43	112.92			EXIST. NATURAL DRAINAGE CHANNEL 1
E3	0	0.00%	0.35	21.21	15.12	3.55	26.34	E1-E3	154.17	0.3500	27.24	2.43	130.93	130.93	88.97	EXIST. NATURAL DRAINAGE CHANNEL 1&2
E4	0	0.00%	0.35	0.16	6.67	6.02	0.33									

LANG TPM 20975
PROPOSED 100-YEAR Q

100-YEAR STORM EVENT

P6	2.75
P24	4.75
P6/P24	57.89%
P6 USED	2.75

NOTE: ADJUST 6 HR PRECIPITATION SO THAT IT IS WITHIN THE RANGE OF 45% TO 65% OF 24 HR PRECIPITATION (NOT APPLICAPLE TO DESERT)

I=7.44(P6)(D^-0.645)

P6 = Adjusted 6-hour storm rainfall amount

D = Duration in minutes (use Tc)

DRAINAGE AREA	IC	IC %	C	AREA	Tc	I	Q	COM. AREA	AREA	COM. C	Tc	I	Q	Q_{T1}	Q_{T2}	REMARK
	ac			ac	min	inch/hr	cfs		ac		min	inch/hr	cfs	cfs	cfs	
P1	0.00	0.00%	0.35	76.90	16.43	3.36	90.52									
P2	0.16	0.29%	0.35	56.79	10.83	4.40	87.89	P1, P2	133.69	0.3507	27.26	2.43	113.76			EXIST. NATURAL DRAINAGE CHANNEL 1
P3	0.68	3.34%	0.37	20.48	15.12	3.55	26.77	P1-P3	154.17	0.3530	27.24	2.43	132.06	132.06	89.86	EXIST. NATURAL DRAINAGE CHANNEL 1&2
P4	0.00	0.00%	0.35	0.16	6.67	6.02	0.33									

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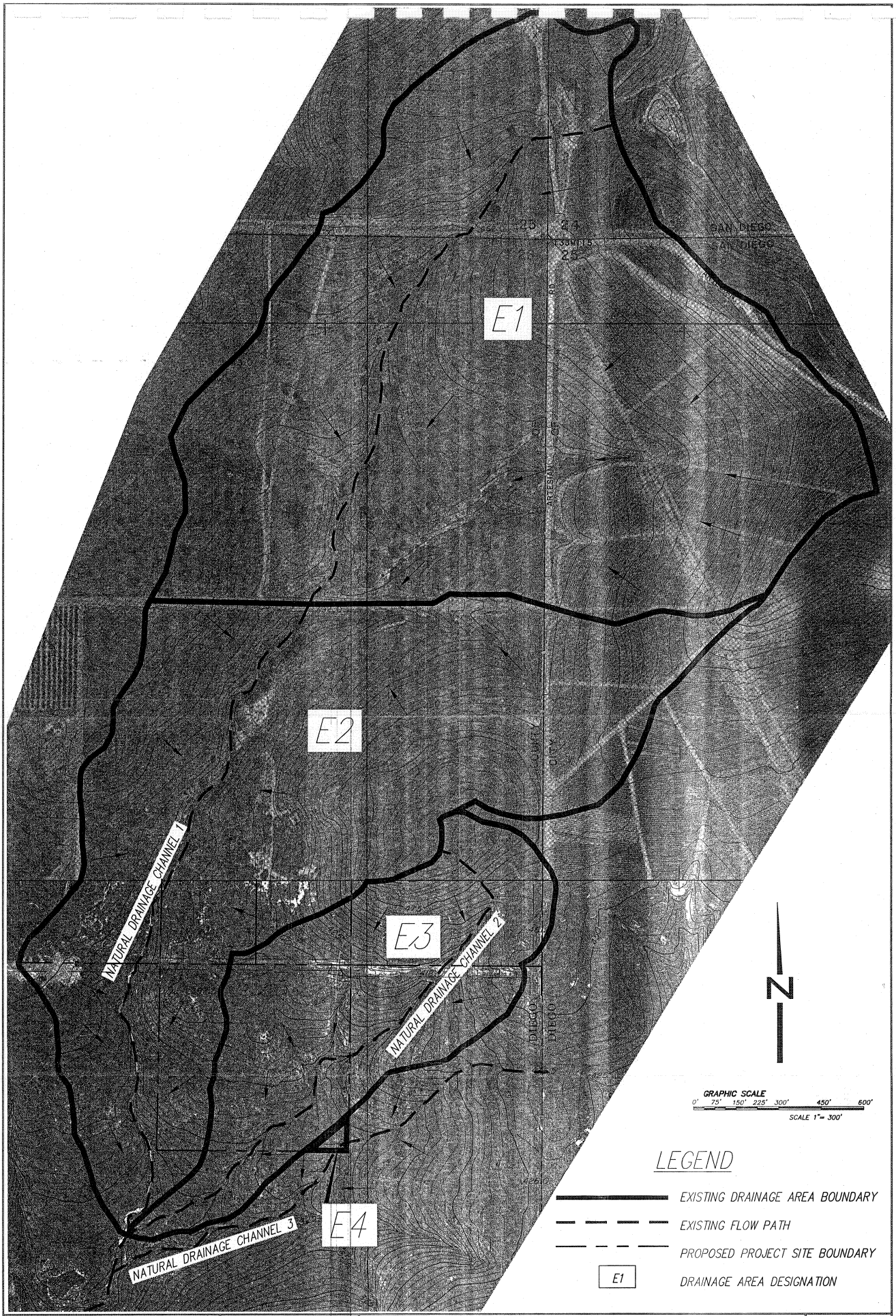

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BEYOND ENGINEERING
15070 AVENUE OF SCIENCE, SUITE 100, SAN DIEGO, CA. 92128
858.385.0500 TEL 858.385.0400 FAX WWW.NOLTE.COM

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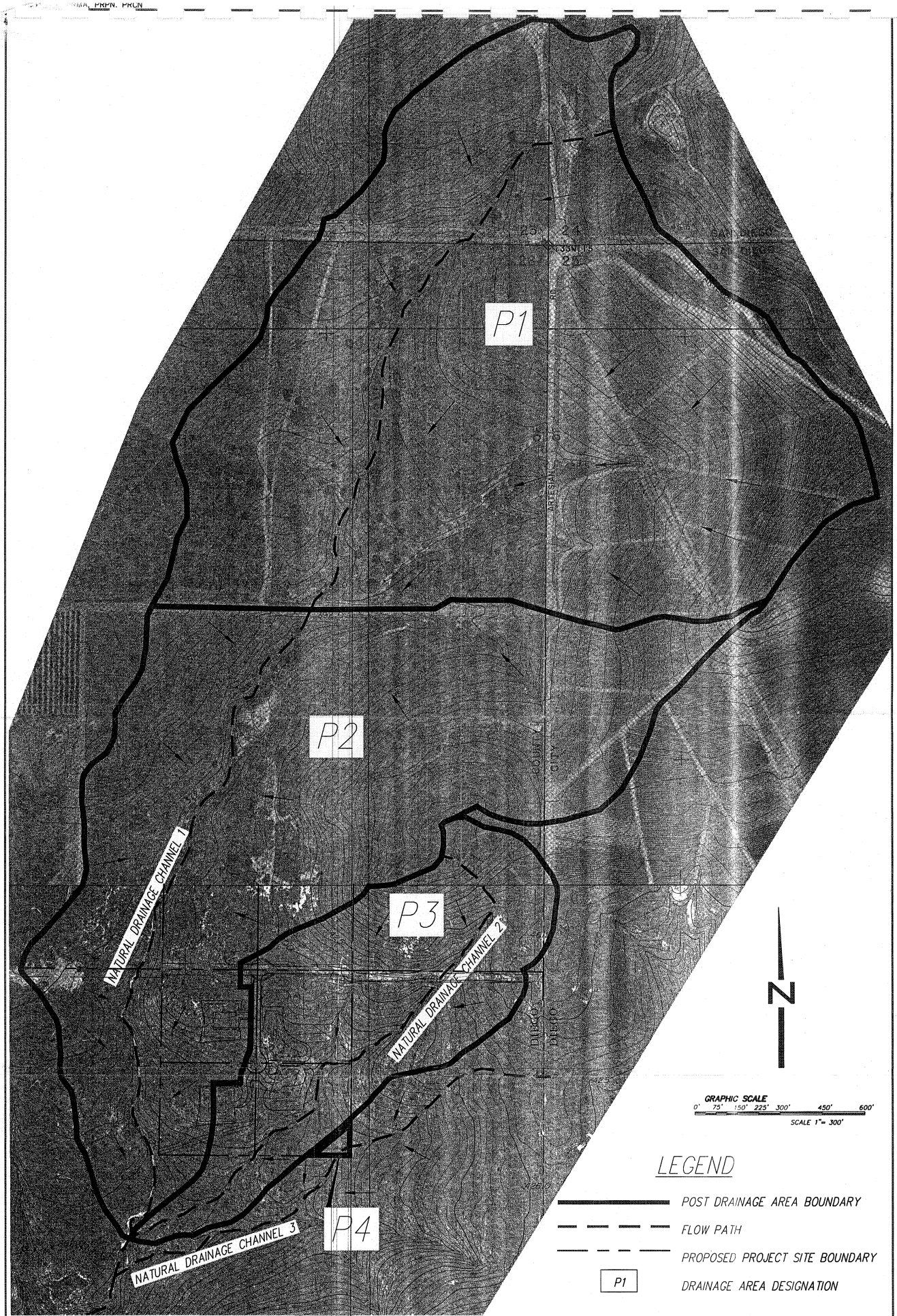
PLOT VIEW: NONE
DESIGNER: LL MGR: JH

REPLACEMENT TPM 20975
EXISTING DRAINAGE AREA MAP

PREPARED FOR: ANTHONY LANG DATE SUBMITTED: 02/2006

SHEET NUMBER 1 OF 2 SHEETS

JOB NUMBER SDB015800-05



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REPLACEMENT TPM 20975
PROPOSED DRAINAGE AREA MAP

PREPARED FOR: ANTHONY LANG DATE SUBMITTED: 02/2006

SHEET NUMBER 2 OF 2 SHEETS
JOB NUMBER SDB015800-05

channel - existing

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.05000	ft/ft
Left Side Slope	4.63	ft/ft (H:V)
Right Side Slope	4.08	ft/ft (H:V)
Discharge	130.93	ft^3/s

Results

Normal Depth	2.03	ft
Flow Area	17.89	ft^2
Wetted Perimeter	18.11	ft
Top Width	17.65	ft
Critical Depth	2.24	ft
Critical Slope	0.02942	ft/ft
Velocity	7.32	ft/s
Velocity Head	0.83	ft
Specific Energy	2.86	ft
Froude Number	1.28	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.03	ft
Critical Depth	2.24	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.02942	ft/ft

channel-post

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.045	
Channel Slope	0.05000	ft/ft
Left Side Slope	4.63	ft/ft (H:V)
Right Side Slope	4.08	ft/ft (H:V)
Discharge	132.06	ft^3/s

Results

Normal Depth	2.03	ft
Flow Area	17.99	ft^2
Wetted Perimeter	18.17	ft
Top Width	17.71	ft
Critical Depth	2.25	ft
Critical Slope	0.02938	ft/ft
Velocity	7.34	ft/s
Velocity Head	0.84	ft
Specific Energy	2.87	ft
Froude Number	1.28	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

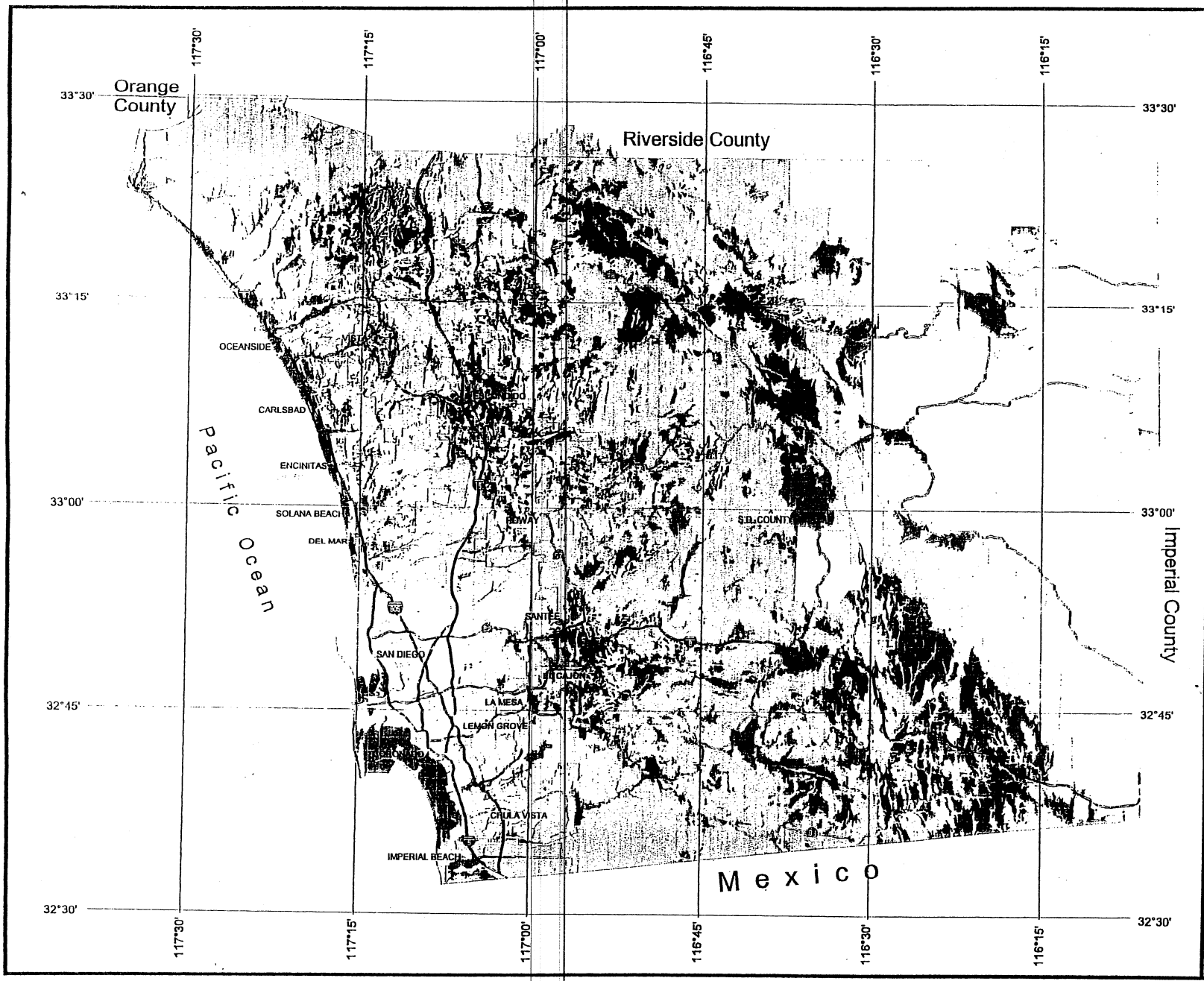
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.03	ft
Critical Depth	2.25	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.02938	ft/ft

APPENDIX B

San Diego County Hydrology Manual
Tables and Figures

County of San Dieg
Hydrology Manua



Soil Hydrologic Groups

Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

N
W E
S

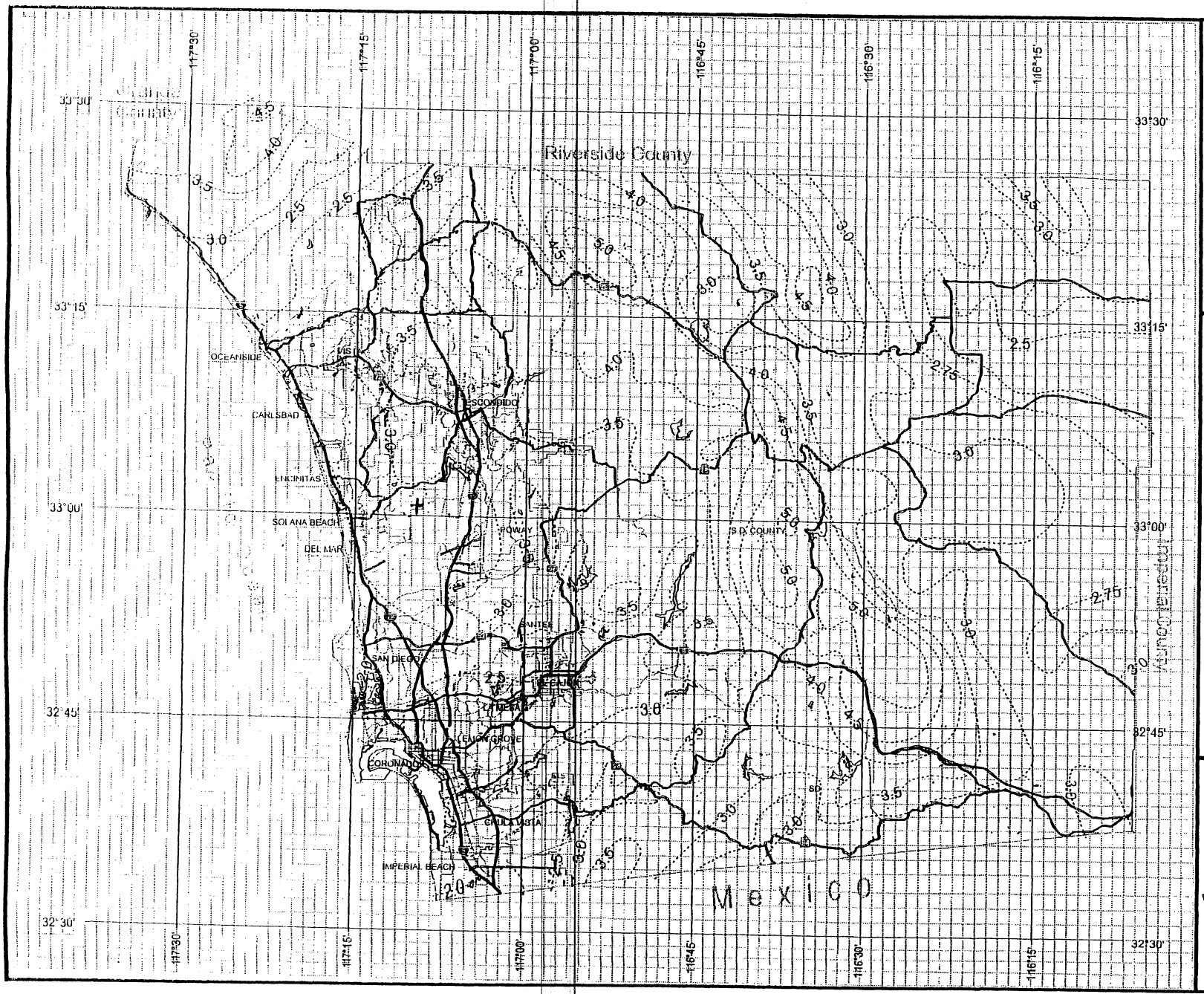
3 0 3 Miles

County of San Diego Hydrology Manual

Rainfall Isopluvials

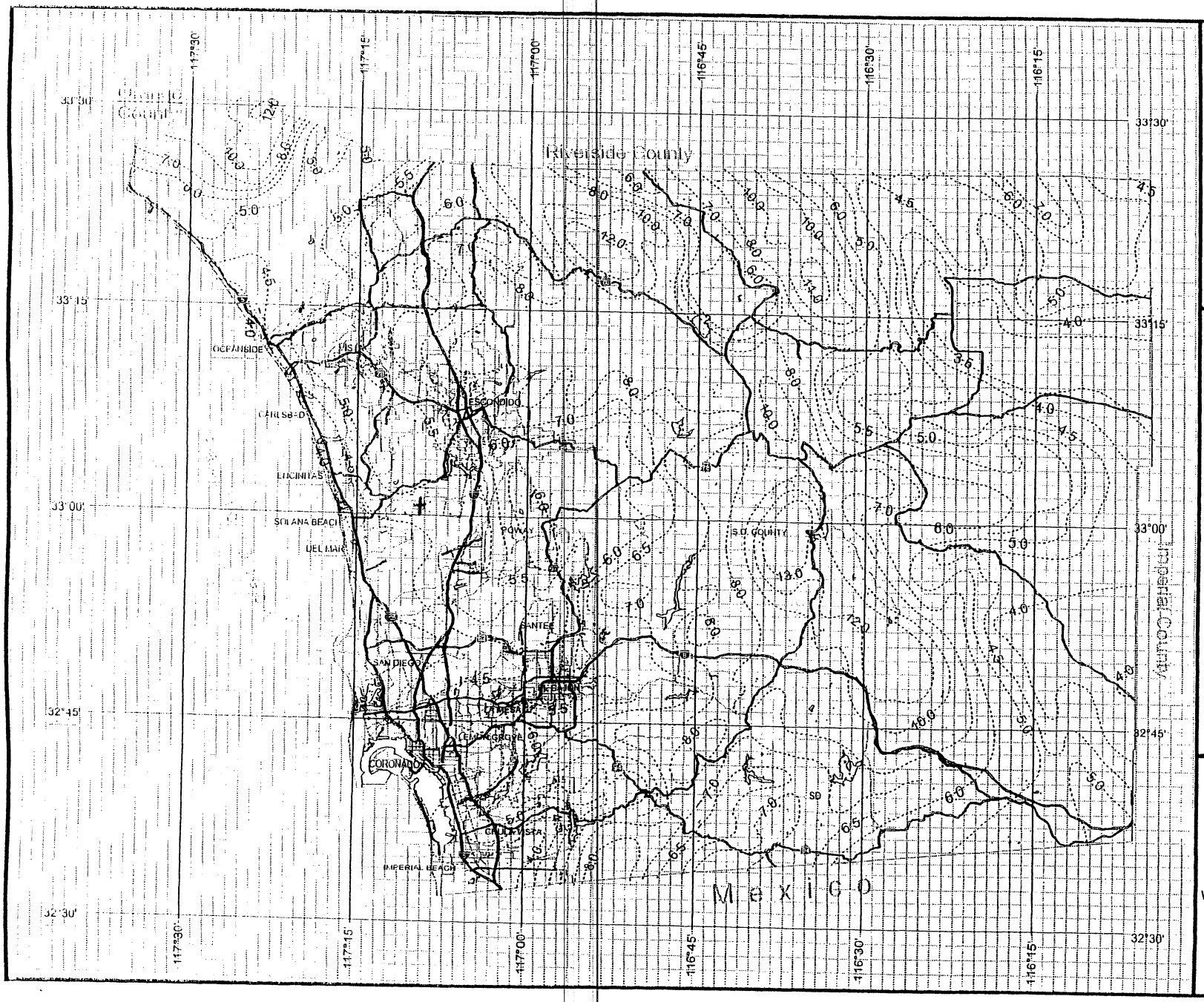
100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS

SanGIS We Have San Diego Covered

N W E S

3 0 3 Miles

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
HRCS Elements	County Elements	% IMPER.	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% 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

HRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

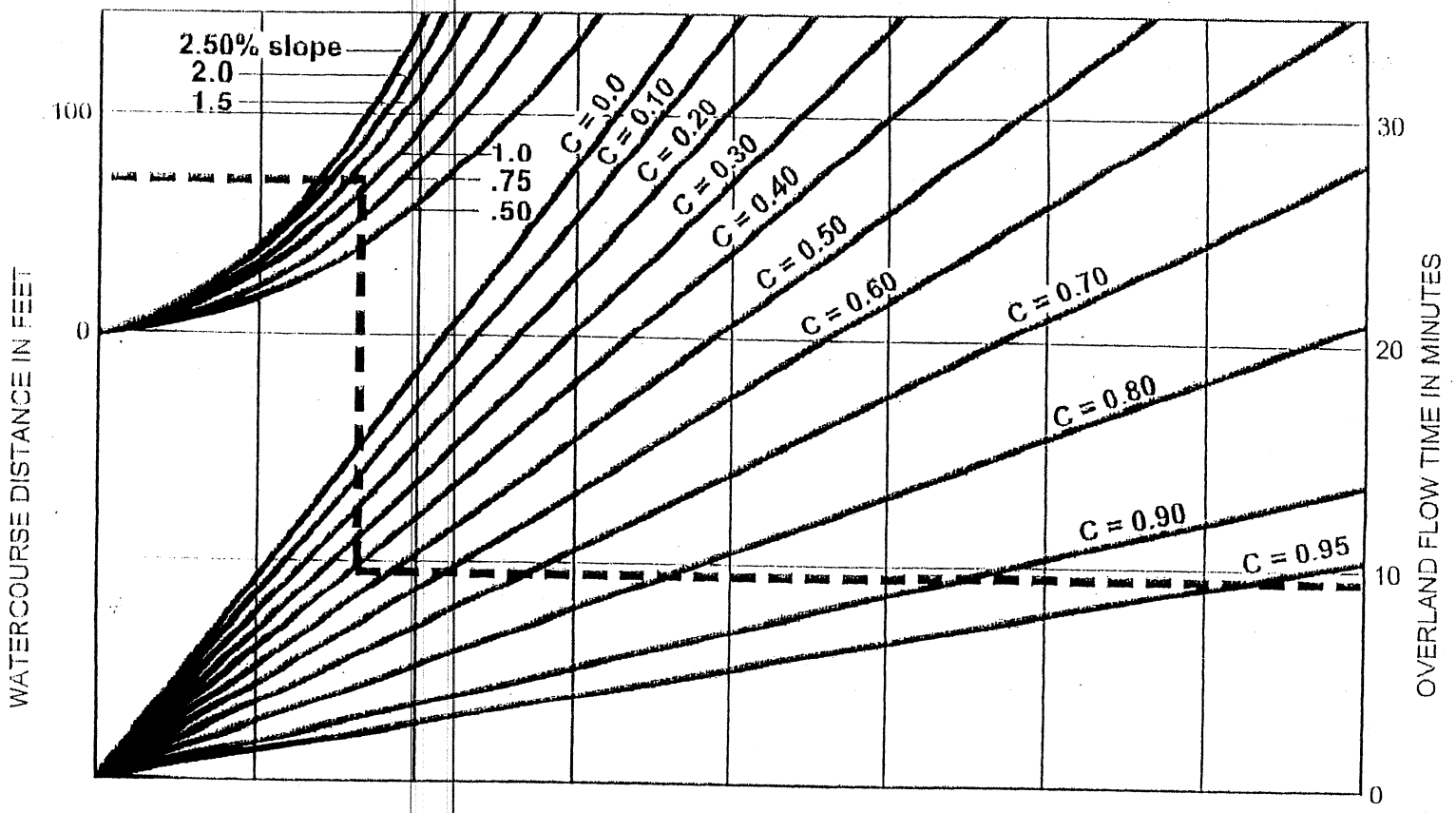
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description



EXAMPLE:

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

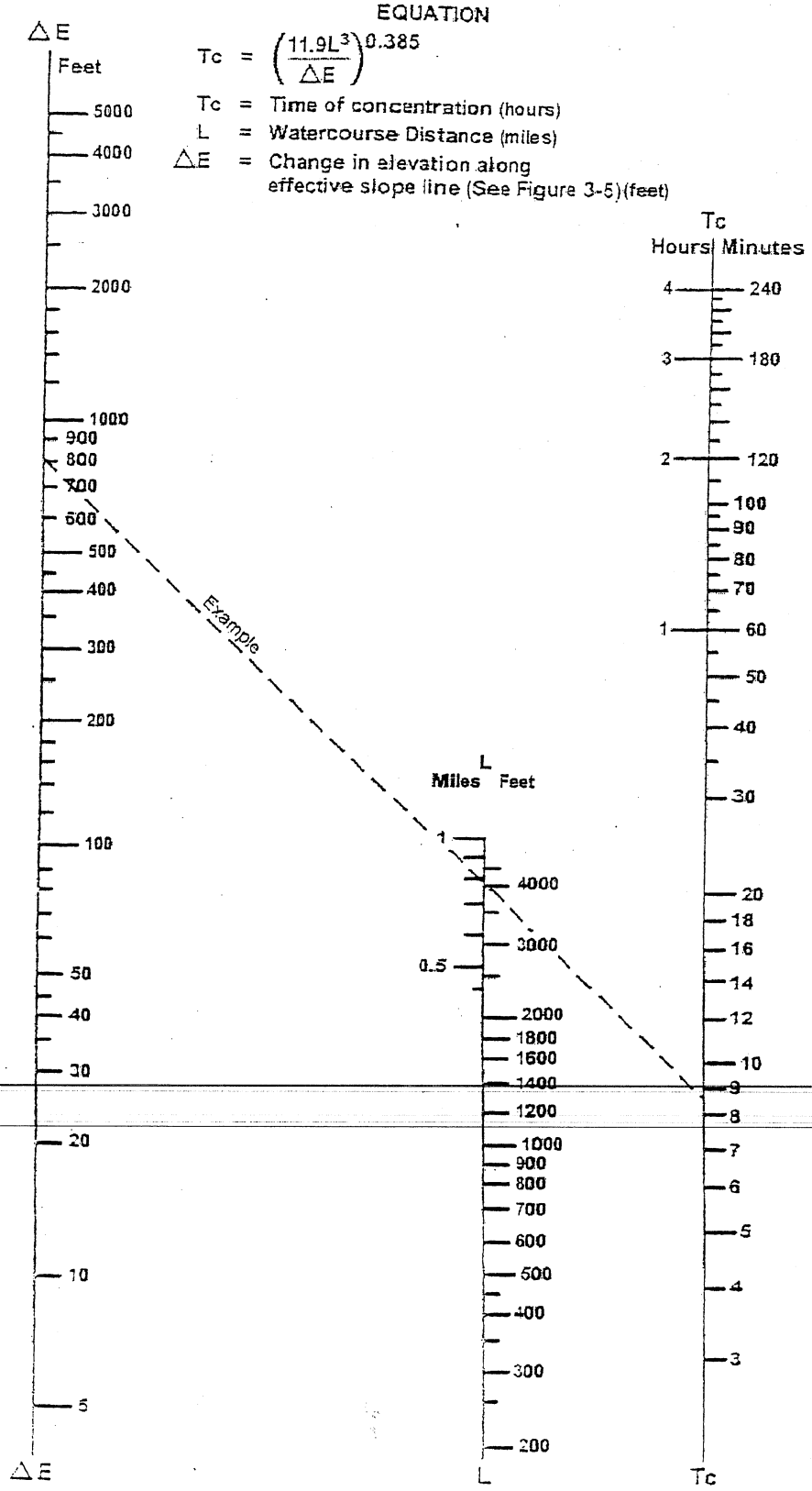
$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

Rational Formula - Overland Time of Flow Nomograph

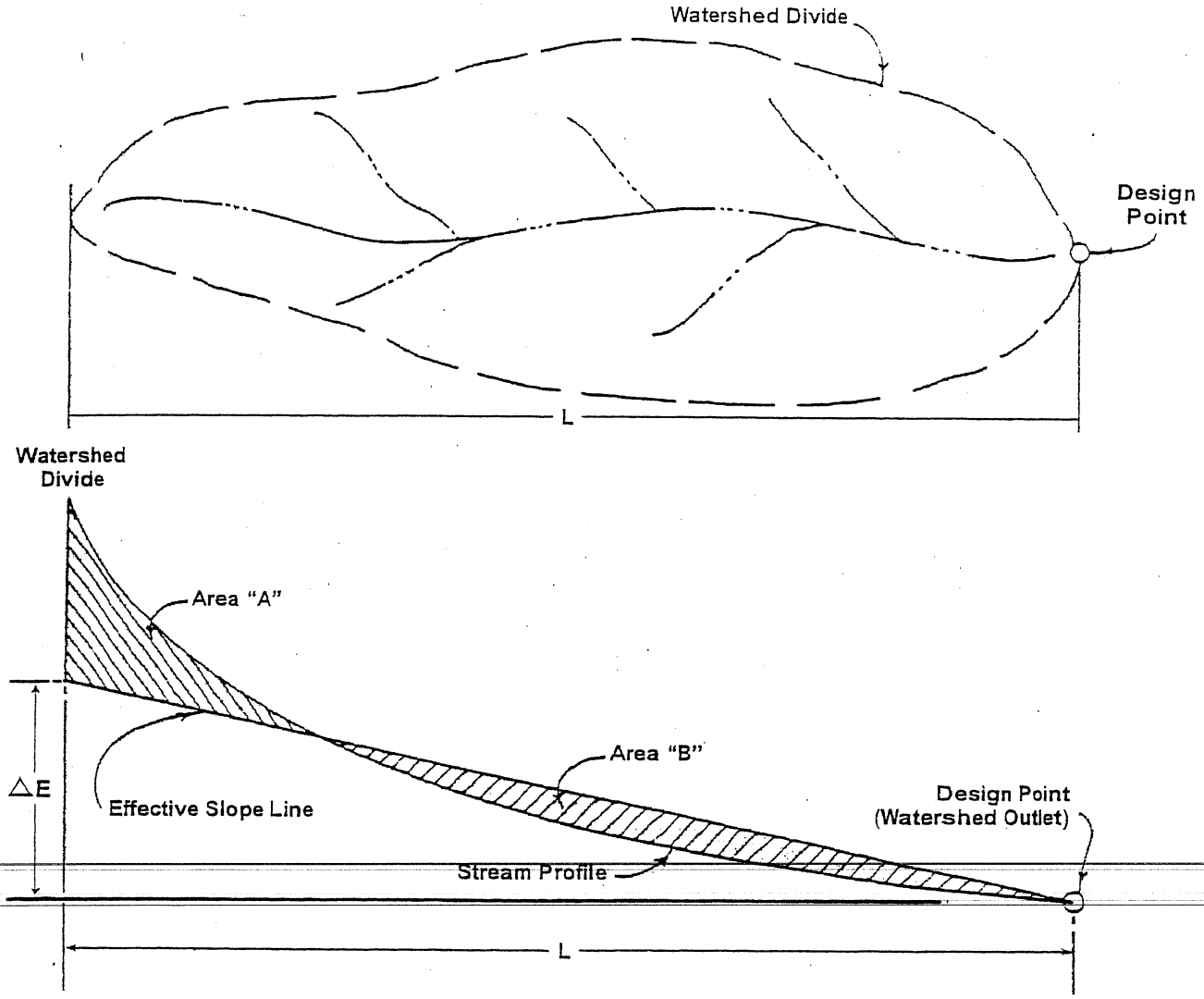
3-3



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

FIGURE 3-4

Nomograph for Determination of Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds



Area "A" = Area "B"

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

FIGURE 3-5

Computation of Effective Slope for Natural Watersheds