PRELIMINARY DRAINAGE REPORT

FOR

PROPOSED RESIDENTIAL DEVELOPMENT
3 LOTS
TPM 20794
APN 186 - 290 - 33
ER# 03-08-063

PREPARED FOR

Earl and Kazue Boyer
28440 Mountain Meadow Road
Escondido, CA 92026

RECEIVED
MAR 17 2008
DEPARTMENT OF PLANNING
AND LAND USE

PREPARED BY

Robert O. Sukup
4322 Sea Bright Place
Carlsbad, CA 92008

REGISTERED PROFESSIONAL ENGINEER
ROBERT O. SUKUP
No. C028802
Exp. 3/31/08
CIVIL
STATE OF CALIFORNIA

March 22, 2006

Robert O. Sukup

The proposed project is to create a 3 lot minor subdivision on a 3 acre parcel of property. The property is triangular in shape and somewhat unique because it is bascally bordered on all three sides by roadways. The east and southeast sides have Mountain Meadow Road [a county roadway] as its border and the northwest/southwest side is bordered by a 20' paved private road. The property naturally flows to the northwest and southwest to the existing private road. There is an existing sump condition near the center west of the property that drains a portion of the property. The eastern side of the property slopes gently westward with the western half sloping moderately to occasionally steep to the existing roadway.

Drainage from a portion of Mountain Meadow Road discharges into the southwest corner of the property via a 36" RCP pipe. That water is presently carried to the natural drainage channel to the west via an existing 30" CMP pipe. A portion of the undeveloped property drains into this 30" CMP as well. The sump area mentioned in the paragraph above has an existing 18" CMP pipe that discharges into a combination concrete swale for lower flows and a paved swaled driveway for large storm flows. This water also discharges to the natural drainage channel to the west.

The existing 18" CMP pipe will be used to handle a portion of the water from the 3 proposed lots. The corresponding calculations show that it has the capacity. The existing 30" CMP pipe will have to be upgraded to accommodate the new driveway alignments, a portion of the water from the project, and the water discharging from the street above.

The attached hydrology calcs, topography maps, etc. that follow show the drainage areas and corresponding flows.

The project as designed will create a slight diversion in how the site presently drains. About half the graded pad of proposed Parcel 2 now flows into Drainage Basin "A". It previously flowed naturally to Drainage Basin "B". The theoretical additional drainage equates to .24 cfs [3.59cfs - 3.35cfs]. This is an insignificant increase when considering how small a portion it is when compared to the total pre development flow of 45.99 cfs. This .24 cfs theoretical diversion of water goes through the proposed rip rap and into a large existing natural drainage course. It is the same natural drainage course that drainage Area "B" flows into. The existing natural drainage course is shown in this report.

The proposed 3 lots will not have a negative affect on downstream drainage courses considering the existing points of discharge remain the same and the

projected increase in flow for the 100 year storm does not exceed the pre-existing condition [6.79cfs vs. 6.03cfs]. Even though there is greater impervious area, the proposed flat pads have increased the time of travel, thus decreasing the "I" value and the ultimate flow.

Appropriate erosion control measures would certainly be required during construction of the proposed project.

HYDROLOGY DISCUSSION

BOYER - TPM 20794

THE SUBJECT PROPERTY IS A SMALL PARCEL OF 3.0 ACRES. NO HOUSES ARE ON THE SITE. THERE ARE SOME EXISTING A.C. ROADS ON THE PROPERTY.

NO OFFSITE WATER SURFACE DRAINS ACROSS THE PROPERTY. THERE IS A 36" RCP THAT DISCHARGES INTO THE PROPERTY AT THE SOUTHWEST CORNER THAT IS THEN COLLECTED BY AN EXISTING 30" CMP THAT DISCHARGES TO THE NATURAL DRAINAGE COURSE TO THE NORTHWEST. THERE IS ALSO AN EXISTING 18" CMP THAT IS ON SITE AND DISCHARGES TO THE NORTHWEST AS WELL. THESE ARE SHOWN ON THE PREDEVELOPMENT MAP ATTACHED

PRE DEVELOPMENT

SOIL TYPE = TYPE C (SEE ATTACHED MAP) C VALUE = .30 (TABLE 3-1 ATTACHED)

$P_6 = 3.7$ FOR INTENSITY DURATION CURVE ($P_{24} = 8.0$)

AREA "A" (MAJOR PORTION OF PROPOSED PARCELS 3 & 2)

$A = 1.49$ ACRES, $L = 270'$, $H = 36'$

$T_c = T_i + T_t$ $\quad T_i = \dfrac{1.8(1.1-C)\sqrt{D}}{\sqrt[3]{S}}$ (FROM FIGURE 3.3)

$C = .30$, $D = 60'$, $S = 10.0\%$ (6' DROP OVER 60')

$$T_i = \frac{1.8(1.1-.3)\sqrt{60}}{\sqrt[3]{10}} = 5.2 \text{ MIN.}$$

FROM FIGURE 3-4 w/ $H = 36$ & $L = 270'$ $t_t \approx 1.6$

$T_c = 5.2 + 1.6 = 6.8$

$I = 7.5$ (FIGURE 3-1)

$Q = CIA = .30 \times 7.5 \times 1.49 = 3.35$ cfs

AREA "B" - PRE DEVELOPMENT (PRIMARILY PROPOSED PARCEL 1)

A = 1.51 ACRES, L = 330', H = 41

$t_i = \frac{1.8(1.1-C)\sqrt{D}}{\sqrt[3]{S}}$, C = .30 D = 50', ΔN = 6', S = 12.0%

$t_i = \frac{1.8(1.1-.3)\sqrt{50}}{\sqrt[3]{12}} = 4.74$

FROM FIGURE 3-4 w/ H = 41 & L = 330, $T_t \approx 1.6$

$T_c = 4.74 + 1.6 = 6.34$

I = 7.6 (FIGURE 3-1)

Q = CIA = .30 x 7.6 x 1.51 = 3.44 cfs.

THE EXISTING 36" RCP ON MOUNTAIN MEADOW ROAD THAT DISCHARGES ONTO PROPOSED PARCEL 3 HAS A Q OF 42.4 cfs. THE 36" RCP IS LINE "O" ON THE IMPROVEMENT PLANS. ATTACHED ARE COPIES OF SHEETS 9 AND 19 OF 48 OF COUNTY IMPROVEMENT PLANS FOR UJ 1112.

POST DEVELOPMENT AREA "A"

THE DRAINAGE WATER FROM THE NEW PADS OF PARCELS 3 & 2 IS DESIGNED TO GO TO THE EXISTING 30" CMP. (BASICALLY PRE DEVELOPMENT AREA "A")

DRAINAGE AREA ≈ 1.72 Ac. (1.21 Ac OF PARCEL 3 + ≈.51 Ac. OF PAD & DYWY OF PARCEL 2)

C = .36 (TABLE 3-1)

T_i = 170' @ 1% ON PARCEL 2 TO GET TO DYWY.

BUT USE 85' @ 2% FROM TABLE 3-2 = 10.0 MIN.

T_t = USE L = 220', H = 28 - FROM FIGURE 3-4 - USE T_t = 1.5 MIN.

T_i (BY FORMULA) = $(1.8)(1.1-.36)\sqrt{85} = 9.74 \approx 10.0$ = OK.

$T_c = T_i + T_t = 10 + 1.5 = 11.5$

$I = 5.8$ FIGURE 3.1

$Q = CIA = .36 \times 5.8 \times 1.72\ Ac = \underline{\underline{3.59\ cfs = \text{AREA A}}}$

AREA "B"

THE DRAINAGE WATER FROM PARCEL 1 AND A PORTION OF PARCEL 2 WILL DRAIN TO THE EXISTING 18" CMP. IT IS AN AREA OF 1.28 Ac. (BASICALLY PRE DEVELOPMENT AREA "B")

$C = .36$ (TABLE 3-1)

FOR T_i: USE 85' @ 2% FROM TABLE 3-2 = 10.0 MIN. (9.74 BY CALC)

T_t: $L \approx 420'$, $H = 12'$ FROM FIGURE 3-4. $T_t \approx 3.3$ MIN.

$T_c = T_i + T_t = 10 + 3.3 = 13.3$

$I = 5.2$ (FIGURE 3.1)

$Q = CIA = .36 \times 5.3 \times 1.28 = 2.44\ cfs$ = AREA "B"

PIPE DESIGN:

THE EXISTING 30" CMP IS AT @ 2% GRADE ±

PER FIGURE 6.1 ATTACHED (NOMOGRAPH FOR PIPE FLOWS)

A 30" PIPE @ 2% WITH A "n" VALUE OF .013 = 58 cfs CAPACITY

CMP HAS AN n VALUE OF .022 ∴ $\frac{.013}{.022} \times 58 = 34$ cfs CAPACITY

$Q_{TOTAL} = 42.4 + 3.59 = 46\ cfs > 34\ cfs$ - 30" CMP NOT O.K

A 36" PIPE @ 2% = 90 cfs > 46 cfs = OK ✓

AT THIS TIME, FIGURE A 36" PIPE (RCP) TO REPLACE THE 30" CMP. FINAL DESIGN MAY ALLOW FOR A 30" RCP.

EXISTING 18" CMP

AN 18" CMP @ 2% HAS A CAPACITY OF $\frac{.013}{.022} \times 15\ cfs = 8.9\ cfs$

PROPOSED FLOW ≈ 2.44 cfs 2.44 cfs < 8.9 cfs = OK ✓

EXISTING 18" = OK ✓

THE WATER FROM THE 18" CMP FLOWS TO A CONCRETE SWALE. THE SWALE IS APPROX. 3' WIDE x 1' DEEP @ 1% MIN.

USING MANNINGS EQUATION - $Q = \frac{AR^{2/3}\, 1.49\sqrt{S}}{n}$

$$Q = \frac{(1.5)(.2273)^{2/3}\, 1.49\sqrt{.01}}{.02} = \frac{(1.5)(.3724)(1.49)(.1)}{.02} = 4.16\,cfs$$

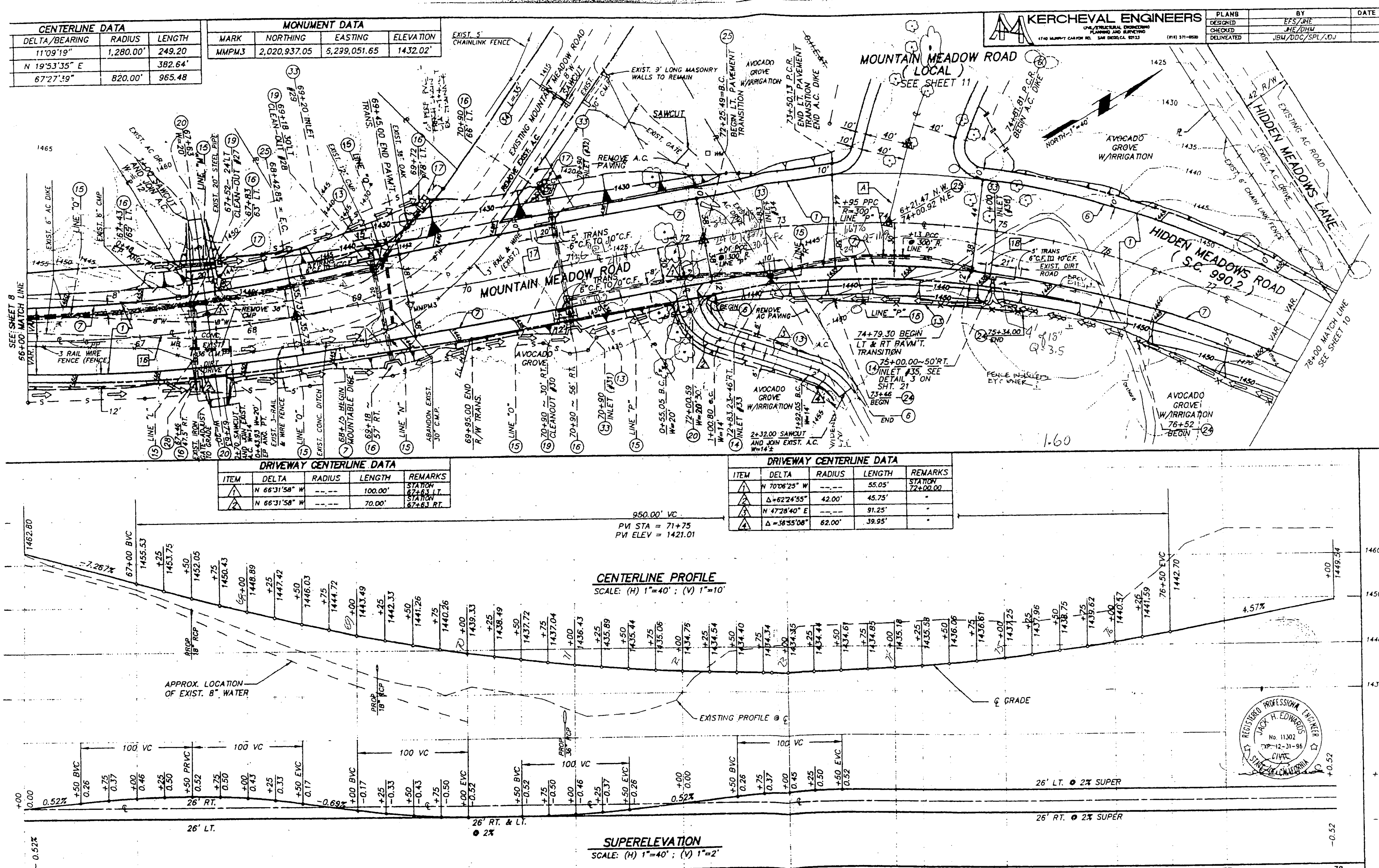
$Q = 4.16\,cfs$ FOR CONC. SWALE $> 2.44\,cfs$ = OK ✓

CENTERLINE DATA		
DELTA/BEARING	RADIUS	LENGTH
11°09'19"	1,280.00'	249.20
N 19°53'35" E		382.64'
67°27'39"	820.00'	965.48

MONUMENT DATA			
MARK	NORTHING	EASTING	ELEVATION
MMPM3	2,020,937.05	6,239,051.65	1432.02'

DRIVEWAY CENTERLINE DATA				
ITEM	DELTA	RADIUS	LENGTH	REMARKS
1	N 66°31'58" W	--.--	100.00'	STATION 67+63 LT.
2	N 66°31'58" W	--.--	70.00'	STATION 67+63 RT.

DRIVEWAY CENTERLINE DATA				
ITEM	DELTA	RADIUS	LENGTH	REMARKS
1	N 70°06'25" W	--.--	55.05'	STATION 72+00.00
2	Δ=62°24'55"	42.00'	45.75'	"
3	N 47°28'40" E	--.--	91.25'	"
4	Δ=38°55'08"	82.00'	39.95'	"



PLANS	BY	DATE
DESIGNED	EFS/JHE	
CHECKED	JHE/DHM	
DELINEATED	JBM/DDC/SPL/JDJ	

STA	66	67	68	69	70	71	72	73	74	75	76	77
EARTHWORK	C=298CY F=22CY	C=29CY F=549CY	C=0.0CY F=2,343CY	C=0.0CY F=3,299CY	C=0.0CY F=3,015CY	C=55CY F=3,234CY	C=1,827CY F=426CY	C=4,055CY F=0.0CY	C=4,063CY F=2CY	C=3,061CY F=25CY	C=4,956CY F=0.0CY	C=5,436CY F=0.0CY

COUNTY OF SAN DIEGO
DEPARTMENT OF PUBLIC WORKS
OFFICE OF THE COUNTY ENGINEER
5555 OVERLAND AVENUE SAN DIEGO CA 92123-1295

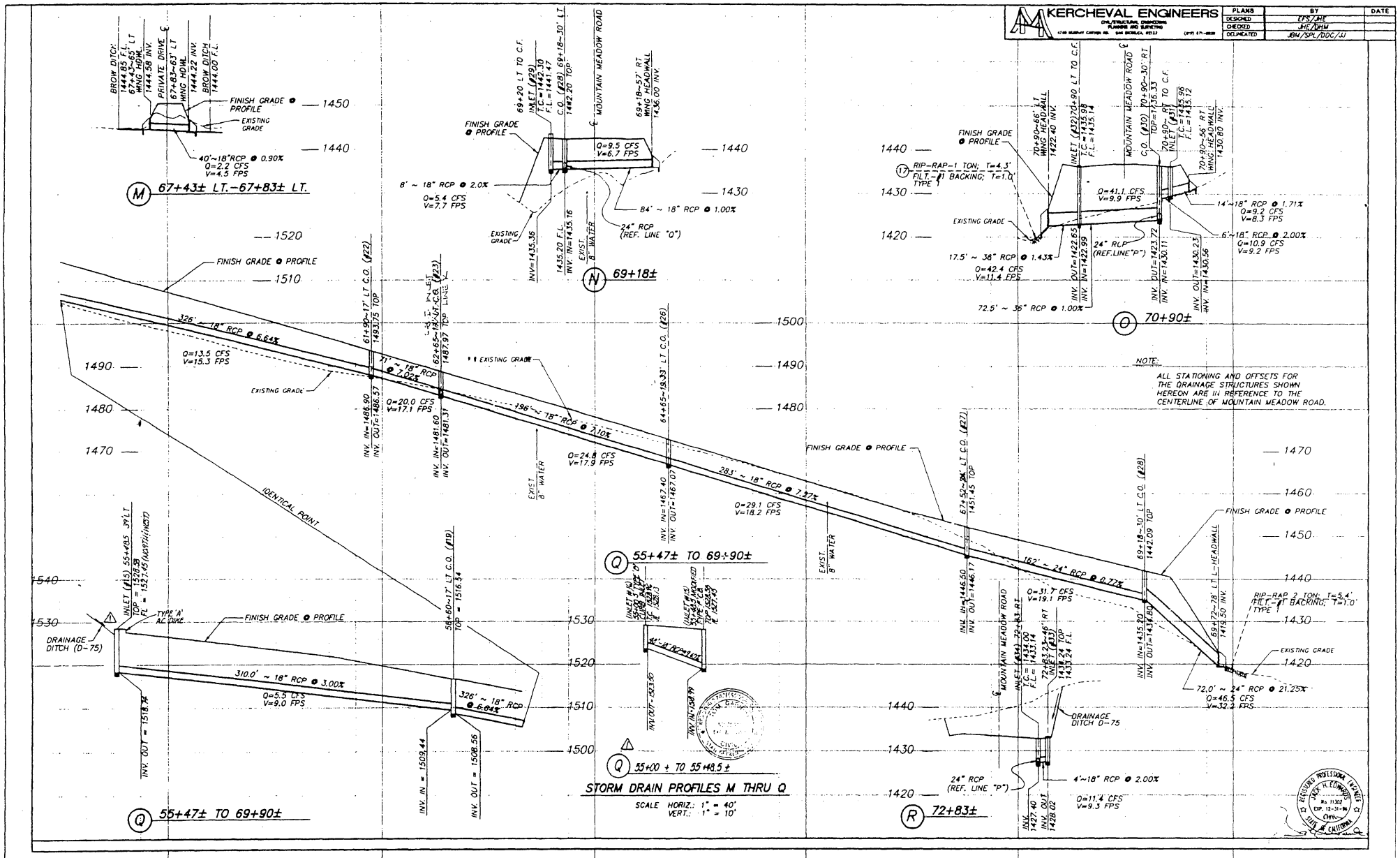
RECOMMENDED BY: Manard F Smith DATE 7-3-95
J. S. Koomer DATE 7-7-95
APPROVED BY: [signature] DATE 7-7-95

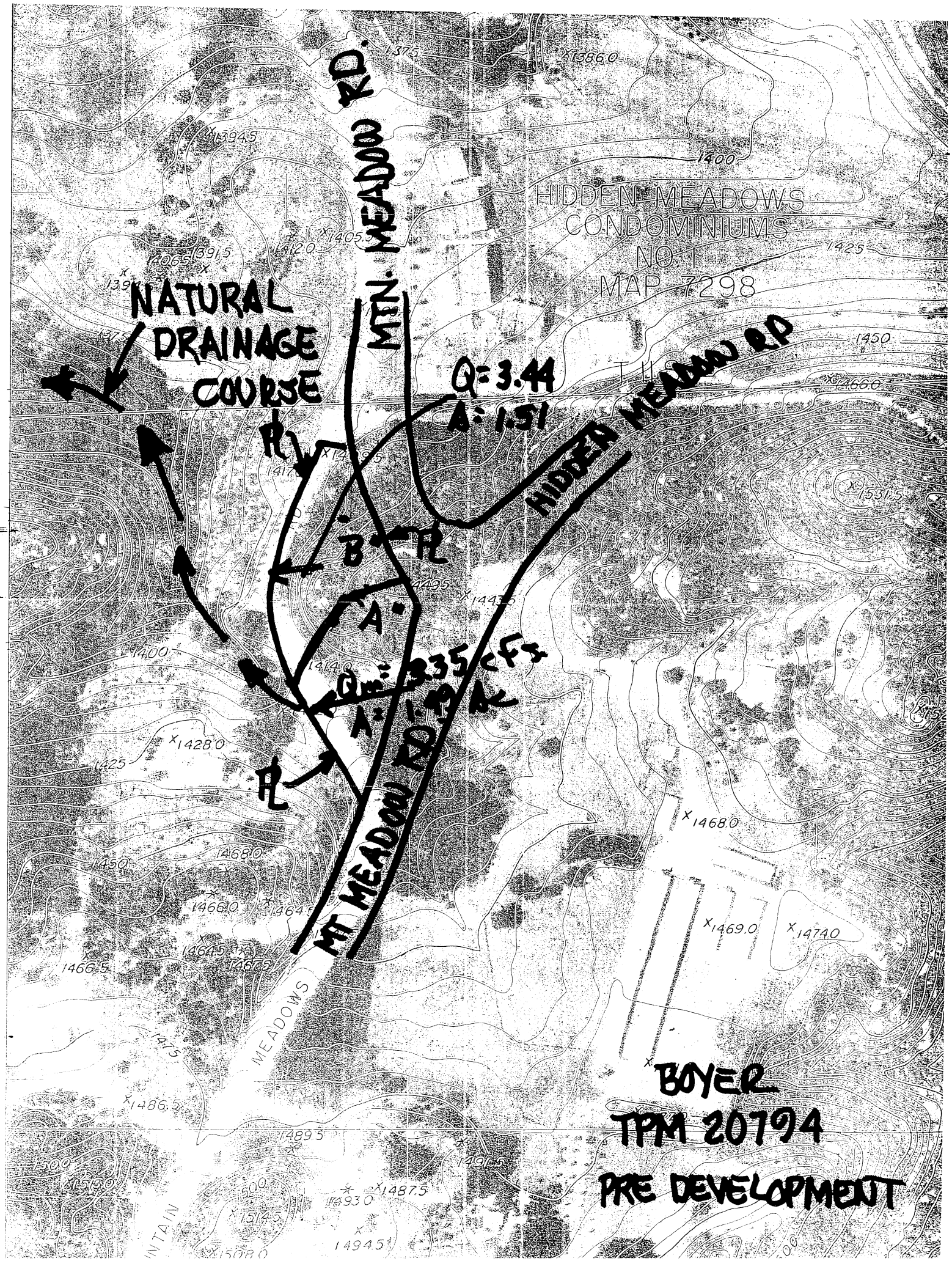
REVISIONS	BY	APPROVED	DATE
1 AS BUILT DRAWING REVISED	MK		

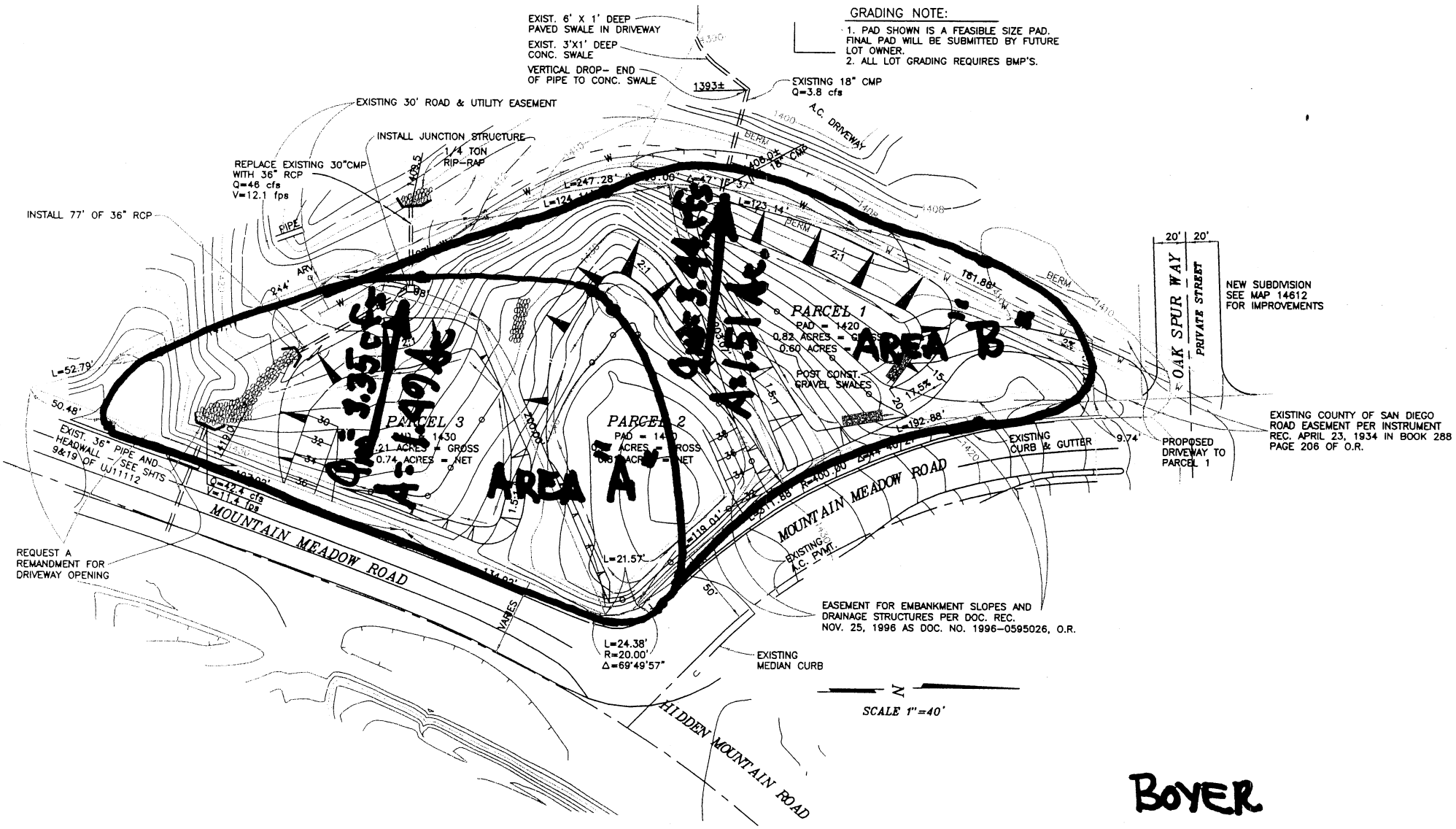
COORDINATE INDEX 374 N 1731 E
CONST. COMPL.

MOUNTAIN MEADOW ROAD IMPROVEMENTS
In The Vicinity of Escondido
PLAN & PROFILE (66+00 – 78+00)

SCALE: HOR. 1"=40' VERT. 1"=10'
W.A. UJ1112 R.S. 603-1
FILE NO.
SHEET 9 OF 48 SHEETS


KERCHEVAL ENGINEERS
PLANS
DESIGNED EFS/JHE
CHECKED JHE/DHW
DELINEATED JBM/SPL/DDC/JJ
BY
DATE
M 67+43± LT.–67+83± LT.
N 69+18±
O 70+90±
Q 55+47± TO 69+90±
Q 55+00 ± TO 55+48.5 ±
R 72+83±
STORM DRAIN PROFILES M THRU Q
SCALE HORIZ.: 1" = 40'
VERT.: 1" = 10'
NOTE:
ALL STATIONING AND OFFSETS FOR THE DRAINAGE STRUCTURES SHOWN HEREON ARE IN REFERENCE TO THE CENTERLINE OF MOUNTAIN MEADOW ROAD.
FINISH GRADE @ PROFILE
EXISTING GRADE
MOUNTAIN MEADOW ROAD
IDENTICAL POINT
DRAINAGE DITCH (D-75)
TYPE 'A' AC DIKE
326' ~ 18" RCP @ 6.64%
0=13.5 CFS V=15.3 FPS
71' ~ 18" RCP @ 1.02%
0=20.0 CFS V=17.1 FPS
196' ~ 18" RCP @ 1.10%
0=24.8 CFS V=17.9 FPS
283' ~ 18" RCP @ 7.77%
0=29.1 CFS V=18.2 FPS
162' ~ 24" RCP @ 0.77%
0=31.7 CFS V=19.1 FPS
72.0' ~ 24" RCP @ 21.25%
0=46.5 CFS V=32.2 FPS
310.0' ~ 18" RCP @ 3.00%
0=5.5 CFS V=9.0 FPS
326' ~ 18" RCP @ 6.64%
8' ~ 18" RCP @ 2.0%
0=5.4 CFS V=7.7 FPS
84' ~ 18" RCP @ 1.00%
24" RCP (REF. LINE "O")
0=9.5 CFS V=6.7 FPS
0=41.1 CFS V=9.9 FPS
14'~18" RCP @ 1.71%
0=9.2 CFS V=8.3 FPS
6'~18" RCP @ 2.00%
0=10.9 CFS V=9.2 FPS
17.5' ~ 36" RCP @ 1.43%
0=42.4 CFS V=11.4 FPS
72.5' ~ 36" RCP @ 1.00%
24" RCP (REF.LINE "P")
4'~18" RCP @ 2.00%
0=11.4 CFS V=9.3 FPS
40'~18"RCP @ 0.90%
0=2.2 CFS V=4.5 FPS
RIP-RAP-1 TON; T=4.3' FILT.-#1 BACKING; T=1.0' TYPE 1
RIP-RAP 2 TON; T=5.4' FILT.-#1 BACKING; T=1.0' TYPE 1
COUNTY OF SAN DIEGO
DEPARTMENT OF PUBLIC WORKS
OFFICE OF THE COUNTY ENGINEER
5555 OVERLAND AVENUE, SAN DIEGO, CA 92123-1295
RECOMMENDED BY: DATE 7-3-95
DATE 7-7-95
APPROVED BY: DATE 7-7-95
REVISIONS
Rev. Inlets #15&16; Rev. SP. Drain Profile
MOUNTAIN MEADOW ROAD IMPROVEMENTS
In The Vicinity of Escondido
STORM DRAIN PROFILES
SCALE: HOR. 1"=40' VERT. 1"=10'
W.A. UJ1112 B.B. 603-1
FILE NO.
SHEET 19 OF 48 SHEETS

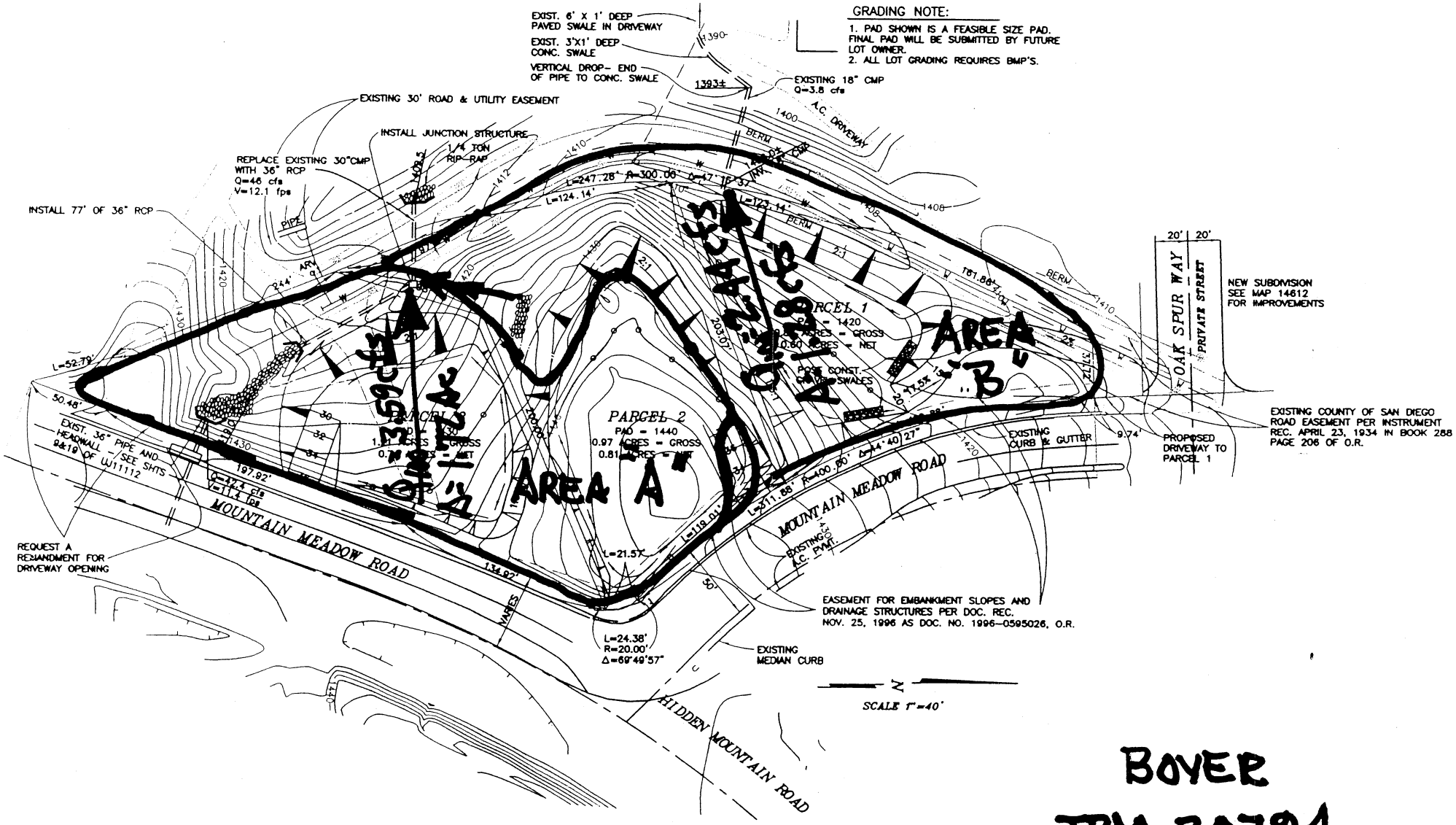

HIDDEN MEADOWS
CONDOMINIUMS
NO. 1
MAP 7298
MTN. MEADOW RD.
NATURAL
DRAINAGE
COURSE
Q=3.44
A=1.51
HIDDEN MEADOW RD
B
A
Q=3.35 cfs
A=1.99 ac
MT MEADOW RD
MEADOWS
BOYER
TPM 20794
PRE DEVELOPMENT



BOYER

TPM 20794

PRE DEVELOPMENT



BOYER
TPM 20794
POST DEVELOPMENT

BOYER
TPM 20794

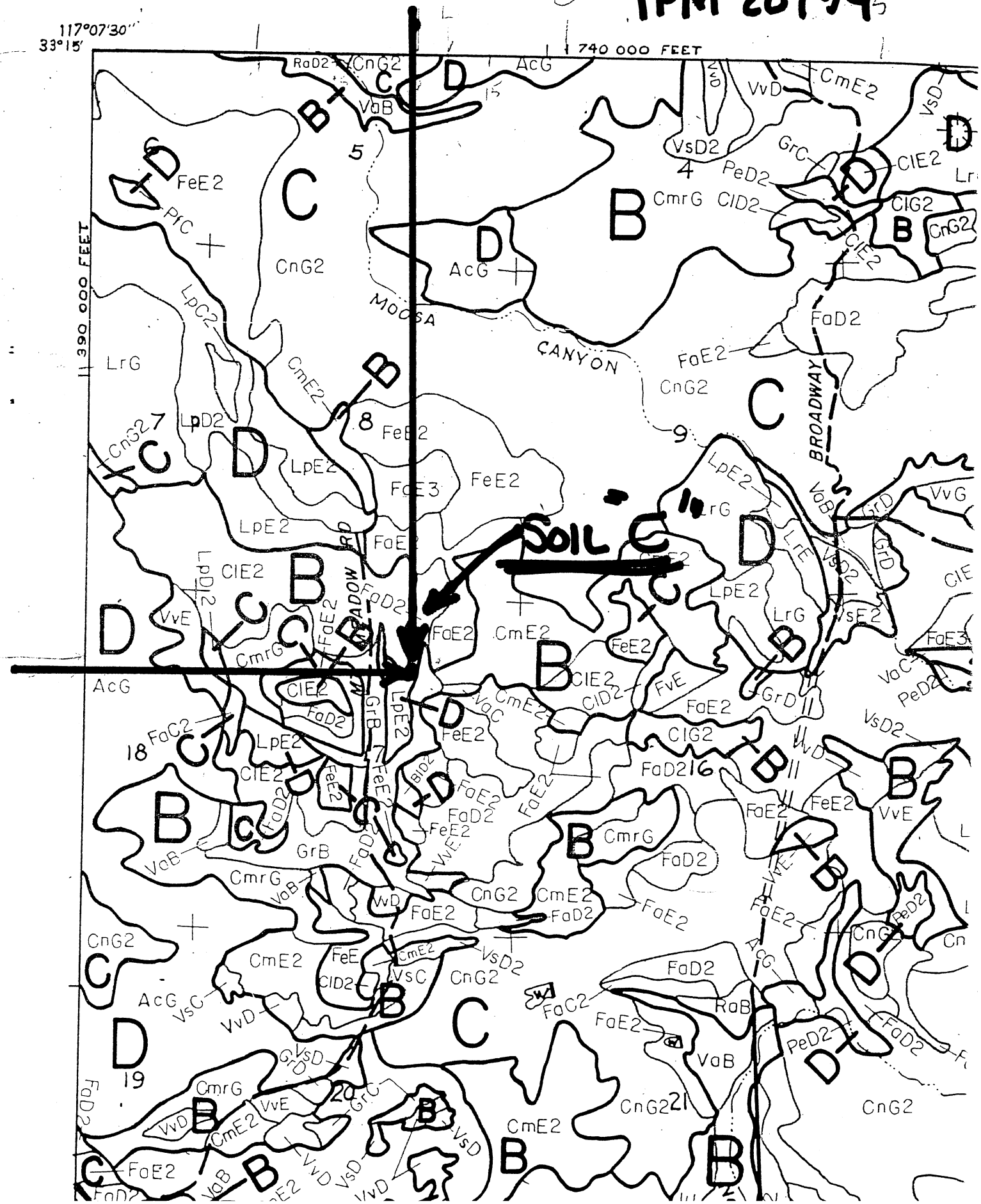


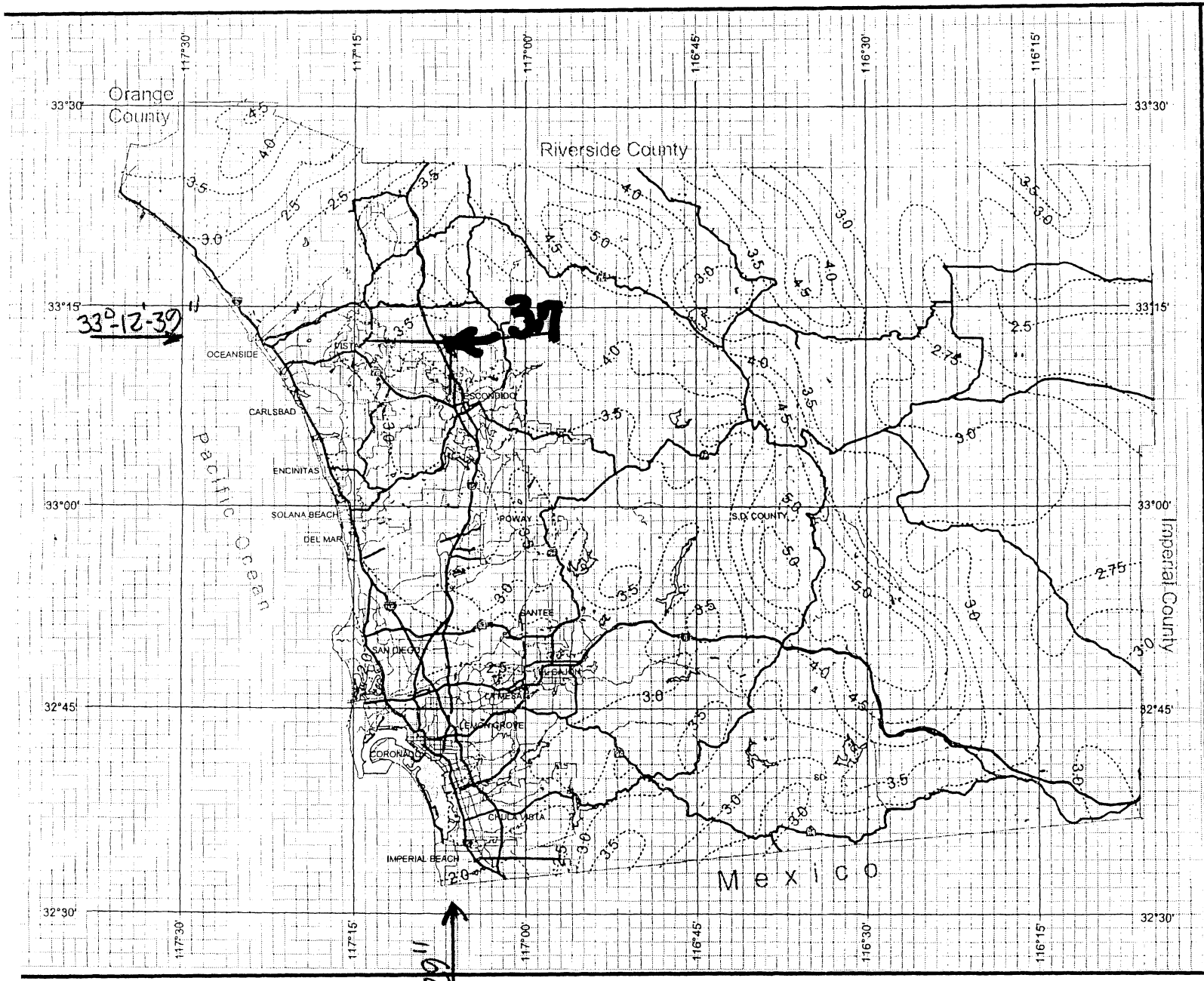
Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (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

PRE DEVELOPMENT

POST DEV.

*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



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

BOYER
TPM 20794

DPW GIS
Department of Public Works
Geographic Information Services

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We Have San Diego Covered!

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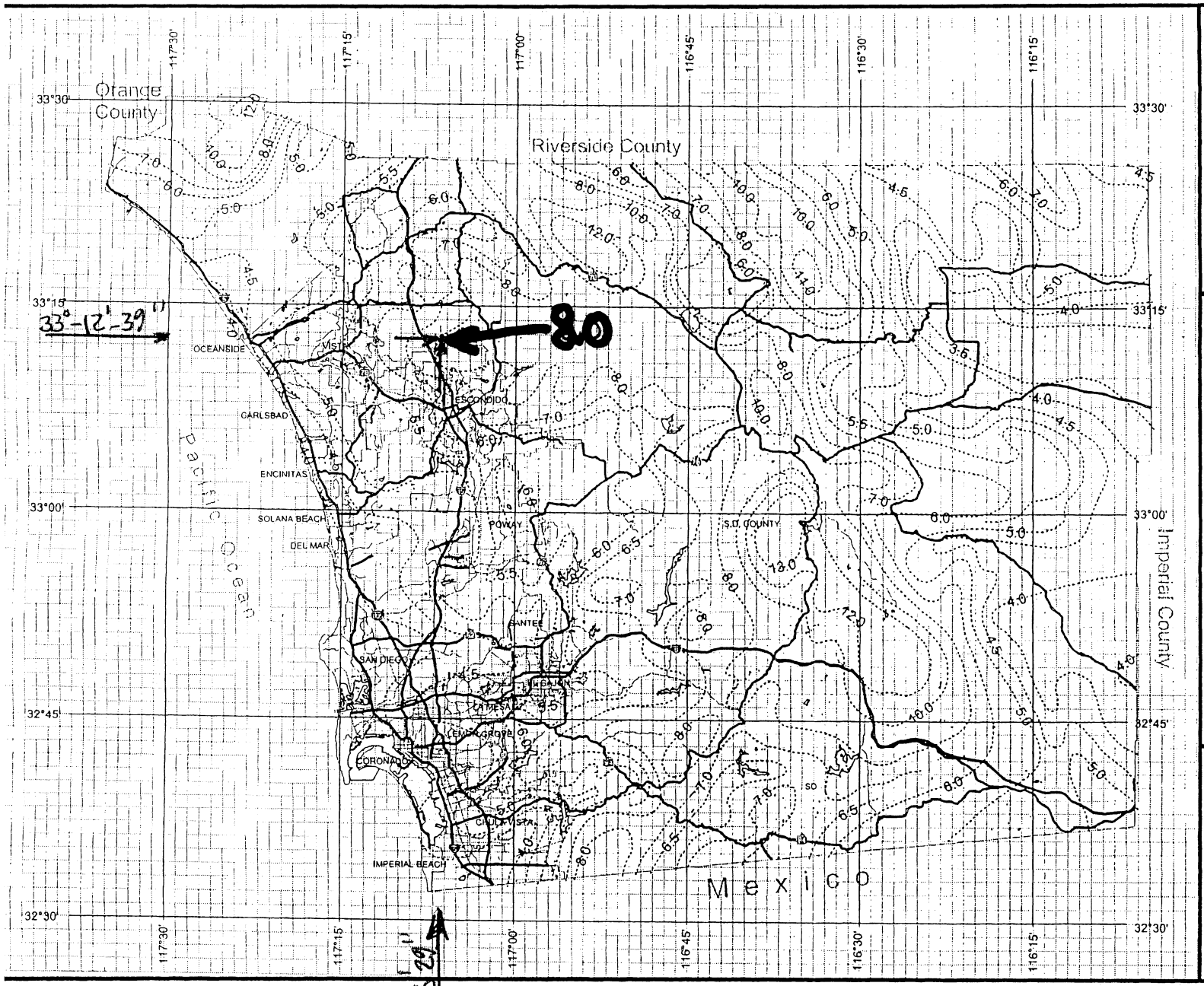

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

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N
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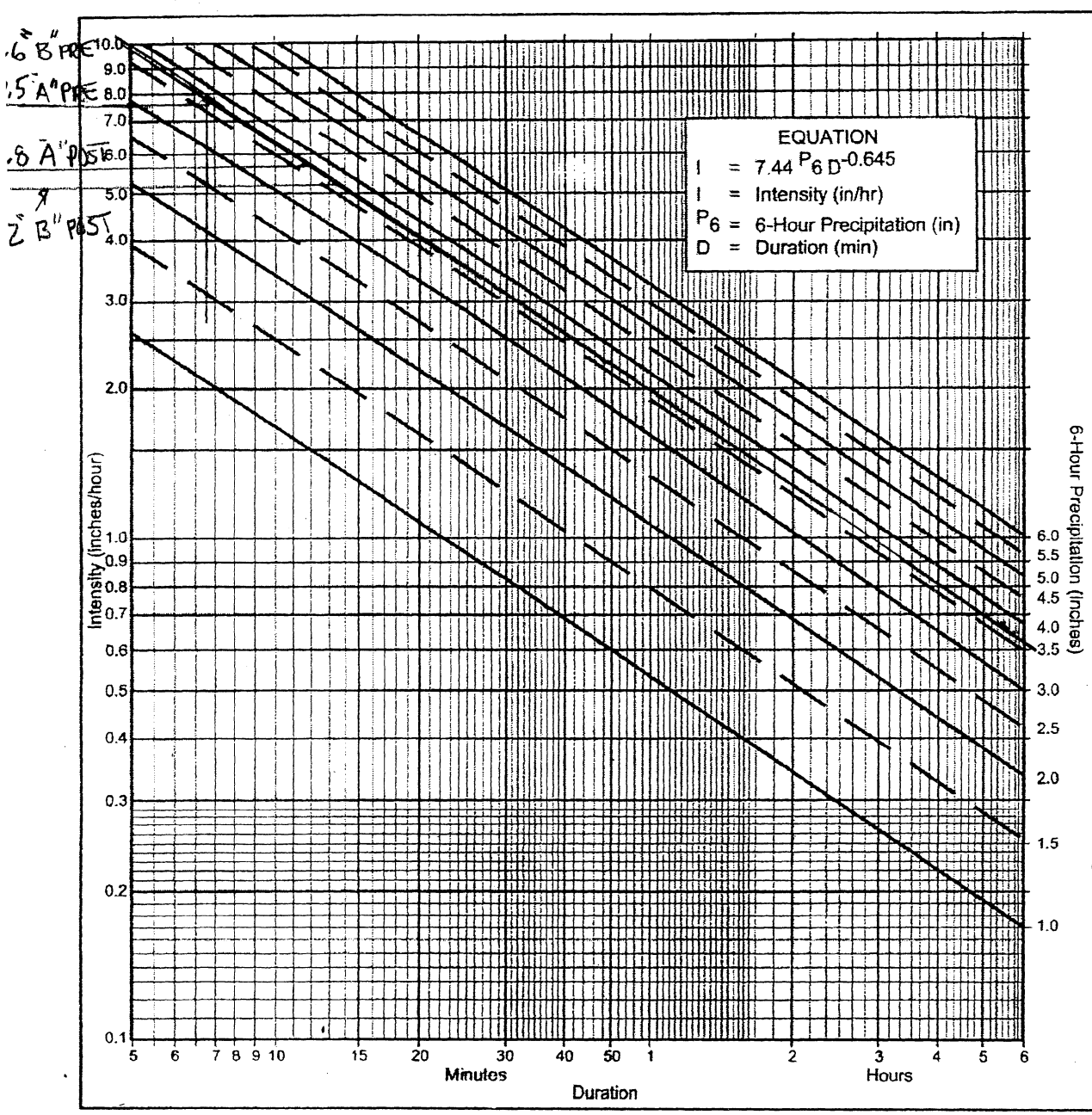


Directions for Application:

(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 bei[illegible]alyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.7 in., P_{24} = 8.0, $\frac{P_6}{P_{24}}$ = 46 %(2)

(c) Adjusted P_6(2) = 3.7 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

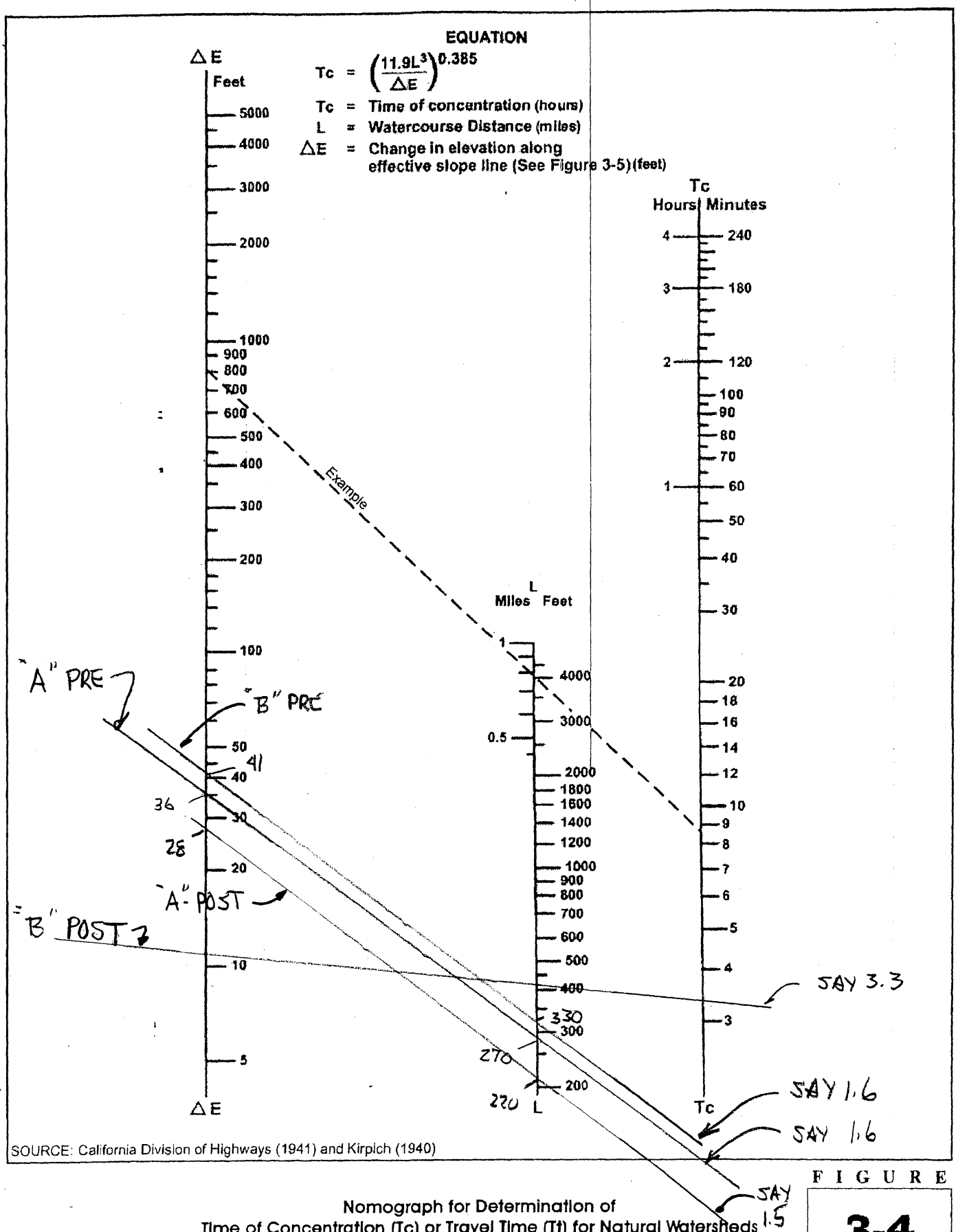
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	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



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

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 I d 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

POST DEV.

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

AREA B

AREA A

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

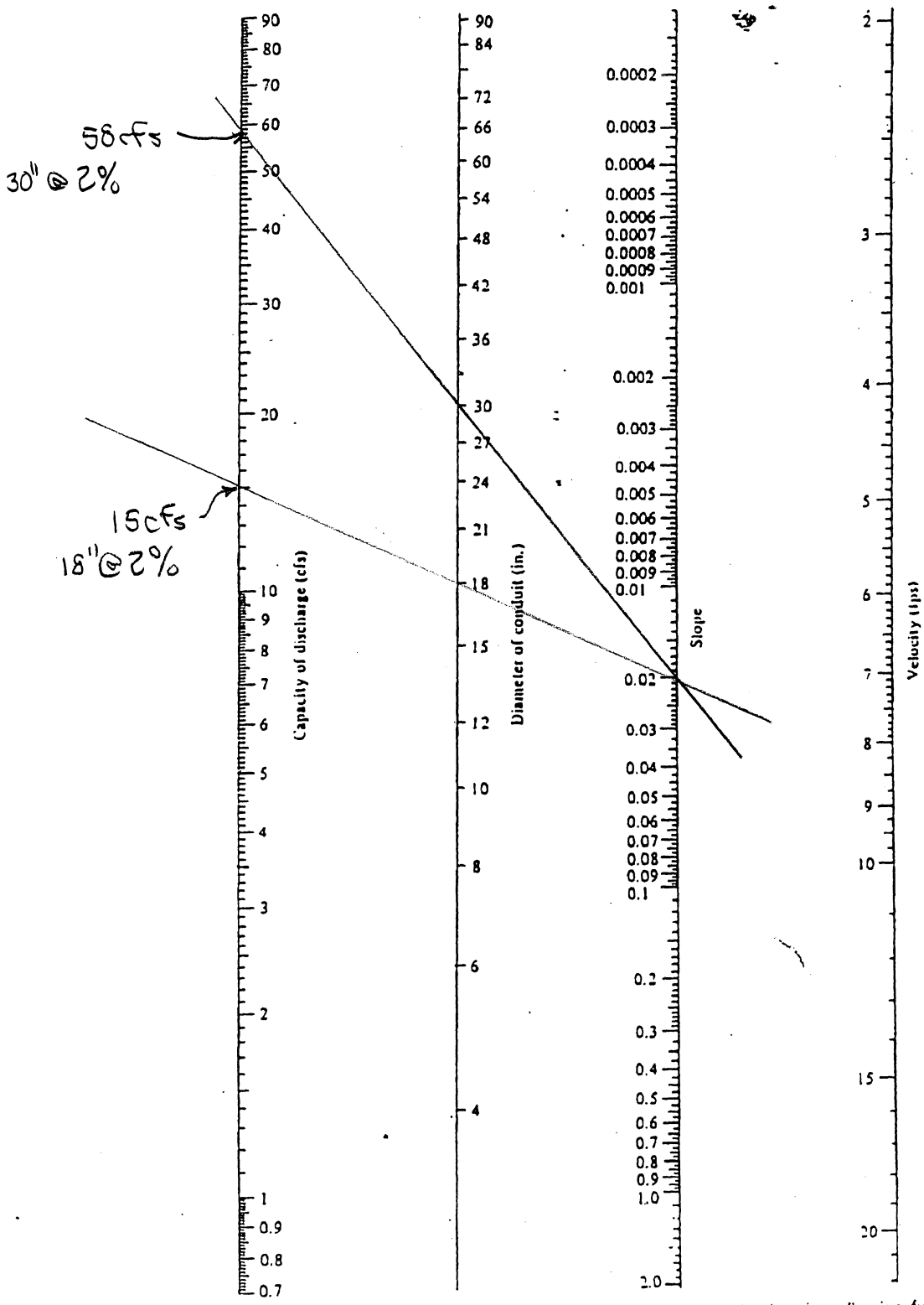


FIGURE 6-1 Nomograph based on Manning's formula for circular pipes flowing full in which $n = 0.013$.