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CREW ENGINEERING
AND SURVEYING
5725 KEARNY VILLA ROAD, SUITE D
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Preliminary Drainage Study

Hydrology and Hydraulic Calculations for Sumac Road T.P.M.

Introduction

The project is located on Sumac Road in Fallbrook. The owners James and Nancy Douglass propose to subdivide the 13.2 acre Parcel C of B/C 05-0152 into 4 Parcels. The property currently has 1 single family residence to remain. The majority of the site is in active agriculture, ornamental flowers. The site has moderate to steep slopes.

This study is to estimate the developed runoff from the site and the surface drainage features that have been proposed to safely convey runoff to the property boundary. This property is at the top of the watershed. No surface runoff enters this property. The watershed analyzed is defined by the property boundary.

The property is dominated by a hill that slopes off steeply to the North where no development is proposed and slopes moderately to the South. Runoff flows from this property via sheet flow. There are limited minor drainage swales.

No diversions will result from the proposed project and runoff quantities exiting the site will remain substantially the same following the development of this property.

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EXPIRES SEPTEMBER 30, 2007

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Methodology

The limits of the drainage basins were determined using county topographic maps at 1"=200' scale. A site inspection and survey was conducted to verify the drainage basin and flow patterns.

The Rational Method (Q=CIA) was used to calculate the runoff.

Manning's Equation was used for ditch and pipe capacity checks.

Intensity based on 100 year frequency storm.

Equation for determining the time of concentration (Tc) for natural watersheds:

$$Tc = Ti + \Sigma Tt$$

Initial Time of Concentration (Ti) determined from Table 3-2

Travel time (Tt) is calculated for each reach of watershed by Manning's Equation

Rational Method intensity calculation:
100 Year Frequency: P6 = 3.2" P24 = 7.0" P6 / P24 =46%; so no adjustment required
~~$D = Tc$, $I = 7.44 \times P6 \times D^{-0.645}$~~

Drainage Basin Parameters

Basin	Length(mi)	Height (ft)	Tc (min)	C	I (in/min)	Area (ac)	Q100(cu.ft./s)	Ti(min)
A	0.14	90.00	9.15	0.32	5.71	13.20	24.12	6.4

Pre-Development vs. Post-Development
Runoff Developed Onsite

	Pre-development	Post-Development
Impervious Area	0.34 acres	0.96 acres
% Impervious	2.6 %	7.3 %
Runoff Developed Onsite	25.63 cfs	27.13 cfs

Change in Developed Runoff Due to Construction = **1.50 cfs**

Weighted Runoff Coefficient Calculation

$$C= 0.90x(\% \text{ Impervious}) + C_p x(1- \%\text{Impervious})$$

Pre-Development

$$C= 0.90 \times (2.6\%) + 0.32 \times (1-2.6\%)$$
$$C= 0.34$$
Therefore Q= 25.63 cfs

Post-Development

$$C= 0.90 \times (12.3\%) + 0.25 \times (1-12.3\%)$$
$$C=0.36$$
Therefore Q= 27.13 cfs

Conclusion

The estimated developed runoff from the site prior to construction is 25.63 cfs and post-construction runoff is approximately 27.13 cfs. This increase is insignificant and will not result in any substantial erosion or siltation onsite or off site due to the energy dissipation devices proposed. Including rock filters around house pads and rip rap sump energy dissipation devices at the exit point of the pads and where water exits the driveway (see attached details). The increase in developed runoff will not cause any existing drainage facilities to become overburdened. The drainage pattern of the site will not significantly change due to the construction of this project.

Table 3-1

RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial	General Industrial	95	0.95 .87	~~0.95~~, .87	~~0.95~~, .87	~~0.95~~, .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
NRCS = 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.

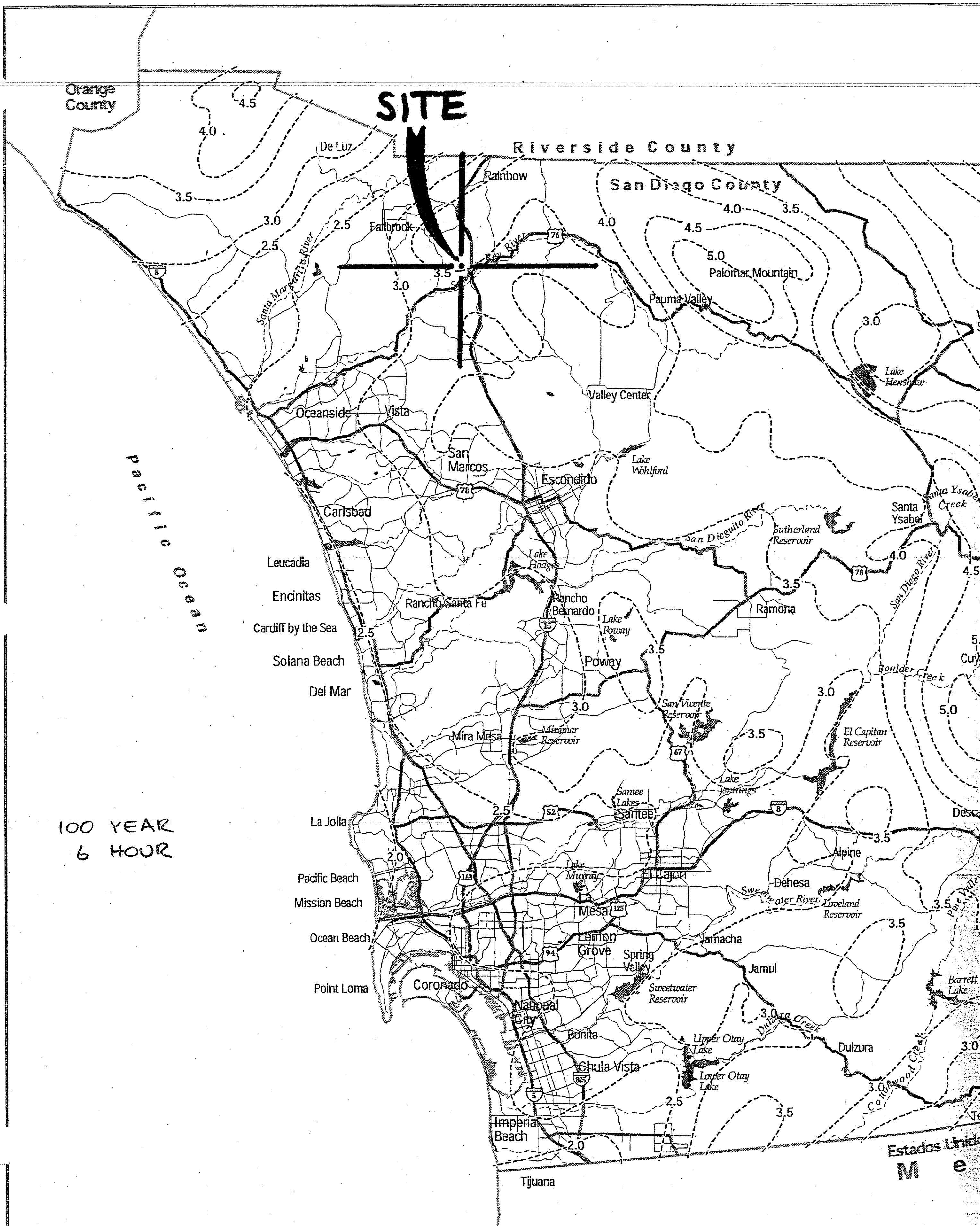
Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved 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/	.5%		1%		2%		3%		5%		10%	
	Acre	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



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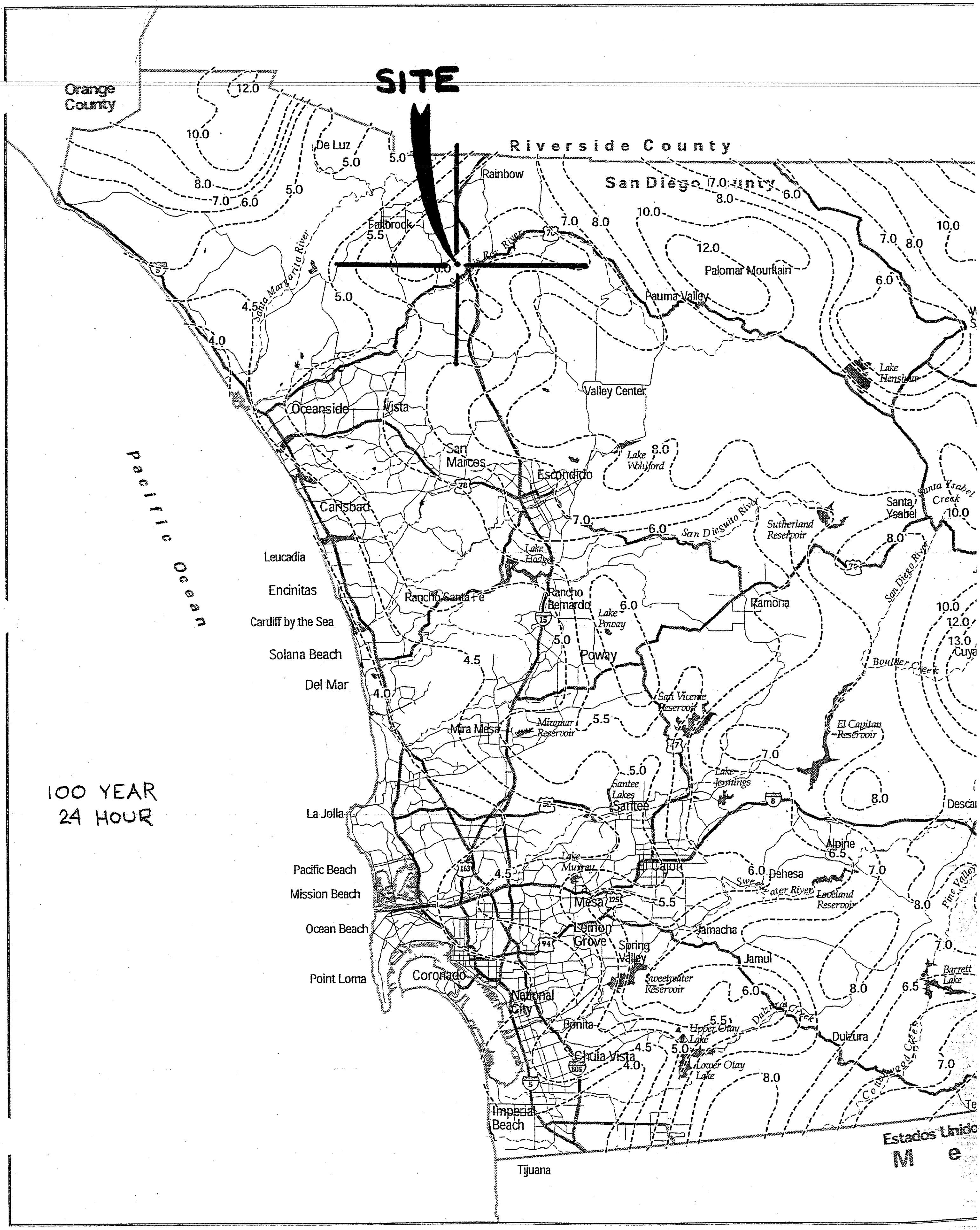

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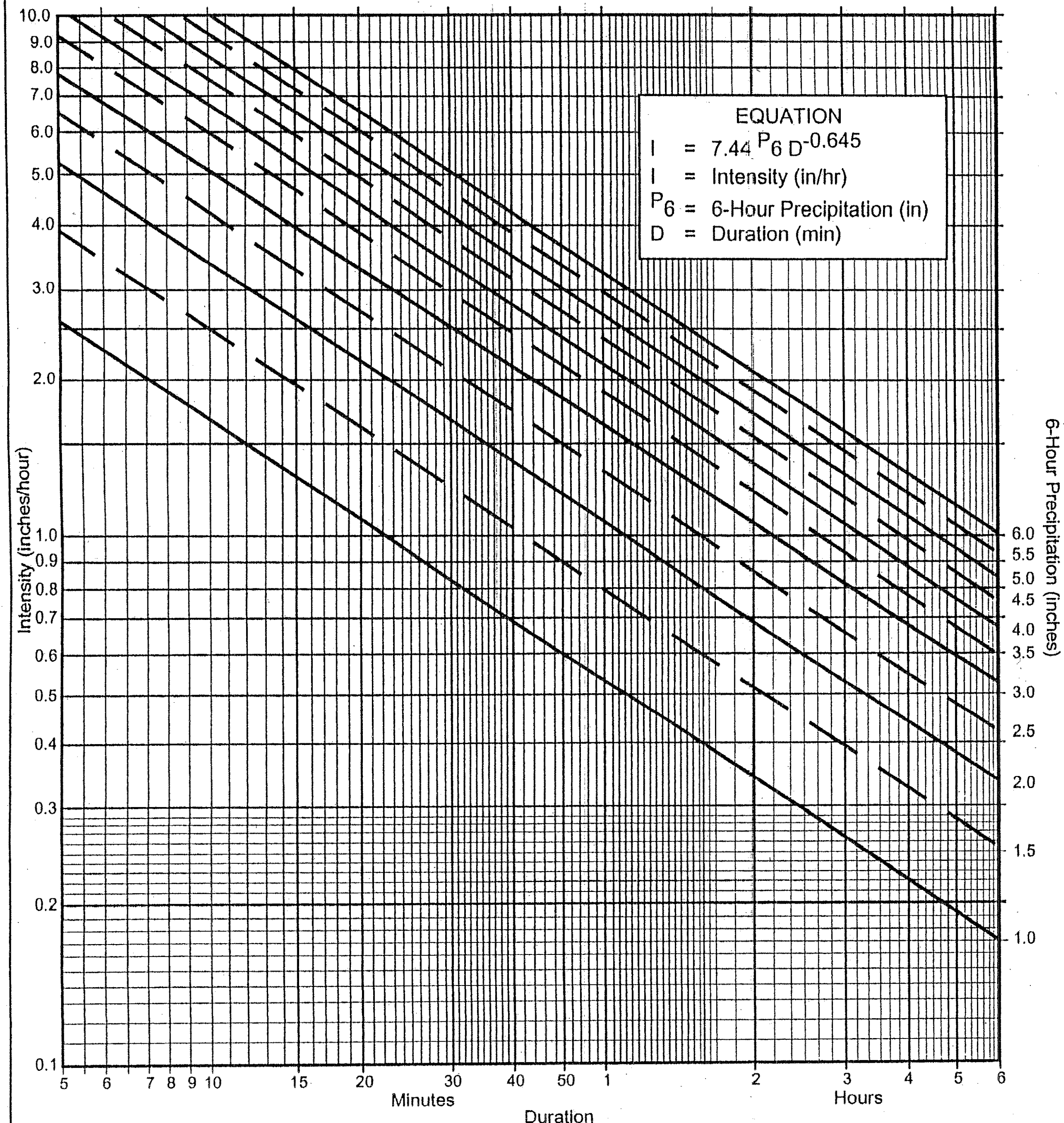


Directions for Application:

(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 applicaple 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 = 3.5 in., P_{24} = 5.8, $\frac{P_6}{P_{24}}$ = 60 %[(2)]

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = ______ min.

(e) I = ______ in./hr.

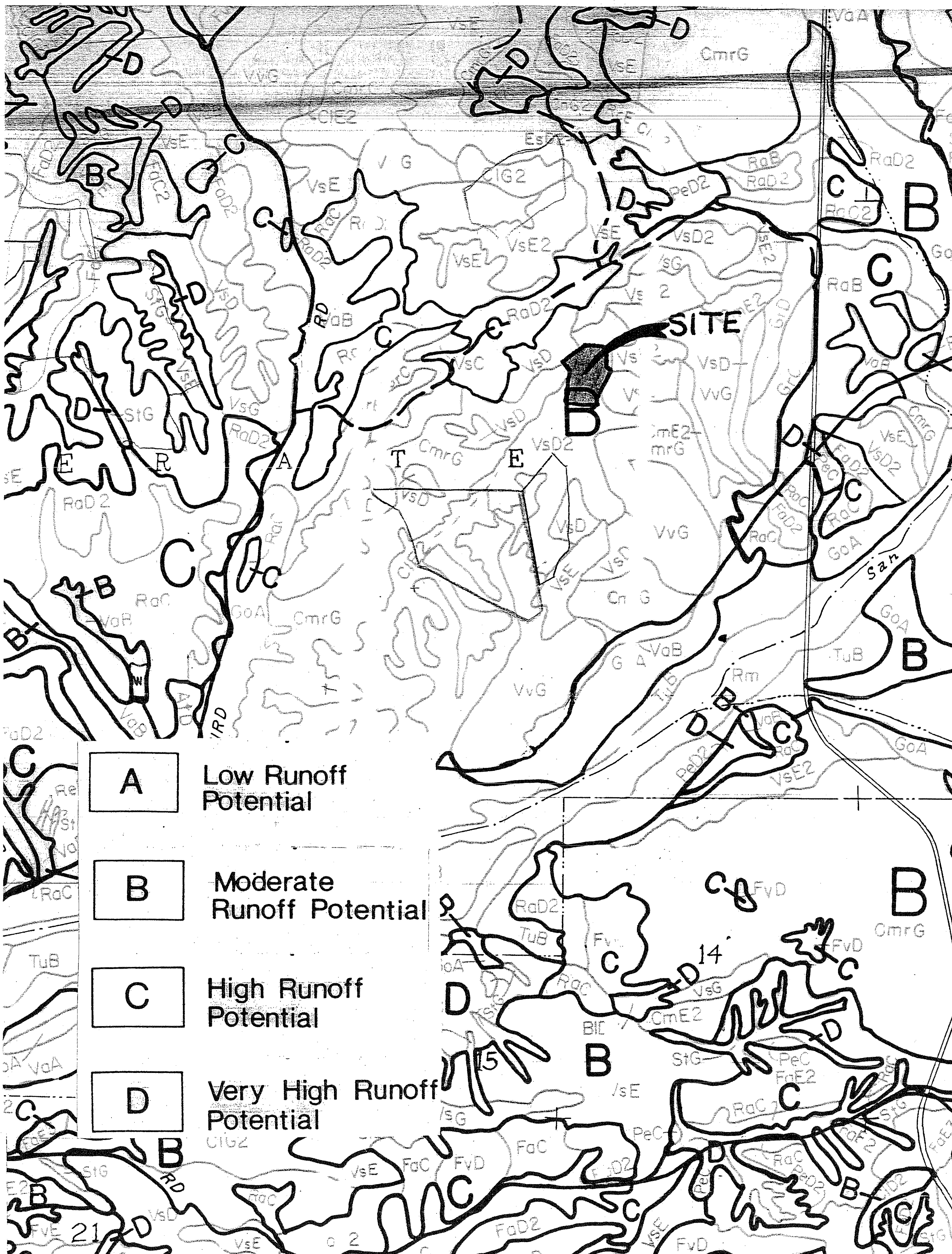
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
	I	I	I	I	I	I	I	I	I	I	I
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	1.86	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	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	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


SITE
A Low Runoff Potential
B Moderate Runoff Potential
C High Runoff Potential
D Very High Runoff Potential

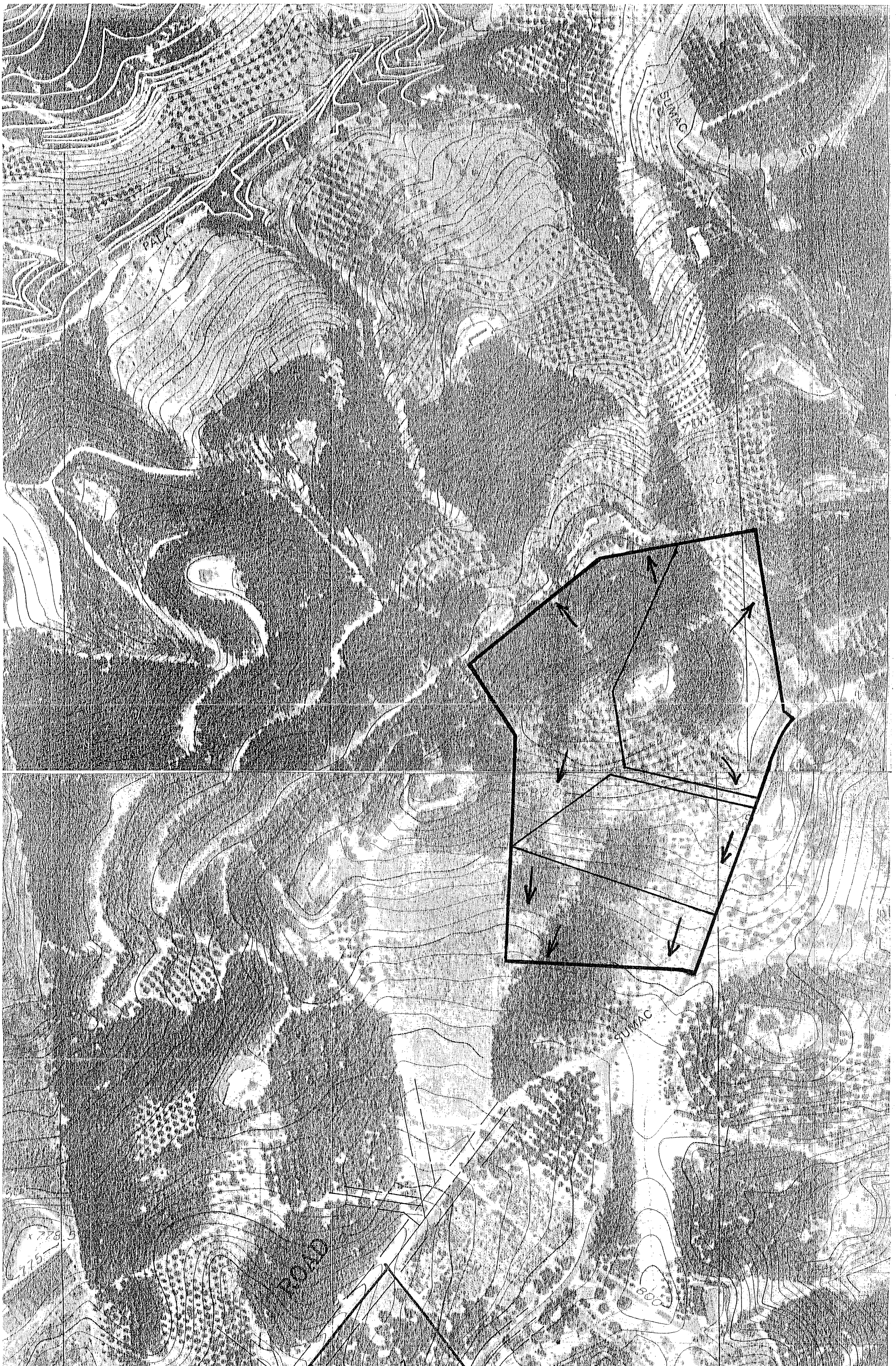
Average Values of Roughness Coefficient (Manning's n)

Type of Waterway	Roughness Coefficient (n)
1. Closed Conduits (1)	
SPIRAL RIB	0.011
Steel (not lined)	0.015
Cast Iron	0.015
Aluminum	.021
Corrugated Metal (not lined)	0.024
Corrugated Metal (2) (smooth asphalt quarterlining)	0.021
Corrugated Metal (2) (smooth asphalt half lining)	0.018
Corrugated Metal (smooth asphalt full lining)	0.012
Concrete RCP	0.012
Clay (sewer)	0.013
Asbestos Cement	0.011
Drain Tile (terra cotta)	0.015
Cast-in-place Pipe	0.015
Reinforced Concrete Box	0.014
PVC	0.009
2. Open Channels (1)	
a. Unlined	
Clay Loam	0.023
Sand	0.020
b. Revetted	
Gravel	0.030
Rock	0.040
Pipe and Wire	0.025
Sacked Concrete	0.025
c. Lined	
Concrete (poured)	0.014
Air Blown Mortar (3)	0.016
Asphaltic Concrete or Bituminous Plant Mix	0.018
d. Vegetated (5)	
Grass lined, maintained	.035
Grass and Weeds	.045
Grass lined with concrete low flow channel	.032
3. Pavement and Gutters (1)	
Concrete	0.015
Bituminous (plant-mixed)	0.016

$R = A / WP$

2.5 1.5

Type of Waterway	Roughness Coefficient (n)
4. Depressed Medians (10:1 slopes[1])	
Earth (without growth)	0.040
Earth (with growth)	0.050
Gravel	0.055
5. Natural Streams[4]	
a. Minor streams (surface width at flood stage < 100 ft)	
(1) Fairly regular section	
(a) Some grass and weeds, little or no brush	0.030
(b) Dense growth of weeds, depth of flow materially greater than weed height	0.040
(c) Some weeds, light brush on banks	0.040
(d) Some weeds, heavy brush on banks	0.060
(e) For trees within channel with branches submerged at high stage, increase all above values by 0.015	
(2) Irregular section, with pools, slight channel meander. Channels (a) to (e) above, increase all values by 0.015	
(3) Mountain streams; no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stage	
(a) Bottom, gravel, cobbles and few boulders	0.050
(b) Bottom, cobbles with large boulders	0.060
b. Flood plains (adjacent to natural streams)	
(1) Pasture, no brush	
(a) Short grass	0.030
(b) High grass	0.040
(2) Cultivated areas	
(a) No crop	0.040
(b) Mature row crops	0.040
(c) Mature field crops	0.050
(3) Heavy weeds, scattered brush	0.050
(4) Light brush and trees	0.060
(5) Medium to dense brush	0.090
(6) Dense willows	0.170
(7) Cleared land with tree stumps, 100-150 per acre	0.060
(8) Heavy stand of timber, little undergrowth	
(a) Flood depth below branches	0.110
(b) Flood depth reaches branches	0.140



DRAINAGE BASIN MAP 1227