TABLE 4.15 SUSPENDED SEDIMENT LOAD ESTIMATED BY CFE (1/3)

RIO APULCO AT BUENOS AIRES (1,000 METERS)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1965			0.34	3.32	125.95	2.71	232.19	491.49	46.24	32.63	0.69	0.24	
66	0.26	0.21	1.34	2.92	3.13	7.08	121.02	115.11	181.28	35.58	1.13	0.41	469.47
67	2.32	2.77	0.36	2.31	29.89	11.03	13.22	25.49	15.34	4.80	1.02	0.25	108.83
68	0.64	3.29	0.18	4.81	3.27	433.09	189.26	25.26	40.79	3.63	1.87		
69	3.76	0.41	0.42	1.46	2.40	29.40	43.96	180.84	38.01	17.84	0.53	0.38	319.41
70	0.33	0.30	0.44	0.39	3.11	2.72	1.52						
71	0.19	0.09	0.13	0.13	9.58	18.80	62.06	152.72	68.65	75.88	1.10	0.17	389.50
72	0.16	0.19	0.59	7.03	1.00	104.69		177.07	125.44	62.22	0.23	0.40	
73	0.14	0.11	0.10	0.06	9.22	525.07	187.46	34.47	71.27	5.17	0.56	0.16	833.79
74	0.75	0.26	0.29	0.21	1.89		519.25	23.43	40.13	4.57	0.65	0.46	
75	0.24			0.19	1.93	141.54	79.52	78.60	44.34	35.27	0.88		
76	0.48		1.15	2.43	1.96	34.26	77.56	126.46	2.55	135.99	0.86		
77		0.18	0.11	0.15	7.47	8.11	82.05	33.06	20.93				
78		0.25	4.30	7.73	0.16	286.56	42.47	8.84	94.50	21.33	0.91		
79		0.20	0.23		0.17	132.84	221.99	250.96	19.96	0.94	1.01		
80		0.20	0.27	0.23	53.67	34.08	14.01	136.06	78.94		1.29		
81		0.34	4.71	1.98	17.58	215.58	119.00	88.78	49.94	56.71	1.53		
82	0.26	0.26	0.61	11.30	21.06	46.38	19.04	21.50	7.09	70.76		0.32	
83													
84	0.26	0.16	0.11	0.64	19.22	109.12	45.50	35.92	245.79	2.19			
85				0.82	0.56	5.17	102.28	56.28	9.10	11.78	0.17		
86		0.07	0.08	1.58	18.71	320.05	36.88				28.44	0.18	
87	0.13	0.09	0.09	0.04	0.27	81.69	133.83	92.10	50.40	1.42	0.22	0.12	360.04
88	0.16	0.10	0.06	1.03	0.14	15.75	48.45	59.34	248.78	1.51	0.31	0.15	375.78
89	0.19	0.16	0.62	0.22	0.82	10.19	111.86	119.93	335.09	23.16	0.48	0.34	603.06
90	0.66	0.50	0.14	0.14	1.54	7.01	68.27	35.49	82.83	11.66	0.50	0.27	209.01
MEAN	0.64	0.48	0.72	2.13	13.39	107.62	107.19	103.01	83.36	29.29	2.11	0.28	

MEAN ANNUAL LOAD BASED ON MONTHLY MEANS = 0.450 MCM

TABLE 4.16 SUSPENDED SEDIMENT LOAD ESTIMATED BY CFE (2/3)

ARROYO SONTALACO AT SONTALACO (1,000 CUBIC METERS)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1965			0.03	0.04	0.06	0.09	0.17	0.23	0.13	0.21	0.10	0.03	
66	0.04	0.04	0.04	0.03	0.03	0.21	0.37	0.13	0.26	0.33	0.19	0.05	1.72
67	0.14	0.09	0.07	0.03	0.06	0.10	0.07	0.15	0.55	0.48	0.23	0.08	2.05
68	0.05	0.04	0.04	0.04	0.06	0.14	0.16	0.27	0.15	0.15	0.06		
69	0.08	0.05	0.04	0.03	0.02	0.02	0.22	0.31	0.97	0.11	0.06	0.41	2.32
70	0.02	0.09	0.03	0.03	0.07	0.04	0.08						
71	0.01	0.01	0.02	0.03	0.04	0.05	0.05	0.06	0.05	0.14	0.19	0.03	0.68
72	0.04	0.02	0.03	0.01	0.01	0.16		0.15	0.14	0.20	0.11	0.05	
73	0.04	0.09	0.03	0.01	0.51	0.10	0.11	0.21	0.15	0.60	0.05	0.06	1.95
74	0.04	0.06	0.01	0.01	0.01	0.25	0.14	0.06	0.72	0.15	0.05	0.04	1.54
75	0.03			0.01	0.01	0.02	0.02	0.06	0.21	0.22	0.07		
76	0.08		0.02	0.01	0.01	0.31	0.13	0.06	0.21	0.29	0.06		
77		0.02	0.02	0.01	0.01	0.02		0.05	0.05	0.29			
78		0.02	0.02	0.02	0.01	2.99	0.20	0.71	0.25	0.25	0.09	0.03	
79		0.04	0.03		1.69	0.21	0.10	2.04	1.13	0.30	0.15		
80		0.02	0.01		0.01	0.01	0.01	1.08	1.67				
81		0.03	0.02	0.01	0.02	0.80	0.60	20.40	0.77	0.18	0.08		
82	0.02	0.03	0.02	0.03	0.06	0.22	0.10	0.08	0.64	2.48		0.05	
83	0.06	0.02	0.01	0.01	0.01	0.05	0.39	0.16	0.72	0.24			
84	0.10	0.05	0.03	0.01	0.04	0.15	0.19	0.12	3.08	0.15	0.04		
85			0.02	0.03	0.03	0.23	0.70	0.61	0.43	0.26	0.01		
86		0.01	0.01	0.01	0.01	0.04	0.07				0.79		
87	0.02	0.01	0.01	0.01	0.09	0.05	0.23	0.34	0.36	0.07	0.04	0.02	1.25
88	0.01	0.01	0.00	0.04	0.01	0.73	0.11	0.14	1.23	0.08	0.01	0.01	2.38
89	0.02	0.03	0.01	0.02	0.01	0.02	0.91	0.66	1.00	0.05	0.05	0.02	2.80
90	0.02	0.02	0.05		0.04	0.06	0.20	0.43	2.03	0.29	0.03	0.01	
MEAN	0.05	0.04	0.02	0.02	0.11	0.27	0.22	1.19	0.70	0.33	0.12	0.06	

MEAN ANNUAL LOAD BASED ON MONTHLY MEANS = 0.00313 MCM

TABLE 4.17 SUSPENDED SEDIMENT LOAD ESTIMATED BY CFE (3/3)

CANAL TUNNEL NO.1 (1,000 CUBIC METERS)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
76										0.38	0.70	0.63	
77	0.48		0.45	0.43	0.70	5.99		1.88	2.78	3.52	0.69	0.46	
78		0.38	0.53	0.35	0.29	20.76	1.73	2.25	2.22	3.75	0.98	0.62	
79	0.46	0.44	0.46	1.29	0.62	10.86	4.05	8.04	1.00	2.85	1.04		
80	1.04	0.62	0.38	0.50	4.43	1.32	0.86	4.98	14.01	1.70	0.72	0.51	31.07
81	0.38	0.26	0.86	0.86	0.38	25.12	9.93	6.81	12.00	2.29	2.47	2.07	63.43
82	0.36	0.36	0.42	0.55	1.55	0.71	0.91	1.02	2.26	4.31	0.49	0.46	13.40
83	0.53	0.31	0.26	0.23	0.32	0.72	8.08	21.20	6.66	1.13	1.69	0.58	41.71
84	0.36	0.30	0.27	0.17	1.99	4.70	2.87	1.10	14.48	1.67	0.68		
85			0.51	0.53	1.02	9.19	4.70	1.88	2.08	5.32	0.69	0.85	
86	0.75		0.31	0.36	0.55	6.12	3.15	0.84	1.81	4.94	9.20	0.87	
87	0.67	0.45	0.53	0.41	0.59	2.52	4.43	2.41	1.94	1.10	0.71	0.50	16.26
88	0.47	0.47	0.52	1.00	0.74	2.17	3.89	10.51	10.73	1.35	0.49	0.74	33.08
89	0.49	0.72	1.25	1.13	0.40	4.29	3.45	6.38			2.81	1.07	
90	1.57	0.97	1.28	0.70	8.88	4.94	6.58	6.42	2.95	3.01	1.72	1.94	40.96
MEAN	0.63	0.48	0.57	0.61	1.61	7.10	4.20	5.41	5.76	2.67	1.67	0.87	

MEAN ANNUAL LOAD BASED ON MONTHLY MEANS = 0.0316 MCM

TABLE 4.18 RIO APULCO AND ARROYO SONTALACO SIZE DISTRIBUTION OF BED MATERIAL

SIEVE No.	SIZE (MM)	RIO APULCO %FINER	ARROYO SONTALACO %FINER
3"	76.2		
2"	50.8		
1"	25.4	92.9	
1/2"	12.7	79.7	93.0
#4	4.76	59.0	78.3
#6	3.35	51.6	71.6
#8	2.36	44.5	63.1
#10	2	38.7	55.2
#20	0.85	28.3	37.1
#40	0.42	14.4	16.0
#50	0.25	9.4	11.2
#100	0.149	2.2	4.1
#200	0.074	0.5	2.0

Notes : Measured by CFE, June 9, 1989

TABLE 4.19 CHARACTERISTICS OF RESERVOIR SEDIMENT DEPOSIT BASED ON 1987 BORE HOLES

HOLE NO.1		HOLE NO.2		HOLE NO. 3		HOLE NO. 4	
SEDIMENT ELEVATION	= 771.53 M	SEDIMENT ELEVATION	= 763.92 M	SEDIMENT ELEVATION	= 768.15 M	SEDIMENT ELEVATION	= 766.09 M
BED ELEVATION	= 734.53 M	BED ELEVATION	= 730.01 M	BED ELEVATION	= 737.05 M	BED ELEVATION	= 735.36 M
ELEVATION (EL. M)	SEDIMENT DEPOSIT	ELEVATION (EL. M)	SEDIMENT DEPOSIT	ELEVATION (EL. M)	SEDIMENT DEPOSIT	ELEVATION (EL. M)	SEDIMENT DEPOSIT
771.53-767.98	CLAYEY SILT	763.92-762.89	SANDY SILT	768.15-767.55	SILT	766.09-756.14	SILT
767.98-758.98	NE SAND	762.89-755.39	SILT	767.55-766.17	SILT	756.14-755.83	SANDY SILT
758.98-754.80	CLAYEY SILT	755.39-753.43	SILT WITH SAND	766.17-764.50	SILT/FINE SAND	755.82-749.66	SILT
754.80-754 55	VERY FINE SAND	753.43-742.21	SANDY SILT	764.59-761.15	CLAYEY SILT	749.66-749.26	SANDY SILT
754.55-752.16	SILTY CLAY	742.21-741.00	SILT WITH SAND	761.15-760.85	SANDY SILT	749.26-739.41	SILT
752.16-752.00	FINE SAND	741.00-740.72	FINE SAND	760.85-760.67	SILT	739.41-738.11	SILTY SAND
752.00-749.65	CLAYEY SILT	740.72-736.00	SILTY SAND	760.67-759.32	FINE SAND	738.11-736.86	SILT
749.68-743.68	SANDY SILT	736.00-735.89	ROCK FRAGMENTS/SAND	759.32-758.20	SILT/FINE SAND	736.86-735.86	SILT/GRAVEL
743.68-741.93	CLAYEY SILT	735.89-733.05	SANDY SILT	758.20-757.70	FINE SAND	735.86-735.36	ROCK FRAGMENTS
741.93-741.00	SANDY SILT	733.05-730.01	ROCK FRAGMENTS	757.70-756.65	SILT		
741.00-740.63	SILTY SAND			756.64-756.58	FINE SAND		
740.63-739.53	CLAYEY SILT			756.58-756.40	SILT		
739.53-737.65	SAND			756.40-755.35	FE SAND/SILT		
737.65-734.53	GRAVELS			755.35-753.54	SANDY SILT		
				753.54-752.70	FINE SAND		
				752.70-752.30	SANDY SILT		
				752.30-749.00	FINE SAND/SILT		
				749.00-748.75	FINE SAND		
				748.75-748.00	SILT		
				748.00-741.12	SANDY SILT		
				741.12-737.60	SAND		
				737.60-737.05	ROCK FRAGMENTS		
PARTICLE SIZE DISTRIBUTION DEPTH EL. 771.53-768.08		PARTICLE SIZE DISTRIBUTION DEPTH EL. 763.56-760.51		PARTICLE SIZE DISTRIBUTION DEPTH EL. 767.55-764.50		PARTICLE SIZE DISTRIBUTION DEPTH EL. 766.09-762.74	
SIZE(MM)	%FINER	SIZE	%FINER	SIZE	%FINER	SIZE	%FINER
1	100.0	1	100.0	1	100.0	1	100.0
0.5	99.9	0.25	99.1	0.25	99.3	0.25	100.0
0.25	99.8	0.5	96.3	0.5	97.9	0.5	99.8
0.177	99.5	0.177	92.7	0.177	96.5	0.177	98.5
0.125	99.1	0.125	90.3	0.125	94.5	0.125	94.5
0.088	99.1	0.088	87.6	0.088	93.1	0.088	91.8
0.074	99.0	0.074	83.7	0.074	92.1	0.074	89.2
0.0625	99.0	0.0625	82.0	0.0625	91.9	0.0625	88.5

TABLE 4.20 PARTICLE SIZE DISTRIBUTION OF RESERVOIR SEDIMENT DEPOSIT BASED ON SAMPLES TAKEN FROM RESERVOIR SHORE LINE

STZE (MM)	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5
			PERCENT FINER		
76.2					
50.8					
38.1					
25.4					
19.1					
12.7	99.6	99.8	99.7		
9.52	99.4	99.8	99.7		
4.76	98.2	99.2	99.6		
2	96.8	98	99.5	99.4	
0.84	88.3	94.6	98.8	97.6	
0.42	54.9	62.4	83	72.2	
0.25	38.1	29.4	46.2	39.7	
0.149	26.4	12.2	21.3	22.3	99.8
0.074	10.1	6.9	15.4	16.2	97.4
0.054	8.4	5.9	14.1	15.1	75.4
0.021	4.9	4.1	8.7	11.6	45.9
0.0047	2.3	1.1	5.1	2.8	10.9

Note: (1) Samples were taken by the Study Team in September, 1992.
(2) Sample numbering is from upstrem to downstream.

TABLE 4.21 (1/4)

PARTICLE SIZE DISTRIBUTION,
RESERVOIR BED MATERIAL AT DRILL HOLE NO. 1

Depth from Surface of Reseroivr Bed (m)	Particle Sizes (mm) Percent Finer									
	.0044	.021	.051	.074	.149	.25	.42	.84	2.00	4.76
3.75 - 3.95	29.3	87.0	100.0							
3.95 - 4.20	61.8	96.5	99.8	100.0						
4.75 - 4.95	52.6	92.8	99.8	100.0						
4.95 - 5.15	40.6	82.3	99.3	100.0						
5.35 - 5.80	64.2	95.8	100.0							
5.95 - 6.10	51.4	99.6	100.0							
6.45 - 6.65	18.5	84.5	98.5	100.0						
7.30 - 7.50	69.8	89.5	98.5	100.0						
7.50 - 7.99	66.1	96.6	100.0							
8.70 - 8.85	59.8	95.5	99.4	100.0						
9.45 - 9.90	45.8	90.9	100.0							
10.20 - 10.40	39.4	83.6	100.0							
10.95 - 11.10	89.2	91.4	97.6	100.0						
11.25 - 11.40	52.6	95.3	99.9	100.0						
11.40 - 11.85	66.5	92.4	100.0							
11.85 - 12.22	17.7	48.0	87.7	100.0						
13.35 - 13.80	61.2	94.4	100.0							
13.95 - 14.20	69.8	91.6	99.7	100.0						
14.75 - 14.90	68.1	95.7	98.9	100.0						
15.20 - 15.65	67.8	95.7	100.0							
15.90 - 16.11	41.1	86.5	97.8	100.0						
17.15 - 17.60	66.5	97.2	100.0							
18.12 - 18.31	49.4	96.2	100.0							
18.50 - 18.88	11.8	18.5	19.2	23.9	58.5	83.4	96.3	99.7	99.8	100.0
19.10 - 19.40	58.2	92.8	96.4	100.0						
19.40 - 19.55				42.8	49.3	58.5	74.4	95.8	99.6	100.0
20.63 - 20.77	66.0	100.0								
21.60 - 21.80	82.0	94.0	96.0	100.0						
23.45 - 23.95	38.1	96.1	100.0							
24.77 - 24.95	46.5	81.1	98.4	100.0						
25.40 - 25.46	32.0	41.2	42.0	46.0	55.4	67.7	83.1	97.6	99.7	100.0
26.30 - 26.68	65.0	91.6	94.2	100.0						
27.35 - 27.68	67.0	86.0	93.0	100.0						
28.00 - 28.34	81.9	99.0	99.4	100.0						
29.30 - 29.62	75.5	99.6	100.0							
31.25 - 31.28	17.0	57.8	65.0	67.0	78.9	85.1	91.7	98.4	99.6	100.0
31.28 - 31.63	70.1	99.7	99.9	100.0						
33.20 - 33.60	47.8	85.6	99.6	100.0						
34.20 - 34.70	64.8	94.7	97.2	100.0						
36.05 - 36.43	45.3	76.4	82.0	100.0						
37.10 - 37.42	40.7	66.9	72.6	100.0						
37.61 - 37.81	27.8	57.0	62.4	100.0						
39.05 - 39.15	22.8	40.0	40.3	40.4	59.2	71.2	82.9	95.9	98.9	100.0
39.15 - 39.37	57.3	97.5	98.9	100.0						
40.45 - 40.65	61.5	94.6	96.9	100.0						
41.10 - 41.46	63.8	89.4	93.8	100.0						
43.05 - 43.40	54.3	85.0	88.8	100.0						
43.95 - 44.33	49.8	81.9	83.3	100.0						
45.30 - 45.80	29.6	66.7	87.4	100.0						
46.20 - 46.50	7.9	21.2	32.6	33.1	38.7	45.3	60.3	88.7	97.7	100.0

TABLE 4.21 (2/4)

PARTICLE SIZE DISTRIBUTION,
RESERVOIR BED MATERIAL AT DRILL HOLE NO. 2

Depth from Surface of Reseroivr Bed (m)	Particle Sizes (mm) Percent Finer									
	.0044	.021	.051	.074	.149	.25	.42	.84	2.00	4.76
1.31 - 1.48	45.5	96.6	99.3	100.0						
2.18 - 2.39	58.4	96.7	100.0							
3.16 - 3.37	54.5	94.9	99.9	100.0						
4.37 - 4.58	78.1	99.2	99.6	100.0						
5.37 - 5.58	42.1	83.6	98.8	100.0						
6.25 - 6.44	46.8	98.7	100.0							
7.44 - 7.63	6.4	17.1	45.5	61.9	95.9	97.6	98.0	98.9	99.5	100.0
7.81 - 8.00	35.5	91.7	100.0							
8.23 - 8.42	30.6	80.7	100.0							
9.48 - 9.65	31.0	81.0	100.0							
10.42 - 10.60	41.5	85.0	100.0							
11.22 - 11.40	13.0	53.0	89.2	100.0						
12.22 - 12.42	63.0	98.9	99.3	100.0						
13.33 - 13.55	46.1	90.8	100.0							
14.47 - 14.64	52.0	97.0	99.3	100.0						
15.26 - 15.45	49.2	87.7	98.9	100.0						
17.70 - 18.00	54.6	90.4	99.5	100.0						
18.65 - 18.83	56.4	95.6	98.0	100.0						
20.82 - 21.00	64.4	96.8	99.4	100.0						
21.60 - 21.80	52.0	96.4	99.2	100.0						
22.20 - 22.40	41.8	94.0	99.1	100.0						
23.60 - 23.80	55.0	98.9	99.4	100.0						
25.20 - 25.40	61.5	97.8	99.6	100.0						
26.40 - 26.60	55.9	923.0	98.4	100.0						
27.50 - 27.77	51.6	89.0	100.0							
29.20 - 29.45	59.3	92.2	99.5	100.0						

TABLE 4.21 (3/4)

PARTICLE SIZE DISTRIBUTION, RESERVOIR BED MATERIAL AT DRILL HOLE NO. 3

Depth from Surface of Reseroivr Bed (m)	Particle Sizes (mm)									
	.0044	.021	.051	.074	.149	.25	.42	.84	2.00	4.76
	Percent Finer									
0.06 - 0.80	23.0	77.7	96.9	100.0						
1.60 - 1.80	13.5	56.4	92.4	100.0						
2.40 - 2.60	12.3	51.8	98.3	100.0						
4.83 - 5.00	3.0	8.5	21.2	31.3	70.6	84.7	94.0	98.5	99.1	100.0
5.20 - 5.40	5.0	14.4	32.6	45.1	85.0	91.8	95.3	98.4	99.4	100.0
5.40 - 5.60	22.4	75.4	97.7	100.0						
6.25 - 6.45	16.3	61.0	91.0	100.0						
8.15 - 8.35	24.2	52.0	70.5	100.0						
9.05 - 9.25	21.7	63.8	95.4	100.0						
10.20 - 10.40	16.7	69.0	96.4	100.0						
11.30 - 11.50	17.6	552.0	89.4	100.0						
16.34 - 16.55	6.5	20.2	58.6	73.1	97.2	98.9	99.3	100.0		
17.20 - 17.40	9.9	38.6	85.8	100.0						
19.80 - 20.05	32.7	95.3	99.2	100.0						
20.55 - 20.78	2.9	6.3	17.3	31.9	98.1	96.7	99.0	99.6	100.0	
22.40 - 22.60	9.5	50.8	95.5	100.0						
24.93 - 25.19	1.9	5.3	14.4	20.0	69.8	84.3	93.7	99.5	100.0	
27.19 - 27.40	11.2	32.8	57.5	67.1	97.1	99.1	99.7	100.0		
29.20 - 29.65	47.7	95.3	100.0							
30.98 - 31.17	19.4	69.4	99.7	100.0						
30.80 - 31.00	2.5	6.1	15.1	24.1	80.9	98.4	99.7	99.9	100.0	
34.58 - 34.80	29.5	84.4	99.3	100.0						
35.89 - 36.10	25.9	85.0	99.2	100.0						
37.68 - 37.90	55.0	93.4	98.2	100.0						
39.14 - 39.36	51.1	94.8	98.9	100.0						
40.75 - 41.00	54.3	91.8	99.8	100.0						
41.81 - 42.02	18.1	51.2	97.1	100.0						
44.30 - 44.50	59.4	94.2	98.9	100.0						

TABLE 4.21 (4/4)

PARTICLE SIZE DISTRIBUTION,
RESERVOIR BED MATERIAL AT DRILL HOLE NO. 4

Depth from Surface of Reseroivr Bed (m)	Particle Sizes (mm) Percent Finer														
	.0044	.021	.051	.074	.149	.25	.42	.84	2.00	4.76	9.52	12.7	19.1	25.4	38.1
1.	3.0	6.0	17.0	33.2	15.4										

PARTICLE SIZE DISTRIBUTION,
RESERVOIR BED MATERIAL AT DRILL HOLE NO. 5

Depth from Surface of Reseroivr Bed (m)	Particle Sizes (mm) Percent Finer														
	.0044	.021	.051	.074	.149	.25	.42	.84	2.00	4.76	9.52	12.7	19.1	25.4	38.1
1.	0.2	0.7	2.5	10.7	25.1	68.7	85.8	92.2	92.6	100.0					
2.	2.0	5.0	12.0	22.0	57.0	77.0	78.0	79.0	100.0						
3.	2.0	5.0	9.0	11.7	23.5	59.8	77.5	96.5	99.1	100.0					
4.				13.5	20.8	38.9	52.9	82.5	94.4	100.0					
5.				33.3	70.3	92.8	94.9	97.7	98.9	100.0					
6.				3.8	9.9	32.3	53.1	76.7	83.6	89.5	95.6	100			
7.				8.8	21.5	38.4	46.1	67.6	78.9	88.7	92.6	97.7	100.0		
8.				2.5	5.5	13.0	17.4	25.7	33.0	59.1	88.4	96.2	100.0		
9.				2.7	4.8	8.6	10.8	20.3	29.0	40.9	49.8	56.5	100.0		
10.				0.3	0.5	0.5	0.5	0.5	0.5	0.5	4.2	20.3	52.0	61.3	100.0
11.				3.3	4.6	5.7	6.4	9.2	13.4	21.9	31.6	57.3	78.8	100.0	
12.				8.6	30.9	68.5	82.0	92.5	95.3	97.6	99.2	100			

TABLE 4.22 PARTICLE SIZE DISTRIBUTION, RESERVOIR BED MATERIAL AT FIFTEEN SURFACE LOCATIONS

Sample No.	Depth from Surface of Reservoir Bed (m)	Particle Sizes (mm) Percent Finer															
		.004	.021	.051	.074	.149	.25	.42	.84	2.00	4.76	9.52	12.7	19.1	25.4	38.1	50.8
1.	3.60 - 3.80	45.2	90.0	99.4	100.0												
2.	0.00 - 0.85	46.2	91.9	100.0													
	1.85 - 2.10	34.7	78.0	98.5	100.0												
	2.85 - 4.20	60.9	96.1	100.0													
3.	0.40 - 0.60	52.2	95.6	99.5	100.0												
	2.66 - 2.86	62.0	92.4	97.3	100.0												
4.	1.83 - 2.00	54.3	91.1	99.3	100.0												
	2.60 - 2.80	51.4	93.9	99.2	100.0												
	3.40 - 3.60	57.0	90.5	97.9	100.0												
5.	1.80 - 2.00	1.0	3.0	13.0	28.1	74.9	92.5	96.3	99.6	99.9							
	2.31 - 2.54	14.3	46.8	69.2	71.7	100.0	96.0	99.2	99.6	100.0							
	3.20 - 3.40	37.0	77.3	94.8	100.0												
7.	1.22 - 1.41	66.3	99.0	99.6	100.0												
	2.20 - 2.40	85.9	99.1	99.5	100.0												
	3.20 - 3.40	45.1	95.2	100.0													
8.	0.31 - 0.48	22.8	76.0	97.9	100.0												
	1.64 - 1.80	40.3	88.8	98.0	100.0												
	2.82 -	13.4	51.5	97.0	100.0												
10.	0.65 - 0.83	2.0	4.3	14.9	30.4	83.4	98.9	99.7	100.0								
	1.30 - 1.65				4.8	54.0	89.6	96.0	99.9	100.0							
	3.20 - 3.40				4.8	33.5	88.4	97.8	100.0								
	3.40 - 3.60	14.6	18.7	93.4	100.0												
12.	0.78 - 1.00				3.4	5.2	28.0	52.8	96.4	99.6	100.0						
	1.78 - 2.00				21.2	40.4	61.1	75.4	98.9	100.0							
	2.42 - 2.60	1.0	2.2	5.0	11.9	19.0	32.6	48.1	89.8	96.4	98.1	100.0					
	3.78 - 4.00				31.3	41.7	63.5	75.5	96.4	99.0	99.3	100.0					
13.	3.40 - 3.60	12.0	67.0	100.0													
14.	0.40 - 0.60				2.0	10.0	35.2	58.4	92.6	99.3	100.0						
	2.64 - 2.82				2.7	21.5	59.2	74.6	82.8	84.7	91.7	96.9	100.0				
15.	0.00 - 1.00								0.1	0.3	3.0	10.9	20.7	38.4	66.2	100.0	
	1.00 - 2.00				0.1	0.4	1.7	2.9	8.3	14.0	31.2	38.6	39.4	47.4	54.3	66.0	100.0
	2.00 - 2.45				4.6	7.3	12.4	18.4	45.7	65.0	80.8	92.9	95.9	100.0			
	2.45 - 3.00				1.3	1.9	3.0	3.8	7.0	10.5	21.4	35.1	38.7	51.6	60.5	68.1	100.0

TABLE 4.23 NATIONAL INDEXES

Year	Population		Gross Domestic Products		
	Total (millions)	Average Annual Growth Rate (%) (5 yrs interval)	G.D.P. (Current) (billion Pesos)	1985 Prices (billion pesos)	Growth Rate (%)
1965	42.69	-	252.0	16,535	-
1970	50.69	3.49	444.3	23,101	-
1975	60.15	3.48	1,100.1	31,716	-
1980	69.66	2.98	4,276	43,773	-
1985	77.94	2.27	47,392	47,392	
1986	79.57	-	79,191	45,655	Δ3.7
1987	81.20	-	192,802	46,403	1.6
1988	82.84	-	389,259	46,964	1.2
1989	84.49	-	503,668	48,493	3.3
1990	86.15	2.20	678,924	50,622	4.4
1991	87.84	-	852,783	52,451	3.6

Source: UN monthly Bulletin of Statistics, International Financial Statistics Yearbook; 1992.

TABLE 4.24 MUNICIPALITY DATA

Number	Municipio	Cabecera Municipal	Elevation (meters)	Area (km2)
Estado de Puebla				
I. Principally in the Rio Apulco Basin				
83	Ixtacamaxtitlan	Ixtacamaxtitlan	2,150	502
200	Xochiapulco	Cinco de Mayo	2,050	57
207	Zacapoaxtla	Zacapoaxtla	1,800	177
212	Zautla	Santiago Zautla	2,000	235
			Total area	971
II. Principally in the Xiuayucan Diversion Area				
17	Atempan	Atempan	1,950	50
186	Tlatlauquitepec	Tlatlauquitepec	1,900	246
204	Yaonahuac	Yoanahuac	1,800	55
211	Zaragoza	Zaragoza	2,300	28
			Total area	379
III. Adjacent Areas				
16	Aquixtla	Aquixtla	2,100	150
43	Cuetzalan del Progreso	Cuetzalan del Progreso	1,000	158
44	Cuyoaco	Cuyoaco	2,500	295
53	Chignahuapan	Chignahuapan	2,320	925
94	Libres	Libres	2,400	305
101	Nauzontla	Nauzontla	1,500	30
105	Ocotepec	Ocotepec	2,400	80
172	Tetela de Ocampo	Tetela de Ocampo	700	418
202	Xochitlan	Xochitlan de V. Suarez	1,000	26
			Total area	2,387
Estado de Tlaxcala				
I. Rio Apulco Basin				
30	Terrente	Terrente	2,400	280
34	Tlaxco	Tlaxco de Mordos	2,330	56
			Total area	336
II. Adjacent Areas				
4	Altzayanc	Villa Altzayance de Hidalgo	2,600	56
31	Tetla	Tetla	2,522	145
			Total area	201

TABLE 4.25 POPULATION DATA (1/2)

Number	Municipio	Population		
		Total	Males	Females
Estado de Puebla				
I. Rio Apulco Basin				
83	Ixtacamaxtitlan	28,405	14,320	14,085
172	Tetela de Ocampo	8,407	4,218	4,189
186	Tlatlauquitepec	4,451	2,305	2,146
200	Xochiapulco	4,086	2,046	2,040
202	Xochitlan de Vicente Suarez	2,242	1,081	1,161
207	Zacapoaxtla	41,855	20,560	21,295
212	Zautla	11,936	5,575	6,361
	Total	101,382	50,105	51,277
II. Xiucayucan Diversion Basin				
17	Atempan	6,897	3,370	3,527
186	Tlatlauquitepec	34,996	17,004	17,992
204	Yaonahuac	4,379	2,159	2,220
211	Zaragoza	10,869	5,287	5,582
212	Zautla	6,188	2,974	3,214
	Total	63,329	30,794	32,535
III. Adjacent Areas				
16	Aquixtla	7,140	3,534	3,606
17	Atempan	5,799	2,902	2,897
43	Cuetzalan del Progreso	35,676	17,641	18,035
44	Cuyoaco	12,410	6,069	6,341
53	Chignahuapan	41,896	21,091	20,805
94	Libres	20,634	10,105	10,529
101	Nauzontla	3,734	1,830	1,904
105	Ocotepec	4,699	2,363	2,336
172	Tetela de Ocampo	16,519	8,091	8,428
186	Tlatlauquitepec	3,000	1,509	1,491
202	Xochitlan	8,223	4,067	4,156
204	Yaonahuac	1,308	677	631
	Total	161,038	79,879	81,159

Source: 1990 Census

TABLE 4.25 POPULATION DATA (2/2)

Number	Municipio	Population		
		Total	Males	Females
Estado de Tlaxcala				
I. Rio Apulco Basin				
30	Terrenate	5,367	2,776	2,591
34	Tlaxco	119	64	55
	Total	5,486	2,840	2,646
II. Adjacent Areas				
4	Altzayanca	11,819	6,055	5,764
30	Terrenate	8,293	4,258	4,035
31	Tetla	15,429	7,654	7,775
34	Tlaxco	26,970	13,385	13,585
	Total	62,511	31,352	31,159
Total, Rio Apulco Basin				
	Puebla	101,382	50,105	51,227
	Tlaxcala	5,486	2,840	2,646
	Total	106,868	52,945	53,873
Total, Xiucayucan Diversion				
	Puebla	63,329	30,794	32,535
	Tlaxcala	-	-	-
	Total	63,329	30,794	32,535
Total, Adjacent Areas				
	Puebla	161,038	79,879	81,159
	Tlaxcala	62,511	31,352	31,159
	Total	223,549	111,231	112,318

TABLE 4.26 POPULATION CHANGES OF MUNICIPALITIES IN THE RIO APULCO BASIN AND THE XIUCAYUCAN DIVISION BASIN

	Population (person)				Growth Rate (%)		
	1960	1970	1980	1990	1960-70	1970-80	1980-90
I. Estado de Puebla (Whole state)	1,973,837	2,508,226	3,347,685	4,126,101	27.1	33.5	23.3
o (1) Aquixtla	6,407	6,568	6,632	7,140	2.6	0.9	7.7
o • (2) Atempan	6,109	7,991	8,172	12,696	30.8	2.3	55.4
o (3) Cuetzalann del Progreso	22,418	24,501	28,877	35,676	9.3	17.9	23.5
o (4) Cuyoaco	8,637	9,544	11,667	12,410	10.5	22.3	6.4
o (5) Chignahuapan	24,733	30,201	33,712	41,896	22.1	11.6	24.3
* (6) Ixtacamaxtitlan	18,084	21,807	26,827	28,405	20.6	23.0	5.9
o (7) Libres	12,394	13,023	17,313	20,634	5.1	32.9	19.2
o (8) Nauzontla	2,744	3,158	3,551	3,734	15.1	12.4	5.2
o (9) Ocotepec	3,505	3,795	4,721	4,699	8.3	24.4	Δ0.5
o * (10) Tetela de Ocampo	18,908	19,967	21,834	24,926	5.6	9.4	14.2
o • * (11) Tlatlauquitepec	24,976	29,113	31,323	42,447	16.6	7.6	35.5
* (12) Xochiapulco	3,462	3,652	3,749	408	5.5	2.7	9.0
o * (13) Xochitlan de Vincente Suarez	7,647	8,042	9,642	10,465	5.2	19.9	8.5
o • (14) Yaonahuac	2,935	3,409	4,163	5,687	16.1	22.1	36.6
* (15) Zacapoaxtla	20,819	26,134	35,456	41,855	25.5	35.7	18.0
• (16) Zaragoza	4,378	6,150	9,070	10,869	40.5	47.5	19.8
• * (17) Zautla	-	14,464	16,834	18,124	-	16.4	7.7
Total	*188156	231,519	273,543	325,749	23.0	18.2	19.1
II. Estado de Tlaxcala (Whole state)	346,699	420,638	556,597	761,277	21.3	32.3	36.8
o (1) Altzayanca	6,726	7,846	9,494	11,819	16.7	21.0	24.5
o * (2) Terrenate	5,983	7,204	9,208	13,660	20.4	27.8	48.3
o (3) Tetla	6,690	7,000	8,491	15,429	4.6	21.3	81.7
o * (4) Tlaxco	16,954	16,405	20,384	27,089	Δ3.2	24.3	32.9
Total	36,353	38,455	47,577	67,997	5.8	23.7	42.9
III. Grand Total							
I. Puebla	188,156	231,519	273,543	325,749	23.0	18.2	19.1
II. Tlaxcala	36,308	38,455	47,577	67,997	5.9	23.7	42.9
G. Total	224,464	269,974	321,120	393,746	20.3	18.9	22.6

Source: INEGI (Instituto Nacional De Estadistica Geografia D Informatica, "PUEBLA: Resultados Definitives Datos Por Localidad, XI Censo General De Poblacion Y Vivienda, 1990),
: Huanchinango, "Region Socioeconomica"

Remarks: * Rio Apulco Basin
• Xiucayucan Division Basin
o Adjacent Area

TABLE 4.27 EMPLOYMENT DATA (1/2)

Number	Municipio	Males	Employed		In Agriculture	
		No.	No.	%	No.	%
I. Rio Apulco Basin						
	Puebla					
83	Ixtacamaxtidan	14,320	6,673	46.6	5,843	87.6
200	Xochiapulco	2,046	874	42.7	779	89.1
207	Zacapoaxtla	20,560	8,755	42.6	5,791	66.1
212	Zautla	8,549	2,791	32.6	1,686	60.6
	Sub-total	45,475	19,093	42.0	14,039	73.5
	Tlaxcala					
30	Terrente	7,034	3,177	45.2	2,668	84.0
34	Tlaxco					
	Sub-total	7,034	3,177	45.2	2,668	84.0
	Total	52,509	22,270	42.4	16,707	75.0
II. Xiucayucan Diversion Basin						
17	Atempan	6,272	2,662	42.4	2,163	81.2
186	Tlatlauquitepec	20,818	9,211	44.2	6,786	73.7
204	Yaonahuac	2,836	1,197	42.2	882	73.7
211	Zaragoza	5,287	2,111	39.9	845	40.0
	Total	35,213	15,181	43.1	10,676	70.3
III. Puebla State		2,008,531	872,628	43.4	386,298	44.3

TABLE 4.27 EMPLOYMENT DATA (2/2)

Number	Manufacture		Construction		Commerce		Community Services	
	No.	%	No.	%	No.	%	No.	%
I. Rio Apulco Basin								
Puebla								
83	147	2.2	272	4.1	106	1.6	45	0.7
200	15	1.7	12	1.4	14	1.6	40	4.6
207	530	6.0	691	7.9	578	6.6	344	3.9
212	520	18.6	151	5.4	244	8.7	47	1.7
Sub-total	1,212	6.3	1,126	5.9	942	4.9	476	2.5
Tlaxcala								
30	142	4.5	176	5.5	48	1.5	13	0.4
Total	1,354	6.1	1,302	5.8	990	4.4	489	2.2
II. Xiucayucan Diversion Basin								
17	100	3.8	108	4.0	78	2.9	80	3.0
186	455	4.9	476	5.2	381	4.1	339	3.7
204	70	5.8	58	4.8	29	2.4	61	5.1
211	243	11.5	127	6.0	253	12.0	265	12.6
Total	868	5.7	769	5.1	741	4.9	745	4.9
III. Puebla State								
	151,256	17.3	65,008	7.4	87,171	10.0	32,083	3.7

TABLE 4.28 TYPES OF LAND OWNERSHIP (1988)

(Unit : ha)

Estado de Puebla*	Total	(Radio)	Group Owned	(Ratio)	Private Owned	(Ratio)	National Property	(Ratio)	Village Owned	(Ratio)	No Data
1. Ixtacamaxtitlan	50,199.13	(100.0)	8,796.16	(17.5)	41,046.97	(81.8)	-		283.76	(0.6)	72.24
2. Tetla de Ocampo	41,813.14	(100.0)	836.03	(2.0)	40,898.05	(97.8)	-		97.06	(0.2)	-
3. Atempan	5,009.84	(100.0)	-		5,009.84	(100.0)	-		-		-
4. Tlatlauquitepec	24,679.92	(100.0)	4,054.13	(16.4)	20,405.09	(82.7)	220.70	(0.9)	-		-
5. Xochiapulco	5,667.74	(100.0)	-		5,667.74	(100.0)	-		-		-
6. Xochitlan de Vincente Suarez	8,401.39	(100.0)	-		8,236.01	(98.0)	-		165.38	(2.0)	-
7. Yaonahuac	5,731.01	(100.0)	-		5,731.01	(100.0)	-		-		-
8. Zacapoaxtla	17,661.01	(100.0)	129.83	(7.0)	16,431.18	(93.0)	-		-		-
9. Zaragoza	3,933.39	(100.0)	2,948.51	(75.0)	984.88	(25.0)	-		-		-
10. Zautla	23,508.03	(100.0)	7,994.10	(34.0)	15,513.93	(66.0)	-		-		-

* Excluded municipalities in adjasent areas

Source: Anuario Estadistico Del Estado De Puebla
Instituto Nacional De Estadistica Geografia E Informatica
Edicion 1990-Pagina 26Y27

TABLE 4 .29 CLIMATOLOGICAL DATA FOR THE RIO APULCO BASIN

I. Basin Wide Average

	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Rainfall (mm)	772	13	13	16	40	68	138	120	114	143	66	26	13
Evaporation (mm)	1,187	90	101	144	144	139	109	99	100	83	90	87	83
Mean Temperature (°C)	13.2	10.8	12.0	14.2	15.7	16.6	15.6	14.4	14.5	14.2	13.3	12.5	11.6

II. Long Term Averages for the Five Individual Stations

Rainfall (mm)

	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
IXTACAMAXTITLAN	584	9	10	16	41	71	104	89	83	96	42	14	8
ZAUTLA	543	10	10	12	25	44	101	78	73	115	45	19	10
LA GLORIA	814	11	12	16	42	70	148	155	149	126	56	18	10
CAPULUAQUE	920	18	16	16	34	53	161	126	107	213	107	47	21
SAN ANTONIO	998	16	18	21	60	101	174	155	159	164	81	31	18

Evaporation (mm)

	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
IXTACAMAXTITLAN	1,488	93	106	162	157	150	128	128	133	101	100	98	88
ZAUTLA	1,050	73	81	128	135	140	102	91	82	75	80	75	72
LA GLORIA	1,355	108	112	156	145	140	109	99	103	87	100	98	95
CAPULUAQUE	1,052	70	80	117	130	127	94	78	82	70	68	70	63
SAN ANTONIO	1,373	105	125	158	154	140	112	101	99	84	102	95	96

Mean Temperature (°C)

	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
IXTACAMAXTITLAN	16	13	14	16	18	19	19	18	18	17	16	15	14
ZAUTLA	16	13	14	16	18	19	18	17	17	17	16	14	13
LA GLORIA	12	11	12	13	14	16	14	13	13	13	13	13	12
CAPULUAQUE	13	11	13	15	17	18	16	15	15	15	13	13	12
SAN ANTONIO	9.3	7.2	8.3	10.3	11.2	11.9	10.6	9.2	9.4	9.1	8.7	8.3	7.3

III. Station La Soledad

	Annual	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Rainfall (mm)	3,325	87	66	91	103	178	452	610	534	575	344	184	102
Evaporation (mm)	1,003	45	53	81	102	118	114	104	112	97	78	53	43
Mean Temperature (°C)	16.9	14.5	14.9	17.0	21.0	22.9	23.2	22.2	21.7	21.4	19.6	17.2	15.4

TABLE 4.30 LAND USE - PUEBLA STATE

I. Principally in the Rio Apulco Basin (Area in Hectares)

Land Use	Ixtacamaxtitlan		Xochiapulco		Zacapoaxtla		Zautla		Total	
	Ha.	%	Ha.	%	Ha.	%	Ha.	%	Ha.	%
(1) Agricola de Temporal	33,419	66.5	3,928	69.3	15,485	87.7	10,367	44.1	63,199	65.1
(2) Agricola Nomada	3,804	7.6					564	2.4	4,368	4.5
(3) Agricola Bajo Riego					180	1.0	-	-	180	0.2
(4) Pecuario Semi Intensivo	12,496	24.9	1,644	29.0	1,789	10.1	12,239	52.1	28,168	29.0
(5) Pecuario Extensivo	480	1.0							480	0.5
(6) Urbano	-	-	96	1.7	212	1.2	338	1.4	646	0.7
(7) No Disponible										
Total	50,199	100	5,668	100	17,666	100	23,508	100	97,041	100

II. Principally in the Xiucayucan Diversion Basin

Land Use	Ixtacamaxtitlan		Xochiapulco		Zacapoaxtla		Zautla		Total	
	Ha.	%	Ha.	%	Ha.	%	Ha.	%	Ha.	%
(1) Agricola de Temporal	4,933	98.5	19,284	78.1	5,513	96.2	2,720	69.2	32,450	82.4
(2) Agricola Nomada										
(3) Agricola Bajo Riego	-	-	154	0.6	-	-	480	12.2	634	1.6
(4) Pecuario Semi Intensivo	-	-	4,707	19.1	85	1.5	545	13.8	5,337	13.6
(5) Pecuario Extensivo										
(6) Urbano	77	1.5	314	1.3	133	2.3	188	4.8	712	1.8
(7) No Disponible	-	-	221	0.9					221	0.6
Total	5,010	100	24,680	100	5,731	100	3,933	100	39,354	100

Notes: Land use
(1) Rain-feed agriculture
(2) Shifting agriculture
(3) Irrigated agriculture
(4) Semi-intensive pasturage
(5) Extensive pasturage
(6) no use

TABLE 5.1 RELATIONSHIP BETWEEN RESERVOIR STORAGE CAPACITY AND ANNUAL ENERGY OUTPUT

H-V APPLIED	HWL (EL. m)	MOL (EL. m)	EFFECTIVE STORAGE (MCM)	ANNUAL ENERGY (GWh)
1992	804.5	797.5	10.2	629.2
1988	804.5	797.5	11.3	630.0
1977	804.5	797.5	11.6	630.0
1962	804.5	797.5	13.3	631.2
1992	804.5	795.0	12.5	629.1
1988	804.5	795.0	14.6	630.3
1977	804.5	795.0	15.5	630.5
1962	804.5	795.0	18.8	632.3
1992	804.5	790.0	16.1	626.3
1988	804.5	790.0	18.5	627.9
1977	804.5	790.0	21.0	629.3
1962	804.5	790.0	27.7	632.0
1992	804.5	785.0	17.6	622.4
1988	804.5	785.0	21.0	624.2
1977	804.5	785.0	24.2	625.6
1962	804.5	785.0	32.6	628.7
1992	804.5	780.0	18.2	617.7
1988	804.5	780.0	22.0	619.7
1977	804.5	780.0	26.5	621.4
1962	804.5	780.0	37.5	625.0
1992	804.5	775.0	18.4	612.8
1988	804.5	775.0	22.3	614.8
1977	804.5	775.0	28.1	616.7
1962	804.5	775.0	41.6	620.8

TABLE 5.2 RUNOFF AVAILABLE FOR SEDIMENT DIVERSION

(Unit : MCM)

	Q (CMS)*							
	30	40	50	60	70	80	90	100
YEAR 1963	3.68	0.27	0.00	0.00	0.00	0.00	0.00	0.00
1964	0.95	0.09	0.00	0.00	0.00	0.00	0.00	0.00
1965	3.91	1.65	0.78	0.00	0.00	0.00	0.00	0.00
1966	29.94	25.05	22.29	20.09	18.38	16.64	14.90	13.19
1967	10.48	6.24	4.69	3.81	2.95	2.10	1.22	0.36
1968	1.66	0.07	0.00	0.00	0.00	0.00	0.00	0.00
1969	34.18	21.22	12.80	7.66	4.35	1.84	0.29	0.00
1970	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1971	14.91	10.25	6.79	3.71	1.43	0.00	0.00	0.00
1972	3.52	1.43	0.03	0.00	0.00	0.00	0.00	0.00
1973	5.92	1.70	0.00	0.00	0.00	0.00	0.00	0.00
1974	98.53	82.72	70.24	59.05	50.93	44.01	38.10	33.15
1975	23.42	14.41	9.29	5.84	3.53	2.44	1.58	0.70
1976	20.18	11.09	6.81	4.42	2.95	2.09	1.23	0.35
1977	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1978	9.60	5.47	3.73	2.44	1.58	0.73	0.00	0.00
1979	41.61	33.49	28.49	24.16	19.85	16.41	14.54	12.80
1980	9.78	6.18	4.46	2.72	1.35	0.47	0.00	0.00
1981	59.21	43.57	34.44	28.37	22.89	18.56	15.65	13.05
1982	6.72	3.58	1.89	1.04	0.18	0.00	0.00	0.00
1983	2.30	0.84	0.00	0.00	0.00	0.00	0.00	0.00
1984	98.61	84.34	72.43	64.36	58.29	52.90	49.14	45.70
1985	6.73	3.79	1.58	0.00	0.00	0.00	0.00	0.00
1986	4.40	2.68	1.19	0.31	0.00	0.00	0.00	0.00
1987	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1988	23.02	20.42	17.83	15.81	14.62	13.74	12.88	12.03
1989	53.33	46.03	39.74	33.70	28.28	24.55	21.95	19.36
1990	9.18	3.98	0.00	0.00	0.00	0.00	0.00	0.00
1991	14.65	7.80	4.26	1.85	0.11	0.00	0.00	0.00
TOTAL	591.95	438.36	343.75	279.33	231.68	196.46	171.50	150.70
AVE.	20.41	15.12	11.85	9.63	7.99	6.77	5.91	5.20

NOTE : * Excess runoff exceeding 'Q' is assumed to be used for sediment diversion

TABLE 5.3 NUMBER OF DAYS AVAILABLE FOR SEDIMENT DIVERSION

	Q (CMS)*							
	30	40	50	60	70	80	90	100
YEAR 1963	7	2	0	0	0	0	0	0
1964	1	1	0	0	0	0	0	0
1965	4	2	1	0	0	0	0	0
1966	7	4	3	2	2	2	2	2
1967	6	3	1	1	1	1	1	1
1968	3	1	0	0	0	0	0	0
1969	18	12	6	5	3	2	1	0
1970	1	0	0	0	0	0	0	0
1971	7	4	4	3	2	1	0	0
1972	5	2	1	0	0	0	0	0
1973	7	4	0	0	0	0	0	0
1974	21	15	14	11	9	7	6	4
1975	12	8	4	4	2	1	1	1
1976	16	7	3	2	1	1	1	1
1977	0	0	0	0	0	0	0	0
1978	7	2	2	1	1	1	0	0
1979	12	8	5	5	5	3	2	2
1980	6	2	2	2	1	1	0	0
1981	22	15	7	7	6	4	3	3
1982	4	3	1	1	1	0	0	0
1983	2	1	0	0	0	0	0	0
1984	20	15	12	8	7	5	4	4
1985	4	3	2	0	0	0	0	0
1986	2	2	1	1	0	0	0	0
1987	3	0	0	0	0	0	0	0
1988	3	3	3	2	1	1	1	1
1989	10	8	7	7	6	3	3	3
1990	7	6	0	0	0	0	0	0
1991	11	6	4	2	2	0	0	0
TOTAL	228	139	83	64	50	33	25	22
AVE.	7.86	4.79	2.86	2.21	1.72	1.14	0.86	0.76

NOTE : * Excess runoff exceeding 'Q' is assumed to be used for sediment diversion

TABLE 5.4 RUNOFF AVAILABLE FOR SEDIMENT FLUSHING

(Unit: MCM)

		Q (CMS)*								
		30	40	50	55.2	60	70	80	90	100
YEAR	1963	25.04	13.56	6.88	4.29	2.93	1.43	0.56	0.00	0.00
	1964	21.18	13.70	9.38	7.53	5.94	4.33	3.46	2.60	1.74
	1965	31.82	16.95	11.03	9.12	7.87	5.28	3.76	2.89	2.03
	1966	126.15	90.49	69.89	63.05	57.82	49.67	44.46	40.28	37.06
	1967	49.09	35.55	27.59	24.45	21.54	16.14	11.75	8.86	7.62
	1968	25.03	9.19	2.90	1.33	0.89	0.03	0.00	0.00	0.00
	1969	183.86	138.85	110.04	98.32	88.70	70.51	54.07	41.06	30.73
	1970	40.40	19.15	8.40	5.00	3.16	0.51	0.00	0.00	0.00
	1971	89.19	64.55	49.07	42.94	38.73	31.45	26.24	22.03	18.57
	1972	61.59	31.29	17.29	12.28	9.02	4.92	2.33	0.48	0.00
	1973	83.16	43.73	21.45	15.42	11.47	6.48	4.63	2.90	1.17
	1974	233.06	194.98	169.16	158.38	149.60	133.98	119.99	107.15	96.48
	1975	145.84	116.21	95.72	86.79	79.04	66.69	56.83	47.33	37.82
	1976	121.51	76.27	49.37	40.17	33.53	23.76	17.90	13.64	10.19
	1977	9.04	5.09	2.45	1.55	0.72	0.00	0.00	0.00	0.00
	1978	87.05	55.76	35.60	29.52	24.55	17.23	12.18	8.12	5.50
	1979	137.24	106.78	83.98	74.59	67.55	56.63	49.59	43.54	37.83
	1980	56.38	42.27	33.99	30.84	28.34	24.02	20.10	16.64	13.60
	1981	262.55	197.34	158.85	144.10	132.38	111.74	94.20	79.35	68.54
	1982	49.81	36.43	27.78	24.41	22.20	18.74	15.29	11.83	8.38
	1983	29.51	17.43	11.80	9.79	8.13	5.75	4.03	2.56	1.69
	1984	266.10	222.53	192.33	181.44	172.39	155.79	142.40	129.85	119.49
	1985	63.38	40.07	28.86	25.23	22.33	17.65	14.13	11.54	8.95
	1986	35.93	25.81	20.22	17.53	15.09	11.53	8.39	5.80	3.94
	1987	27.04	14.70	7.75	4.90	2.61	0.13	0.00	0.00	0.00
	1988	64.78	52.55	46.39	43.37	40.94	37.49	34.03	31.08	28.48
	1989	132.12	111.16	98.29	93.26	88.69	79.60	72.06	66.01	59.97
	1990	79.92	47.53	32.81	28.00	24.27	16.71	9.80	3.95	1.56
	1991	89.22	56.61	36.04	29.04	24.21	16.56	11.94	8.48	5.26
	TOTAL	2626.99	1896.53	1465.31	1306.64	1184.64	984.75	834.12	707.97	606.60
	AVE.	90.59	65.40	50.53	45.06	40.85	33.96	28.76	24.41	20.92

NOTE : * Excess runoff exceeding 'Q' is assumed to be used for sediment flushing through spillwa

TABLE 5.5 NUMBER OF DAYS AVAILABLE FOR SEDIMENT FLUSHING

		Q (CMS)*								
		30	40	50	55.2	60	70	80	90	100
YEAR	1963	18	10	6	5	2	1	1	0	0
	1964	12	5	5	4	3	1	1	1	1
	1965	25	11	5	3	3	3	1	1	1
	1966	58	30	17	14	12	7	5	4	3
	1967	21	13	7	7	7	6	4	2	1
	1968	28	11	6	2	1	1	0	0	0
	1969	70	39	27	25	22	21	16	13	11
	1970	33	16	8	6	4	2	0	0	0
	1971	37	20	15	11	9	7	5	4	4
	1972	52	25	12	9	6	3	3	2	0
	1973	57	32	16	11	8	3	2	2	2
	1974	55	39	24	24	20	17	16	14	11
	1975	46	28	20	19	18	14	11	11	11
	1976	69	40	23	17	16	8	5	4	4
	1977	6	4	2	2	2	0	0	0	0
	1978	47	29	14	12	12	6	5	4	2
	1979	42	32	23	19	16	10	7	7	6
	1980	22	12	7	7	5	5	4	4	3
	1981	104	55	36	30	27	22	19	15	10
	1982	21	12	8	7	4	4	4	4	4
	1983	24	9	5	4	4	2	2	1	1
	1984	66	42	27	22	21	17	15	12	12
	1985	37	18	10	7	7	5	3	3	3
	1986	19	7	6	6	5	4	3	3	2
	1987	20	9	7	6	5	1	0	0	0
	1988	21	8	7	6	4	4	4	3	3
	1989	36	17	14	11	11	10	7	7	7
	1990	53	22	14	9	9	8	8	5	2
	1991	50	28	20	13	10	7	4	4	3
	TOTAL	1149	623	391	318	273	199	155	130	107
	AVE.	39.62	21.48	13.48	10.97	9.41	6.86	5.34	4.48	3.69

NOTE : * Excess runoff exceeding 'Q' is assumed to be used for sediment flushing through spillway.

Table 6.1 TRAP EFFICIENCY OF SOLEDAD RESERVOIR

	Total storage (x 10^6 m3)	Capacity – Inflow ratio	Trap efficiency
(1) Reservoir volume at EL. 804.5 m in 1962	58.753	0.103	0.73
(2) Reservoir volume at EL. 804.5 m in 1977	28.828	0.050	0.66
(3) Reservoir volume at EL. 804.5 m in 1988	22.305	0.039	0.63
(4) Reservoir volume at EL. 804.5 m in 1990	21.171	0.037	0.62
(5) Reservoir volume at EL. 804.5 m in 1992	18.398	0.032	0.61

Notes: (1) Mean annual inflow: 572.694 x 10^6 m3
(2) The mean trap efficiency over 30-year period (1962 - 1992) is assumed to be about 0.65.

TABLE 6.2 MEAN MONTHLY SEDIMENT CONCENTRATION MEASURED AT TURBINE UNIT NO.1

YEAR/MONTH	SIZES >0.062mm (mg/l)	SIZES <0.062mm (mg/l)
1989 JAN	26	17
FEB	33	35
MAR	33	32
APR	26	25
MAY	25	21
JUN	32	27
JUL	154	32
AUG	257	31
SEP	133	5
OCT	14	3
NOV	9	4
DEC	16	0
1990 JAN	12	12
FEB	16	23
MAR	19	20
APR	20	23
MAY	25	28
JUN	90	54
JUL	231	161
AUG	114	81
SEP	28	89
OCT	19	57
NOV	27	35

TABLE 6.3 RESERVOIR CROSS SECTIONS (1992 CONDITION) (1/2)

SECTION NO. / DISTANCE FROM DAM SITE

#91 /250m		#89 /450m		#87 /670m		#82 /920m		#80 /1050m		/1270m (NEW SECTION)		#67 /1500m		/1630m (NEW SECTION)		#61 /1820m		#60 /1950m	
DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)
0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R
30	800.0	12	800.0	10	800.0	2	800.0	14	800.0	9	800.0	2	800.0	10	800.0	10	800.0	7	800.0
39	795.0	140	800.0	142	795.0	4	795.0	24	795.0	32	795.0	6	795.0	16	795.0	26	795.0	22	797.0
55	790.0	165	795.0	153	790.0	16	790.0	38	790.0	74	790.0	160	790.0	280	791.0	64	796.5	144	797.2
74	785.0	178	790.0	166	785.0	26	787.2	68	785.9	162	786.8	264	790.0	452	792.5	110	796.1	153	795.0
82	780.0	190	785.0	240	781.2	60	785.4	124	785.5	276	786.9	288	795.0	530	791.5	176	795.3	173	795.0
150	776.7	201	780.0	274	785.0	168	785.2	182	785.5	400	787.0	318	800.0	580	791.9	232	795.3	188	796.0
176	780.0	232	777.2	344	790.0	280	785.0	306	790.0	456	790.0	322	805.0 L	586	793.0	254	794.5	206	797.4
189	785.0	342	780.0	364	795.0	304	784.9	314	795.0	464	795.0			598	794.0	282	794.1	254	797.0
211	790.0	428	785.0	375	800.0	346	787.1	324	800.0	470	800.0			602	795.0	322	792.9	320	797.2
214	795.0	442	790.0	412	805.0 L	352	790.0	336	805.0 L	492	805.0 L			608	800.0	344	792.6	358	796.3
224	800.0	456	795.0			356	795.0							611	805.0 L	434	792.7	368	798.6
252	805.0 L	468	800.0			364	800.0									436	793.6	378	800.0
		482	805.0 L			394	805.0 L									444	795.0	387	805.0 L
																458	800.0		
																466	805.0 L		

TABLE 6.3 RESERVOIR CROSS SECTIONS (1992 CONDITION) (2/2)

SECTION NO. / DISTANCE FROM DAM SITE

#59 /2040m		#56 /2130m		#54 /2250m		#51 /2410m		#45 /2760m		/3010m (INTERPOLATED)		#32 /3200m		#26 /3510m		#21 /3790m		/3900m (INTERPOLATED)	
DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)
0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R
13	800.0	12	800.0	12	800.0	6	800.0	10	800.0	12	800.0	27	800.0	33	800.0	8	803.2	200	800.0
21	798.5	68	798.0	80	796.0	24	798.1	14	799.0	16	799.0	31	797.2	96	799.0	15	800.2	236	799.0
64	796.1	72	796.7	96	797.9	160	798.1	107	799.3	23	798.1	68	797.9	152	800.0	52	800.0	312	800.0
90	797.2	100	795.8	104	794.2	187	797.9	113	798.7	192	798.0	82	800.7	186	805.0 L	77	798.7	388	805.0 L
165	797.5	122	795.6	128	796.0	225	796.3	119	797.5	350	798.6	161	800.0			115	800.0		
181	795.2	126	797.8	220	796.8	230	798.3	186	797.2	516	799.0	180	805.0 L			150	805.0 L		
204	797.2	175	798.0	234	798.4	256	781.1	203	797.2	546	800.0								
276	796.6	224	798.0	302	798.4	261	800.0	238	800.0	550	805.0 L								
330	797.3	256	797.3	308	795.4	271	805.0 L	240	805.0 L										
346	800.0	278	798.1	324	795.7														
362	805.0 L	282	800.0	334	798.5														
		300	805.0 L	342	797.5														
				348	800.0														
				358	805.0 L														

SECTION NO. / DISTANCE FROM DAM SITE

#13 /4180m		#11 /4570m		/4660m (INTERPOLATED)		#8 /4700m		#7 /4860m		#5 /5210m		#2 /5710m	
DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)	DIST. (M)	ELEV. (M)
0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R	0	805.0 R
5	803.8	6	801.3	87	801.3	22	800.0	4	802.4	10	802.0	14	800.0
20	800.0	30	800.0	228	800.0	48	800.0	21	800.0	40	800.0	32	799.0
82	800.0	74	800.0	310	800.0	62	805.0 L	41	800.0	58	800.0	47	800.0
90	805.0 L	82	803.3	328	805.0 L			55	801.4	66	805.0 L	52	801.0
		88	805.0 L					60	805.0 L			55	805.0 L

TABLE 7.1

PRELIMINARY COST ESTIMATE

NEW INTAKE AND LOW LEVEL OUTLET - ALTERNATIVE C + F

NEW INTAKE STRUCTURE & NEW LOW LEVEL OUTLET		PRELIMINARY COST ESTIMATE (*)					
No.	Description	Units	Quant.	Unit Price (N) Peso	Cost (N) Peso	Unit Price (U.S. $)	Cost (U.S. $)
	NEW INTAKE STRUCTURE						
1	Cofferdam (cells)	sq.m.	2,500	1,500	3,750,000	500	1,250,000
2	Excavation (Rock)	cu.m.	3,000	63	188,700	21	62,900
3	Concrete	cu.m.	3,500	760	2,660,000	253	886,667
4	Gates (4.5m x 4.5m)	ea.	2	1,500,000	3,000,000	500,000	1,000,000
5	Trashracks (8m x 12m)	ea.	1	1,500,000	1,500,000	500,000	500,000
	POWER TUNNEL(D=4m,L=100m.)						
6	Excavation (Rock)	cu.m.	2,000	74	148,000	25	49,333
7	Tunnel Concrete + Plug	cu.m.	1,200	760	912,000	253	304,000
8	Shotcrete	cu.m.	160	380	60,800	127	20,267
9	Rockbolts	m.	540	88	47,466	29	15,822
	L.L.OUTLET TUNNEL(D=4m,L=215m						
10	Excavation (Rock)	cu.m.	4,300	74	318,200	25	106,067
11	Concrete	cu.m.	1,520	760	1,155,200	253	385,067
12	Shotcrete	cu.m.	300	380	114,000	127	38,000
13	Rockbolts	m.	1,100	88	96,690	29	32,230
	L.L. OUTLET STRUCTURE						
14	Excavation (Rock)	cu.m.	2,000	63	125,800	21	41,933
15	Concrete	cu.m.	1,000	760	760,000	253	253,333
16	Hollow Jet Valve (D=1.7m.)	ea.	1	1,500,000	1,500,000	500,000	500,000
17	Electrical, Controls, etc	ea.	1	2,250,000	2,250,000	750,000	750,000
18	Yard, Misc. Strucrures	ea.	1	3,000,000	3,000,000	1,000,000	1,000,000
19	Mobilization, Unwatering, etc	ea.	1	3,000,000	3,000,000	1,000,000	1,000,000
	Subtotal:				24,586,856		8,195,619
	Contigency @ 30%				7,376,057		2,458,686
	TOTAL:				31,962,913		10,654,304

(*) Based partially on Unit Cost Prices for Civil Works Provided by CFE, Dec. 1992 ($US = 3 New Peso)

TABLE 7.2

PRELIMINARY COST ESTIMATE

SETTLING BASIN - ALTERNATIVE G

SETTLING BASIN (30m x 110m)		PRELIMINARY COST ESTIMATE (*)					
No.	Description	Units	Quant.	Unit Price (N) Peso	Cost (N) Peso	Unit Price (U.S. $)	Cost (U.S. $)
	SETTLING BASIN						
1	Cofferdam (cells)	sq.m.	9,000	1,500	13,500,000	500	4,500,000
2	Excavation (Rock)	cu.m.	51,000	63	3,207,900	21	1,069,300
3	Concrete	cu.m.	11,000	760	8,360,000	253	2,786,667
4	Gates (4.5m x 4.5m)	ea.	3	1,500,000	4,500,000	500,000	1,500,000
	SLUICE SHAFT(D=4m,L=70m.)						
5	Excavation (Rock)	cu.m.	1,380	280	386,400	93	128,800
6	Concrete	cu.m.	500	760	380,000	253	126,667
7	Shotcrete	cu.m.	100	380	38,000	127	12,667
8	Rockbolts	m.	950	88	83,505	29	27,835
	SLUICE TUNNEL(D=4m,L=278m.)						
9	Excavation (Rock)	cu.m.	5,500	74	407,000	25	135,667
10	Concrete	cu.m.	2,000	760	1,520,000	253	506,667
11	Shotcrete	cu.m.	400	380	152,000	127	50,667
12	Rockbolts	m.	1,500	88	131,850	29	43,950
	POWER TUNNEL(D=4m,L=185m.)						
13	Excavation (Rock)	cu.m.	3,700	74	273,800	25	91,267
14	Tunnel Concrete + Plug	cu.m.	1,600	760	1,216,000	253	405,333
15	Shotcrete	cu.m.	300	380	114,000	127	38,000
16	Rockbolts	m.	1,000	88	87,900	29	29,300
	D/S RIVER OUTLET						
17	Excavation (Rock)	cu.m.	15,000	63	943,500	21	314,500
18	Concrete	cu.m.	1,500	760	1,140,000	253	380,000
19	Hollow Jet Valve (D=1.7m.)	ea.	1	1,500,000	1,500,000	500,000	500,000
20	Electrical, Controls, etc	ea.	1	3,750,000	3,750,000	1,250,000	1,250,000
21	Yard, Misc. Strucrures	ea.	1	3,000,000	3,000,000	1,000,000	1,000,000
22	Mobilization, Unwatering, etc	ea.	1	4,500,000	4,500,000	1,500,000	1,500,000
	Subtotal:				49,191,855		16,397,285
	Contigency @ 30%				14,757,557		4,919,186
	TOTAL:				63,949,412		21,316,471

(*) Based partially on Unit Cost Prices for Civil Works Provided by CFE, Dec. 1992 ($US = 3 New Peso)

TABLE 7.3

PRELIMINARY COST ESTIMATE

CHECK DAM SITE B - ALTERNATIVE I

CHECK DAM SITE B - ALTERNATIVE I (DAM CREST ELEVATION 1425) (H=40+15=55m, W=278m, V=194,000cu.m.)		PRELIMINARY COST ESTIMATE (*)					
No.	Description	Units	Quant.	Unit Price (N) Peso	Cost (N) Peso	Unit Price (U.S. $)	Cost (U.S. $)
	CHECK DAM SITE B						
1	Cofferdam (cells)	sq.m.	1,500	1,500	2,250,000	500	750,000
2	Excavation (Rock)	cu.m.	6,000	63	377,400	21	125,800
3	Excavation (Common)	cu.m.	120,000	25	3,000,000	8	1,000,000
4	Concrete - RCC	cu.m.	194,000	69	13,386,000	23	4,462,000
5	Concrete Regular	cu.m.	1,500	760	1,140,000	253	380,000
6	Foundation Treatment	ea.	1	2,250,000	2,250,000	750,000	750,000
7	Yard, Misc. Strucrures	ea.	1	750,000	750,000	250,000	250,000
8	Mobilization, Unwatering, etc	ea.	1	2,250,000	2,250,000	750,000	750,000
	Subtotal:				25,403,400		8,467,800
	Contigency @ 30%				7,621,020		2,540,340
	TOTAL:				33,024,420		11,008,140

(*) Based partially on Unit Cost Prices for Civil Works Provided by CFE, Dec. 1992 ($US = 3 New Peso)

TABLE 7.4

PRELIMINARY COST ESTIMATE

SAND CONVEYANCE TUNNEL WITH DIVERSION DAM - ALTERNATIVE J

SAND CONVEYANCE TUNNEL WITH DIVERSION DAM - ALTERNATIVE J (Assume Diversion Dam equals 1/3 the Size/Quantities of Check Dam -Site B)		PRELIMINARY COST ESTIMATE (*)					
No.	Description	Units	Quant.	Unit Price (N) Peso	Cost (N) Peso	Unit Price (U.S. $)	Cost (U.S. $)
	DIVERSION DAM - ALTERNATIVE J						
1	Cofferdam (cells)	sq.m.	500	1,500	750,000	500	250,000
2	Excavation (Rock)	cu.m.	2,000	63	125,800	21	41,933
3	Excavation (Common)	cu.m.	40,000	25	1,000,000	8	333,333
4	Concrete - RCC	cu.m.	65,000	69	4,485,000	23	1,495,000
5	Concrete Regular	cu.m.	500	760	380,000	253	126,667
6	Foundation Treatment	ea.	1	750,000	750,000	250,000	250,000
	SAND CONV.TUNNEL (D=4m,L=4Km)						
7	Excavation (Rock)	cu.m.	72,000	63	4,528,800	21	1,509,600
8	Concrete (T=.3m)	cu.m.	16,000	760	12,160,000	253	4,053,333
9	Shotcrete	cu.m.	6,000	380	2,280,000	127	760,000
10	Rockbolts	m.	22,000	88	1,931,600	29	643,867
11	Yard, Intake, Misc. Strucrure	ea.	1	4,500,000	4,500,000	1,500,000	1,500,000
12	Gates, Mechanical, Electrical	ea.	1	3,000,000	3,000,000	1,000,000	1,000,000
13	Mobilization, Unwatering, etc	ea.	1	4,500,000	4,500,000	1,500,000	1,500,000
	Subtotal:				40,391,200		13,463,733
	Contigency @ 30%				12,117,360		4,039,120
	TOTAL:				52,508,560		17,502,853

(*) Based partially on Unit Cost Prices for Civil Works Provided by CFE, Dec. 1992 ($US = 3 New Peso)

Table 7.5

PERTINENT DATA FOR
NEW POWER INTAKE AND TUNNEL SEGMENT

INTAKE STRUCTURE	
Type	Vertical Reinforced Concrete
Invert Elev. - m	785
Top Elev. - m	806.5
Hydraulic Design Capacity - cms	55.2
Intake Gate	
Type	Fixed-Wheel Gate
Number	1
Size - m	4.0 x 4.0
Trashrack Size - m	7.0(w) x 8.5(h)
Velocity Thru Gross Area - mps	1.0
Bulkhead Size - m	4.0(w) x 6.0(h)
Gate Control House	
Dimensions - m	7.0(l) x 6.0(w) x 5.0(h)
TUNNEL	
Type	Pressure, Circular Concrete-lined
Diameter (I.D.) - m	4.0
Length[1] - m	114.0
OPERATING REQUIREMENTS	
Minimum water submergence above tunnel crown - m	5.0
Minimum Reservoir Water Surface El. for Power Operation - m	794.0

[1] To the existing power tunnel connection

Table 7.6

PERTINENT DATA FOR CONVERSION OF EXISTING POWER INTAKE INTO NEW LOW LEVEL OUTLET FACILITY

INTAKE STRUCTURE	
Type	Use Existing Structure/Rehab Existing Gate and Replace Trashrack
TUNNEL	
Type	Pressure, Circular Concrete-Lined
Diameter (I.D.) - m	4.0
Length[1] - m	290
Steel Lining	
Thickness - mm	13
Length - m	48
OUTLET STRUCTURE	
Type	Hydraulic-Controlled Fixed-Cone Valve
Fixed-Cone Valve	
Number	1
Size - m	2.4
Hydraulic Capacity - cms	15 to 70
Design Head - m	57
Guard Valve	
Type	Butterfly Valve
Size - m	3.5

[1] From the connection with the existing tunnel.

Table 7.7

PERTINENT DATA FOR
CHECK DAM ON THE APULCO RIVER NEAR HUAHUAXTLA

RESERVOIR	
Normal Max. Water Surface Elev. - m	1489
Available Storage Capacity - mcm	17.6
Surface Area - hectares	68.0
Design Life - years	15
DAM	
Type	Roller-Compacted Concrete
Crest Elev. - m	1494
Crest Length - m	294
Upstream Slope	Vertical
Downstream Slope	0.8H : 1V
Maximum Height above Riverbed - m	34
RCC Dam Volume - cm	138,000
SPILLWAY	
Type	Free Overflow in Central Portion of Dam with Stilling Basin
Crest Elev. - m	1489
Crest Length - m	100
Design Flood (1,000 - yr) - cms	1,306
Maximum Flood Level of Design Flood	1492.3
Stilling Basin	
Floor Elev. - m	1455
Length - m	35
Guide Wall Elev. - m	1466
Design Tailwater Elev. - m	1463
DIVERSION OF RIVER DURING CONSTRUCTION	
Method	Two Stages using Fill Cofferdams and Low Level Outlet thru Base of Partially Constructed Dam
Design Flood (5 - yr) - cms	343
First Stage	Diversion thru Left Bank of River Section
Cofferdam	
Crest Elev. - m	1464
Length - m	340
Second Stage	Diversion thru Low Level Outlet
Cofferdam	
Crest Elev. - m	1467
Length - m	90
Intake Structure for River Diversion/Reservoir Bottom Outlet	
Invert Elev. - m	1459.5
Outlet Elv. - m	1459.0
Size - m	5.5 x 5.5
Length - m	29.5
Gate Type	Fixed Wheel
Gate Size - m	5.5 x 5.5
River Diversion Intake	
Invert Elv. - m	1459.5
Closure	Concrete stoplogs
High Level Intake	
Invert Elv. - m	1487.0
Opening Size (s sides) - m	5.5 (w) x 4.0 (h)

TABLE 8.1(1/2) CONSTRUCTION COST OF NEW POWER INTAKE AND LOW LEVEL OUTLET

Item No.	Description	Unit	Quantity	Unit Price ($N)	Cost ($N)	Cost Summary ($N)
A	NEW POWER INTAKE					
	Unwatering During Construction					
	Circular Cell Cofferdam					
	Steel Sheet Piles	SQM	2,500	1,500.00	3,750,000	
	Fill For Cells	CM	16,000	16.00	256,000	
	Unwatering	LS	1	600,000.00	600,000	
	Intake Structure					
	Excavation (Rock)	CM	5,900	63.00	371,700	
	Concrete					
	Structure	CM	2,230	760.00	1,694,800	
	Gate House	CM	50	760.00	38,000	
	Retaining Walls	CM	780	760.00	592,800	
	Access Road Surface	CM	70	380.00	26,600	
	Fill	CM	16,300	28.00	456,400	
	Intake Gate (4m x 4m)	EA	1	900,000.00	900,000	
	Bulkhead (4mx6m)	EA	1	400,000.00	400,000	
	Trashrack (7m x 8.5m)	EA	1	750,000.00	750,000	
	Electrical, Controls, Misc.	LS	1	1,350,000.00	1,350,000	
						11,186,300
B	NEW POWER TUNNEL SEGMENT (I.D. = 4.0m, L = 114m)					
	Excavation (Rock)	CM	2,240	74.00	165,760	
	Rockbolts	M	910	88.00	80,080	
	Shotcrete	CM	180	380.00	68,400	
	Concrete Lining	CM	810	760.00	615,600	
	Concrete Plug for Existing Tu	CM	450	760.00	342,000	
						1,271,840
C	INTAKE FOR LOW LEVEL OUTLET (Rehab of Existing Intake)					
	Rehab Existing Gate	LS	1	600,000.00	600,000	
	Replace Trashrack	LS	1	750,000.00	750,000	
						1,350,000

TABLE 8.1(2/2) CONSTRUCTION COST OF NEW POWER INTAKE AND LOW LEVEL OUTLET

Item No.	Description	Unit	Quantity	Unit Price ($N)	Cost ($N)	Cost Summary ($N)
D	LOW LEVEL OUTLET TUNNEL (I.D. = 4.0m, L = 290m)					
	Excavation (Rock)	CM	5,700	74.00	421,800	
	Rockbolts	N	2,300	88.00	202,400	
	Shotcrete	CM	450	380.00	171,000	
	Concrete Lining	CM	2,050	760.00	1,558,000	
	Steel Lining (t=13mm, L=48m)	KG	60,100	7.64	459,164	
						2,812,364
E	L.L.O. OUTLET STRUCTURE					
	Excavation (Rock)	CM	5,100	63.00	321,300	
	Concrete	CM	340	760.00	258,400	
	Hollow Jet Valve (D=2.1m)	EA	1	1,650,000.00	1,650,000	
	Butterfly Valve (D=2.7m)	EA	1	1,560,000.00	1,560,000	
	Electrical, Controls, Misc. Eq	LS	1	900,000.00	900,000	
						4,689,700
F	D/S CHANNEL IMPROVEMENTS FROM NEW OUTLET TO SPILLWAY					
	Clear & Grub Existing Riverbed	SQM	10,000	1.50	15,000	
	Removal of Loose Rock near Spillway Impact Area	CM	4800	28.00	134,400	
						149,400
G	MOBILIZATION & CONSTRUCTION ACCESS (Incl. Acces Shaft)	LS	1	3,000,000.00	3,000,000	
						3,000,000
	Subtotal Direct Costs					24,459,604
	Contingencies (25%)					6,114,901
	TOTAL CONSTRUCTION COST					30,574,505 ($N)
						10,191,502 ($US)
	Engineering & Administration (15%)					4,586,176 ($N)
	TOTAL COSTS					35,160,681 ($N)
						11,720,227 ($US)

TABLE 8.2 CONSTRUCTION COST OF CHECK DAM

Item No.	Description	Unit	Quantity	Unit Price ($N)	Cost ($N)	Cost Summary ($N)
A	RIVER DIVERSION DURING CONSTRUCTION (2Stages)					
	Fill Cofferdams					
	First Stage	CM	33,000	16	528,000	
	Second Stage	CM	10,000	16	160,000	
	Diversion Outlet (Thru First Stage Dam Construction)					
	Concrete	CM	2,800	760	2,128,000	
	Channel Excavation	CM	6,000	25	150,000	
	Bulkhead gate	LS	1	1,050,000	1,050,000	
	Stoplog (Diversion)	LS	1	750,000	750,000	
	Stoplog (Tower)	LS	1	900,000	900,000	
						5,666,000
B	DAM					
	Excavation (Rock)	CM	27,200	63	1,713,600	
	Excavation (Common)	CM	126,886	25	3,172,150	
	Roller-Compacted Concrete	CM	138,325	105	14,524,125	
	Concrete - Walls	CM	1,850	760	1,406,000	
	Concrete - Basin Slab	CM	8,100	380	3,078,000	
	Foundation Treatment	LS	1	2,250,000	2,250,000	
						26,143,875
C	MOBILIZATION, CONSTRUCTION ACCESS, ROAD RELOCATION, ETC.	LS	1	2,250,000	2,250,000	
						2,250,000
	Sub Total Direct Costs					34,059,875
	Contigencies (20%)...(*)					6,811,975
	TOTAL CONSTRUCTION COST					40,871,850($N)
						13,623,950($US)
	Engineering & Administration (15%)					6,130,778($N)
	TOTAL COSTS					47,002,628($N)

Note: (*) Use 20% contigency since two preliminary estimates were obtained from specialized US contractors.

15,667,543($US)

Table 9.1 UNIT CONSTRUCTION COST AND ENERGY GENERATION COST OF POWER PLANT

(Price at mid 1991)

Power Plant	Capacity (MW)	Unit Construction Cost								Energy Generation Cost							
		Direct Cost		Direct and Indirect Cost		Capitalized as of Operation Start 12%		Capitalized as of Operation Start 14%		Investment		Fuel		O & M		Total	
		(x mil Peso/kW)	Index	(x mil Peso/kW)	Index	(x mil Peso/kW)	Index	(x mil Peso/kW)	Index	(Peso/kWh)	Index	(Peso/kWh)	Index	(Peso/kWh)	Index	(Peso/kWh)	Index
Conventional thermal	2 x 350	1.663	100	1.812	100	2.561	100	2.708	100	53.21	100	109.01	100	2.69	100	164.91	100
	2 x 160	2.025	122	2.207	122	3.086	120	3.258	120	64.12	121	118.89	109	4.48	167	187.49	114
	2 x 84	2.380	143	2.594	143	3.596	140	3.791	140	74.71	140	126.37	116	6.80	253	207.88	162
	2 x 37.5	2.915	175	3.177	175	4.249	166	4.451	164	88.28	166	137.12	126	11.61	432	237.01	144
Gas turbine	1 x 30	0.942	57	0.989	55	1.217	48	1.258	46	147.05	276	132.53	122	20.41	759	299.99	182
Gas turbine/diesel	1 x 30	0.969	58	1.018	56	1.253	49	1.295	48	151.36	284	247.99	227	20.41	759	419.76	255
Combined cycle (gas)	1 x 250	1.825	110	2.025	112	2.804	109	2.956	109	68.31	128	93.78	86	14.85	552	176.94	107
Combined cycle (diesel)	1 x 250	1.859	112	2.063	114	2.857	112	3.012	111	69.59	131	165.41	152	14.85	552	249.85	152
Diesel	2 x 32.5	4.268	257	4.482	247	5.516	215	5.702	211	122.15	230	86.97	80	11.72	436	220.66	134
Coal-fired thermal	2 x 350	2.406	145	2.673	148	4.017	157	4.291	158	84.62	159	60.48	55	5.30	197	150.40	91
- do - without desulfurator	2 x 350	2.526	152	2.807	155	4.218	165	4.506	166	88.86	167	47.72	44	4.83	180	141.41	86
- do - with desulfurator	2 x 350	3.003	181	3.337	184	4.840	189	5.144	190	107.06	201	50.11	46	17.52	651	174.69	106
Medium nuclear plant (USA)	2 x 1000	6.513	392	7.157	395	15.028	587	17.035	629	306.33	576	17.50	16	23.66	880	347.49	211
Improved nuclear plant (USA)	2 x 1000	4.043	243	4.443	245	7.185	281	7.776	287	146.45	275	17.50	16	23.66	880	187.61	114
Medium nuclear plant (France)	2 x 1000	3.310	199	3.637	201	5.881	230	6.365	235	119.88	225	17.50	16	15.30	569	152.68	93
Geothermal																	
Cerro Prieto	1 x 20	2.095	126	2.520	139	2.992	117	3.074	114	53.43	100	65.51	60	14.34	533	133.28	81
Los Azufres	1 x 20	2.095	126	2.520	139	2.992	117	3.074	114	53.43	100	73.32	67	14.34	533	141.09	86
Hydropower																	
Aguamilpa	3 x 320	1.863	112	2.068	114	3.186	124	3.416	126	155.35	292	4.46	4	1.29	48	161.10	98
Agua Prieta	2 x 120	1.911	115	2.121	117	3.083	120	3.273	121	181.97	342	12.74	12	4.44	165	199.15	121
La Amistad	2 x 33	1.859	112	2.063	114	2.832	111	2.978	110	122.12	230	8.92	8	11.46	426	142.50	86
Bacurato	2 x 46	2.652	159	2.944	162	4.041	158	4.249	157	150.58	283	8.92	8	7.48	278	166.98	101
Caracol	3 x 198	3.108	187	3.450	190	5.804	227	6.325	234	248.57	467	4.46	4	2.00	74	255.03	155
Comedero	2 x 55	2.022	122	2.245	124	3.081	120	3.240	120	121.82	229	8.92	8	6.40	238	137.14	83
Chicoasén	5 x 300	3.109	187	3.451	190	5.329	208	5.723	211	154.66	291	4.46	4	0.88	33	160.00	97
Peñitas	4 x 105	3.929	236	4.361	241	6.976	272	7.533	278	165.47	311	4.46	4	2.48	92	172.41	105
Zirr Apàn	2 x 140	4.137	249	4.592	253	6.913	270	7.387	273	161.81	304	6.37	6	1.83	68	170.01	103

Source: CFE

TABLE 9.2 CASH FLOW FOR ECONOMIC ANALYSIS BY FUEL COST SAVING IN COAL-FIRED THERMAL PLANT

(Unit : million US$)

	Year	Cost			Benefit				Net Benefit
		Capital Cost	O&M Cost	Total Cost	Capital Cost	O&M Cost	Fuel Cost	Total Cost	(B-C)
1	1995	9.42		9.42					-9.42
2	1996	9.42		9.42					-9.42
3	1997	9.42	2.40	11.82					-11.82
4	1998		2.55	2.55					-2.55
5	1999		2.55	2.55					-2.55
6	2000		2.55	2.55		1.13	12.98	14.11	11.56
7	2001		2.55	2.55		1.13	12.98	14.11	11.56
8	2002		2.55	2.55		1.13	12.98	14.11	11.56
9	2003		2.55	2.55		1.13	12.98	14.11	11.56
10	2004		2.55	2.55		1.13	12.98	14.11	11.56
11	2005		2.55	2.55		1.13	12.98	14.11	11.56
12	2006		2.55	2.55		1.13	12.98	14.11	11.56
13	2007		2.55	2.55		1.13	12.98	14.11	11.56
14	2008		2.55	2.55		1.13	12.98	14.11	11.56
15	2009		2.55	2.55		1.13	12.98	14.11	11.56
16	2010		2.55	2.55		1.13	12.98	14.11	11.56
17	2011		2.55	2.55		1.13	12.98	14.11	11.56
18	2012		2.55	2.55		1.13	12.98	14.11	11.56

EIRR = 18.27%

Notes : (1) Total construction cost is US$ 28.25 x 10^6.
(2) During the construction, power stop is inevitable due to plug concrete in the power tunnel. Loss of energy is valued at US$ 2.40 x 10^6.
(3) O&M cost for hydropower is assumed at 2% of capital cost plus existing cost of US$ 2.0 x 10^6.
(4) O&M cost for coal-fired thermal plant is assumed at US$ 0.00176 / kWh x 1.15.
(5) Fuel cost is assumed at US$ 0.0202 / kWh x 1.15.
(6) Energy output is assumed at 90% of the past average output of 621GWh due to use of water for sluicing sediment load.

TABLE 9.3 CASH FLOW FOR ECONOMIC ANALYSIS BY INSTALLATION AND OPERATION OF NEW COAL-FIRED THERMAL PLANT

(Unit : million US$)

	Year	Cost			Benefit				Net Benefit
		Capital Cost	O&M Cost	Total Cost	Capital Cost	O&M Cost	Fuel Cost	Total Cost	(B-C)
1	1995	9.42		9.42					-9.42
2	1996	9.42		9.42					-9.42
3	1997	9.42	2.40	11.82	74.33			74.33	62.51
4	1998		2.55	2.55	74.33			74.33	71.78
5	1999		2.55	2.55	74.33			74.33	71.78
6	2000		2.55	2.55		1.13	12.98	14.11	11.56
7	2001		2.55	2.55		1.13	12.98	14.11	11.56
8	2002		2.55	2.55		1.13	12.98	14.11	11.56
9	2003		2.55	2.55		1.13	12.98	14.11	11.56
10	2004		2.55	2.55		1.13	12.98	14.11	11.56
11	2005		2.55	2.55		1.13	12.98	14.11	11.56
12	2006		2.55	2.55		1.13	12.98	14.11	11.56
13	2007		2.55	2.55		1.13	12.98	14.11	11.56
14	2008		2.55	2.55		1.13	12.98	14.11	11.56
15	2009		2.55	2.55		1.13	12.98	14.11	11.56
16	2010		2.55	2.55		1.13	12.98	14.11	11.56
17	2011		2.55	2.55		1.13	12.98	14.11	11.56
18	2012		2.55	2.55		1.13	12.98	14.11	11.56

EIRR = 177.33%

Notes : (1) Peak capacity for 5 hours with 90% dependable flow :
220,000 x [7.57 x (24 / 5) / 55.2] = 144,800 kW
220,000 kW : installed capacity
7.57 m3/s : 90% dependable flow
55.2 m3/s : max. plant discharge
(2) Unit construction cost of coal-fired thermal plant is US$ 1,339 / kW in 1991.
(3) Capital cost of new thermal plant is:
144,800 kW x US$ 1,339 / kW x 1.15 = US$ 222,970

TABLE 9.4 CASH FLOW FOR FINANCIAL RATE OF RETURN

(Unit : million US$)

	Year	Cost			Revenue	Balance
		Capital Cost	O&M Cost	Total Cost		
1	1995	10.25		10.25		-10.25
2	1996	10.25		10.25		-10.25
3	1997	10.25	2.40	12.65		-12.65
4	1998		3.05	3.05		-3.05
5	1999		3.05	3.05		-3.05
6	2000		3.05	3.05	12.58	9.53
7	2001		3.05	3.05	12.58	9.53
8	2002		3.05	3.05	12.58	9.53
9	2003		3.05	3.05	12.58	9.53
10	2004		3.05	3.05	12.58	9.53
11	2005		3.05	3.05	12.58	9.53
12	2006		3.05	3.05	12.58	9.53
13	2007		3.05	3.05	12.58	9.53
14	2008		3.05	3.05	12.58	9.53
15	2009		3.05	3.05	12.58	9.53
16	2010		3.05	3.05	12.58	9.53
17	2011		3.05	3.05	12.58	9.53
18	2012		3.05	3.05	12.58	9.53

IRR = 14.05%

Notes : (1) Assuming that the existing dredger be repaired at US$ 2.5 million.
(2) Revenue is assumed as follows.

Total energy generated	:	621 x 10^6 kWh
Loss by flushing	:	10 %
Loss by station use and by transmission	:	10 %
Revenue attributable to generating side	:	50 %

621 x 10^6 kWh x 0.9 x 0.9 x US$ 0.05/kWh x 0.5 = 12.575 x 10^6 kWh

TABLE 9.5 CASH FLOW FOW FOR LOAN REPAYABILITY

(Unit : million US$)

	Year	Cost				Revenue	Balance	Accumulated balance
		Capital Cost	O&M Cost	Interest	Repayment of principal			
1	1995	10.25		0.256			-0.256	-0.256
2	1996	10.25		0.769			-0.769	-1.025
3	1997	10.25	2.40	1.281			-3.681	-4.706
4	1998		3.05	1.538			-4.588	-9.294
5	1999		3.05	1.538			-4.588	-13.881
6	2000		3.05	1.384	3.075	12.58	5.071	-8.810
7	2001		3.05	1.230	3.075	12.58	5.225	-3.585
8	2002		3.05	1.076	3.075	12.58	5.379	1.794
9	2003		3.05	0.923	3.075	12.58	5.533	7.326
10	2004		3.05	0.769	3.075	12.58	5.686	13.013
11	2005		3.05	0.615	3.075	12.58	5.840	18.853
12	2006		3.05	0.461	3.075	12.58	5.994	24.846
13	2007		3.05	0.308	3.075	12.58	6.148	30.994
14	2008		3.05	0.154	3.075	12.58	6.301	37.295
15	2009		3.05	0	3.075	12.58	6.455	43.750
16	2010		3.05			12.58	9.530	53.280
17	2011		3.05			12.58	9.530	62.810
18	2012		3.05			12.58	9.530	72.340
Total		30.75	48.15	12.300	30.750	163.54	72.340	

Notes : (1) Loan with an interest rate of 5% for a repayment period of 15 years including 5 year grace period.
(2) Principal is repaid uniformly over 10 years.

TABLE 10.1 TURBIDITY OF WATER IN SOLEDAD RESERVOIR AND TAILRACE

(A) Soledad Reservoir — Measured on Oct. 6 '92

Water depth (m)	Measuring Points R1 (ppm)	R2 (ppm)	R3 (ppm)	R4 (ppm)	R5 (ppm)	R12 (ppm)
0	-	-	-	-	-	-
2	48.4	33.8	53.2	43.2	77.5	39.2
4	62.2	31.4	53.2	49.1	94.4	31.5
6	62.2	42.7	53.2	57.6	95.2	25.3
8	58.2	53.4	54.1	49.7	96.3	25.3
10	54.9	52.6	48.1	53.0	76.7	32.2
12	54.9	50.3	48.4	45.9	95.7	37.2
14	54.9	50.2	48.4	45.9	90.4	49.8
16		48.4				50.6
18						51.8
20						
Water temperature (°C)	16.9~17.6	17.0~18.1	17.0~17.6	16.9~17.7	16.9~17.9	16.5~18.2

(B) Tailrace — Measured on Oct. 6 '92

Water depth (m)	Measuring Points P1 (ppm)	P2 (ppm)	P3 (ppm)	P4 (ppm)
0 ~ 2	57.8~63.9	8.0	-	13.6~15.1
Water temperature (°C)	17.1~17.6	20.2~20.3	-	21.8

Notes: Power plant on Oct. 6, '92 was fully operated.

TABLE 10.2 MEASUREMENT OF TURBIDITY OF WATER BY TURBIDITY METER

(A) Soledad Reservoir
Date : September 23, 1993
Reservoir Water Level : EL. 803.57 m (13.00) to EL. 803.54 m (14.00)

Depth (m)	(1) Near Power Intake		(2) Center of Dam		(3) Right Side of Dam	
	Temperature (°C)	Turbidity (ppm)	Temperature (°C)	Turbidity (ppm)	Temperature (°C)	Turbidity (ppm)
0 - 2	20.5	65.9	20.5	66.2	20.5	66.3
2 - 4	20.2	65.3	20.2	66.3	20.2	66.2
4 - 6	20.0	67.4	19.9	68.4	19.8	67.1
6 - 8	19.8	71.8	19.9	72.4	19.8	71.8
8 - 10	19.8	71.6	19.8	69.9	19.7	72.5
10 - 12	19.8	74.5	19.8	72.4	19.7	73.2
12 - 14			19.8	73.3		
14 - 16			19.8	73.6		
16 - 18			19.7	73.4		
18 - 20			19.7	73.9		

Notes : Values are the average for 10 seconds.

(B) Mazatepec Powerstation
Date : September 23, 1993, 11:00 to 11:30

Depth (m)	(1) Just upstream of tailrace		(2) Just downstream of tailrace	
	Temperature (°C)	Turbidity (ppm)	Temperature (°C)	Turbidity (ppm)
0 - 2	21.3	20 ~ 24	20.0	76.4 ~ 81.1

Notes : Values are the average for 10 seconds.
Power plant was operated fully on Sept. 23 and the power discharge was approximately 55 m3/s.

(C) Downstream Section of Apulco/Tecolutla River
Date : September 24, 1993, 11:00 to 14:00

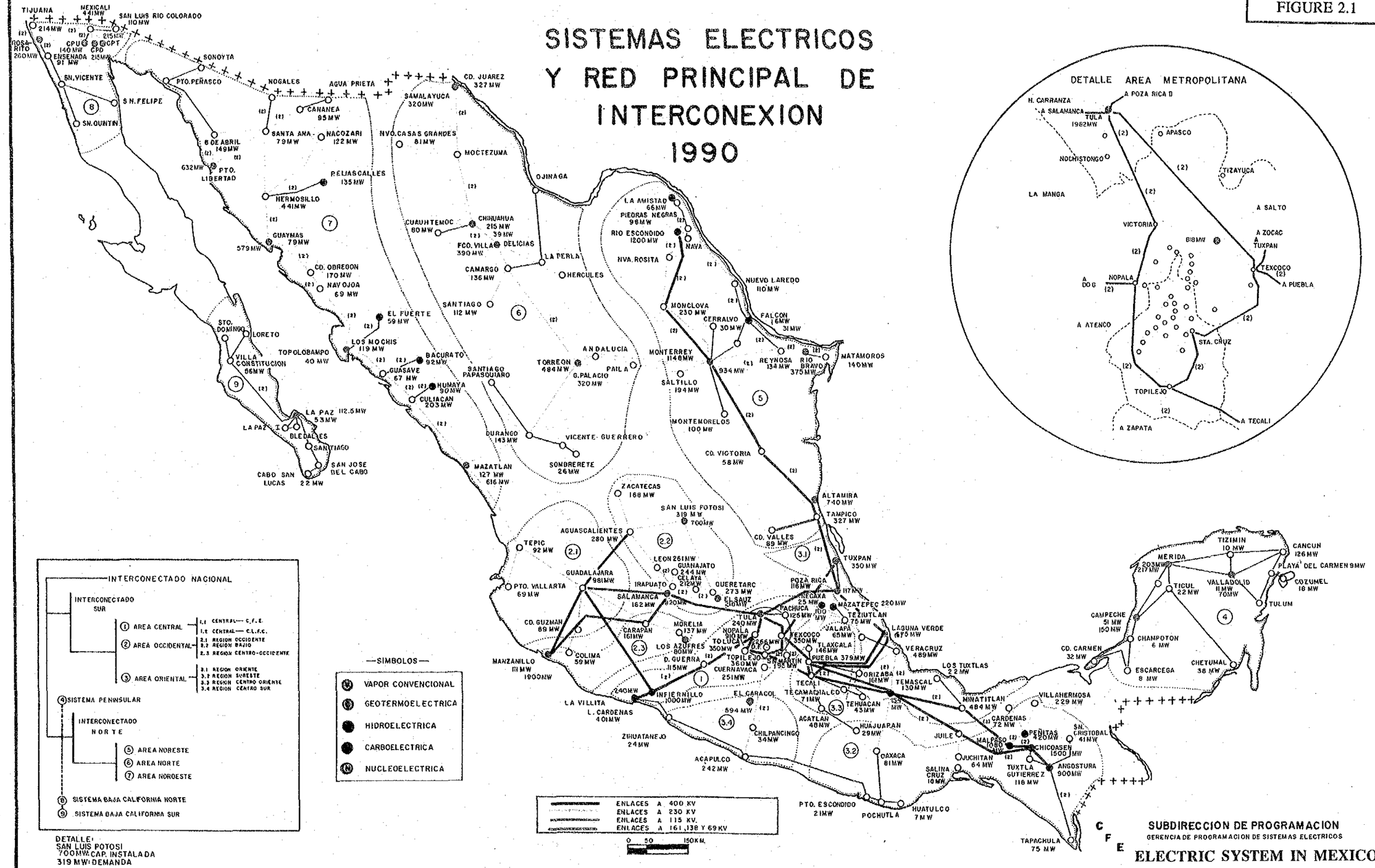
Depth (m)	(1) Necaxa River near junction		(2) El. Espinal		(3) El. Remolino		(4) Bridge at Gutierrez Zamora	
	Temperature (°C)	Turbidity (ppm)	Temperature (°C)	Turbidity (ppm)	Temperature (°C)	Turbidity (ppm)	Temperature (°C)	Turbidity (ppm)
0 - 2	24.7	165 ~ 174	24.8	221 ~ 233	24.4	283 ~ 305	24.2	335 ~ 356

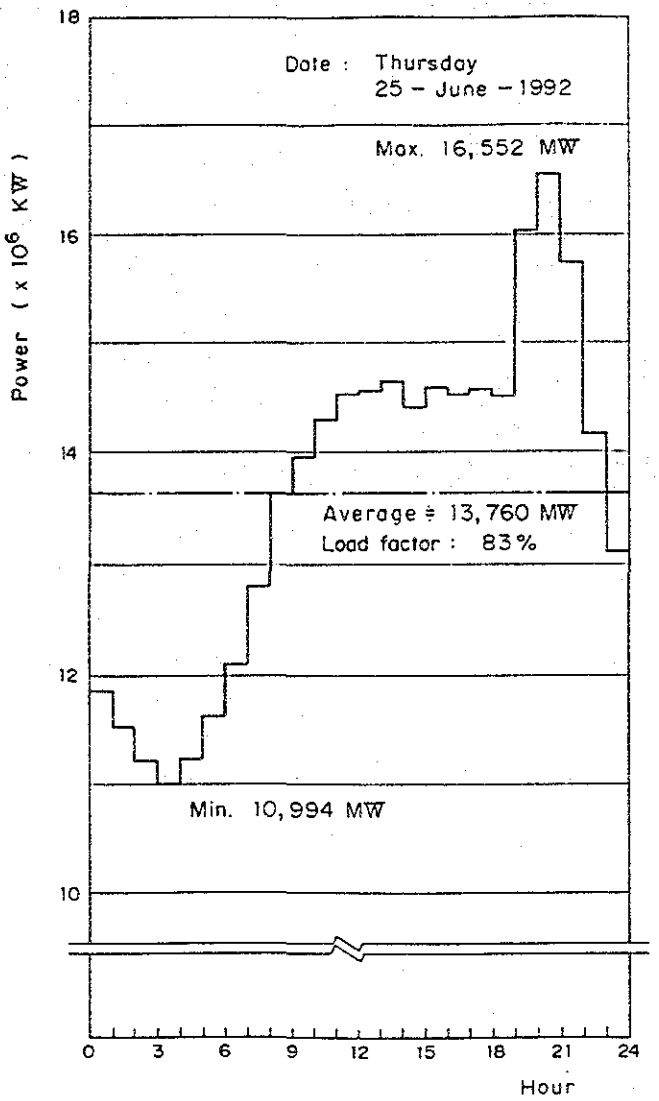
Note : Locations (1) approx. 40 km from Mazatepec and 75 km from the estuary
(2) approx. 68 km from the estuary
(3) approx. 40 km from the estuary
(4) approx. 13 km from the estuary

FIGURES

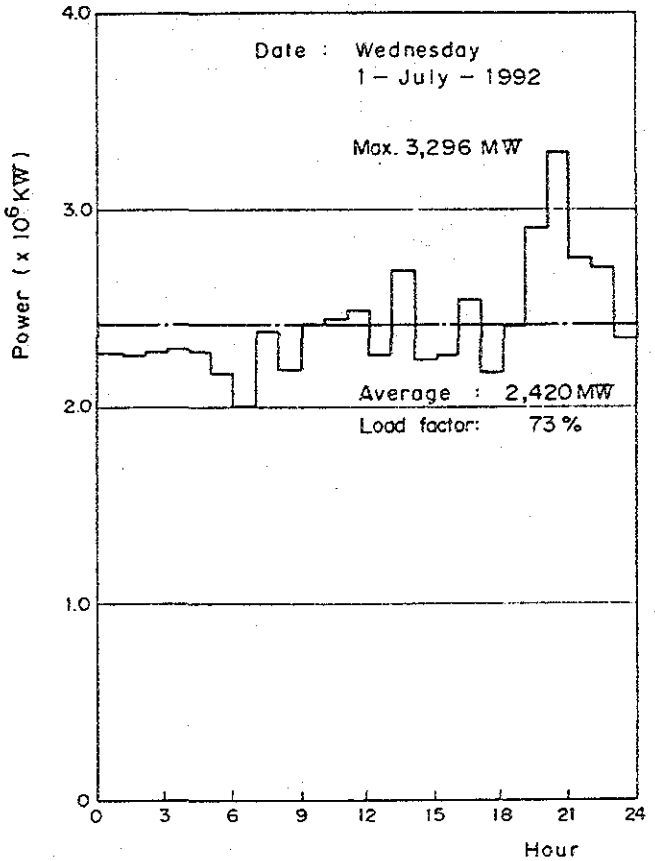
FIGURE 2.1

SISTEMAS ELECTRICOS Y RED PRINCIPAL DE INTERCONEXION 1990





DAILY LOAD CURVE OF NATIONAL INTERCONNECTED SYSTEM (Exld. BAJA CALIFORNIA)

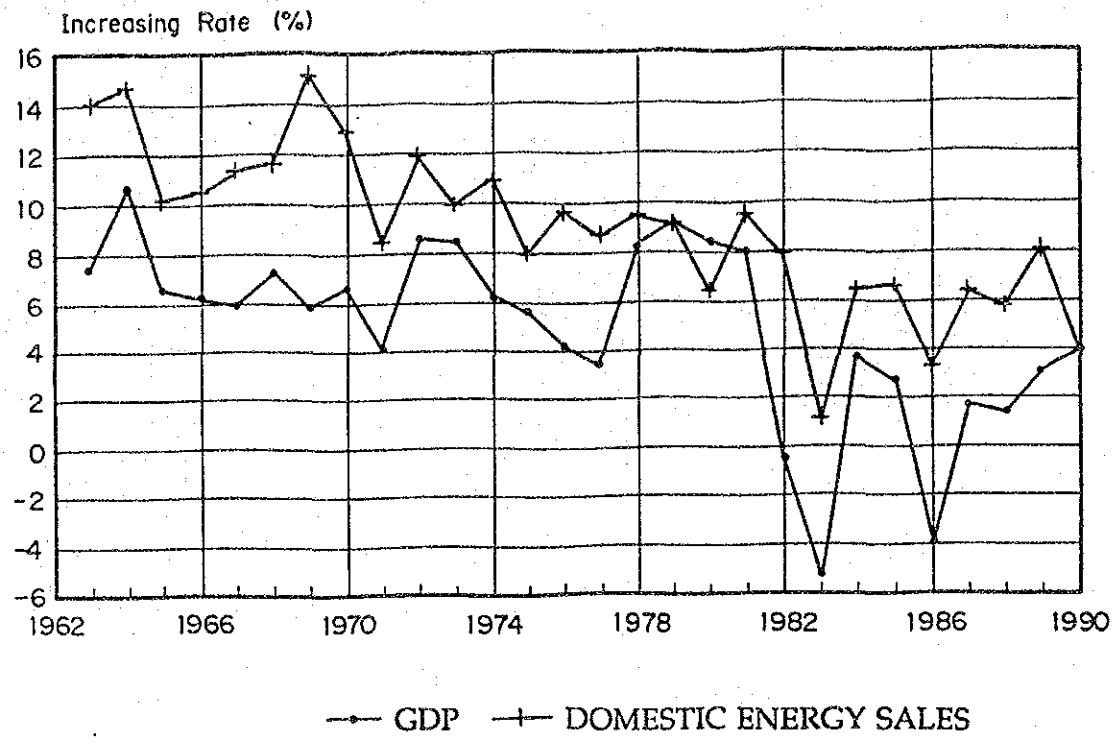


DAILY LOAD CURVE OF ORIENTAL AREA

TYPICAL DAILY LOAD CURVES IN NATIONAL INTERCONNECTED SYSTEM AND ORIENTAL AREA

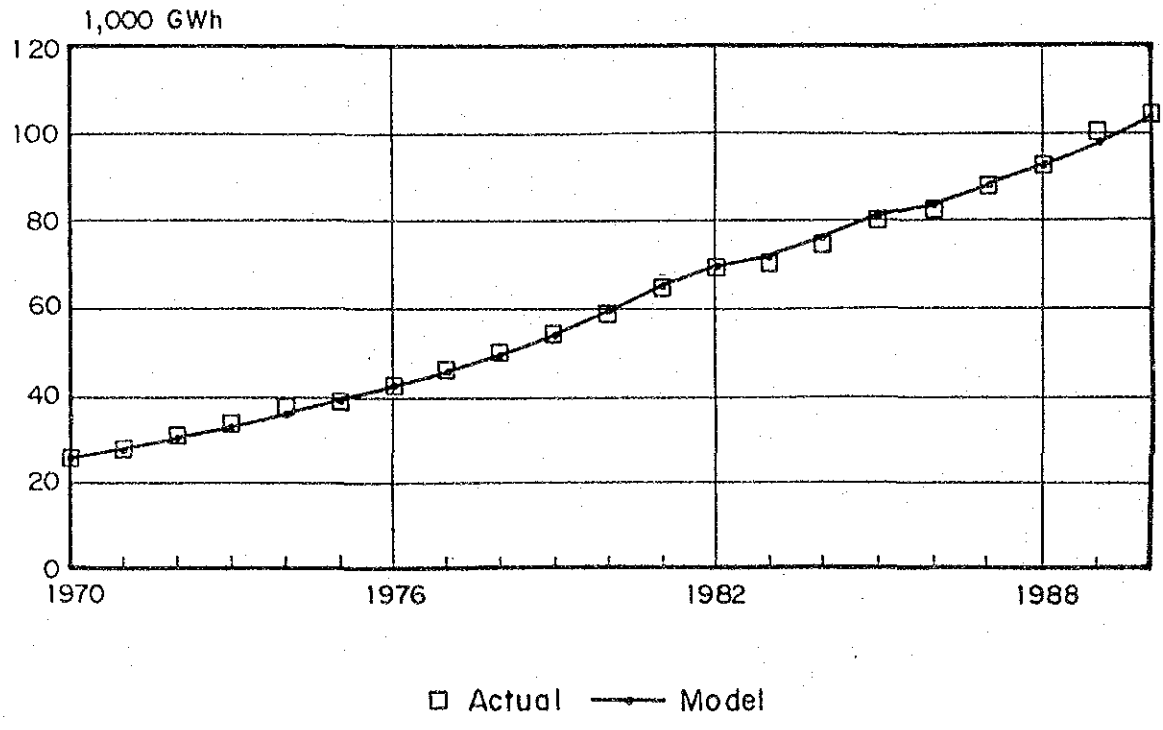
FIGURE 2.2

FIGURE 2.3



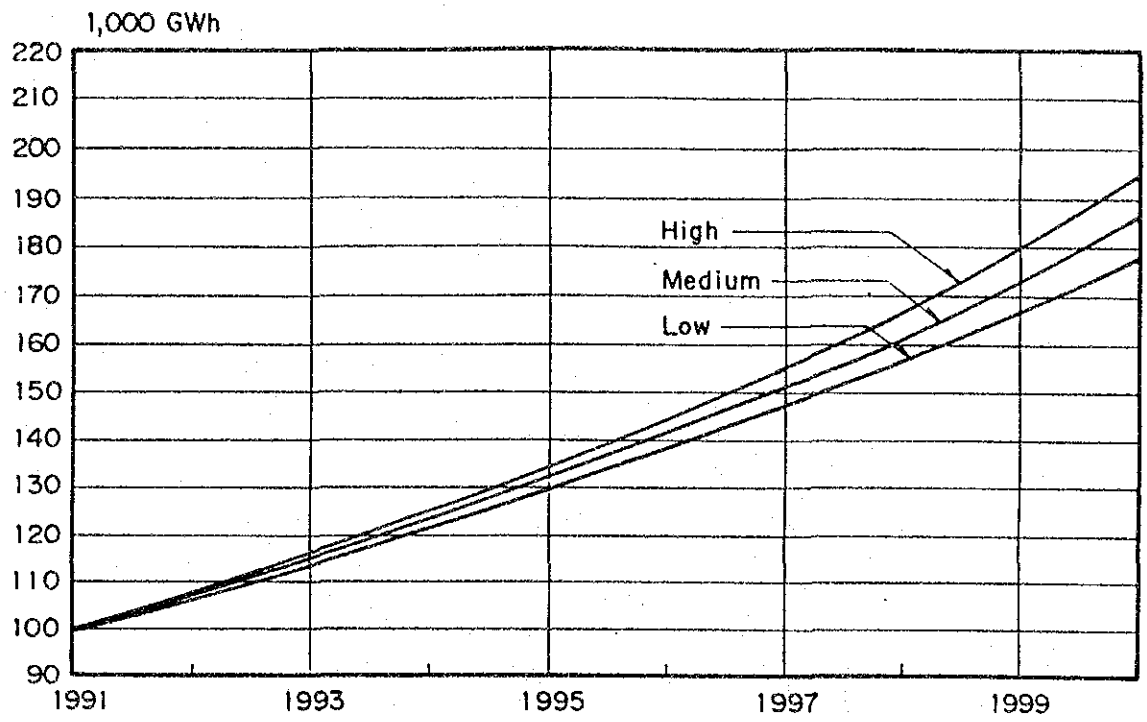
INCREASE RATE OF DOMESTIC ENERGY SALES AND GDP

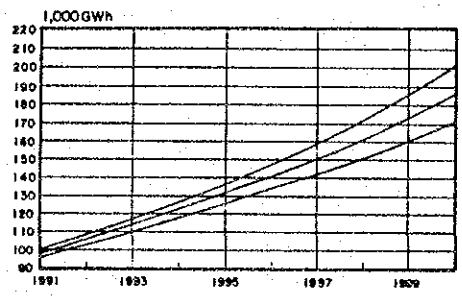
FIGURE 2.4



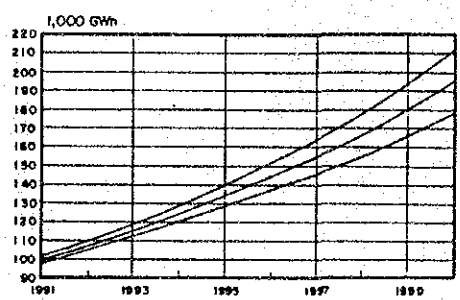
VERIFICATION OF ECONOMETRIC MODEL BY ACTUAL DEMAND

FIGURE 2.5

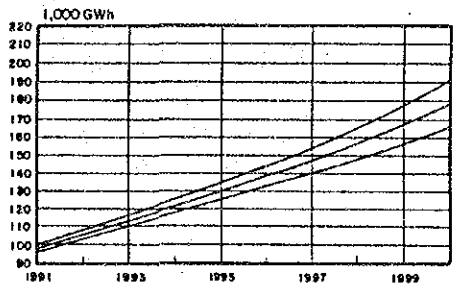




MEDIUM SCENARIO WITH 80% RELIABILITY



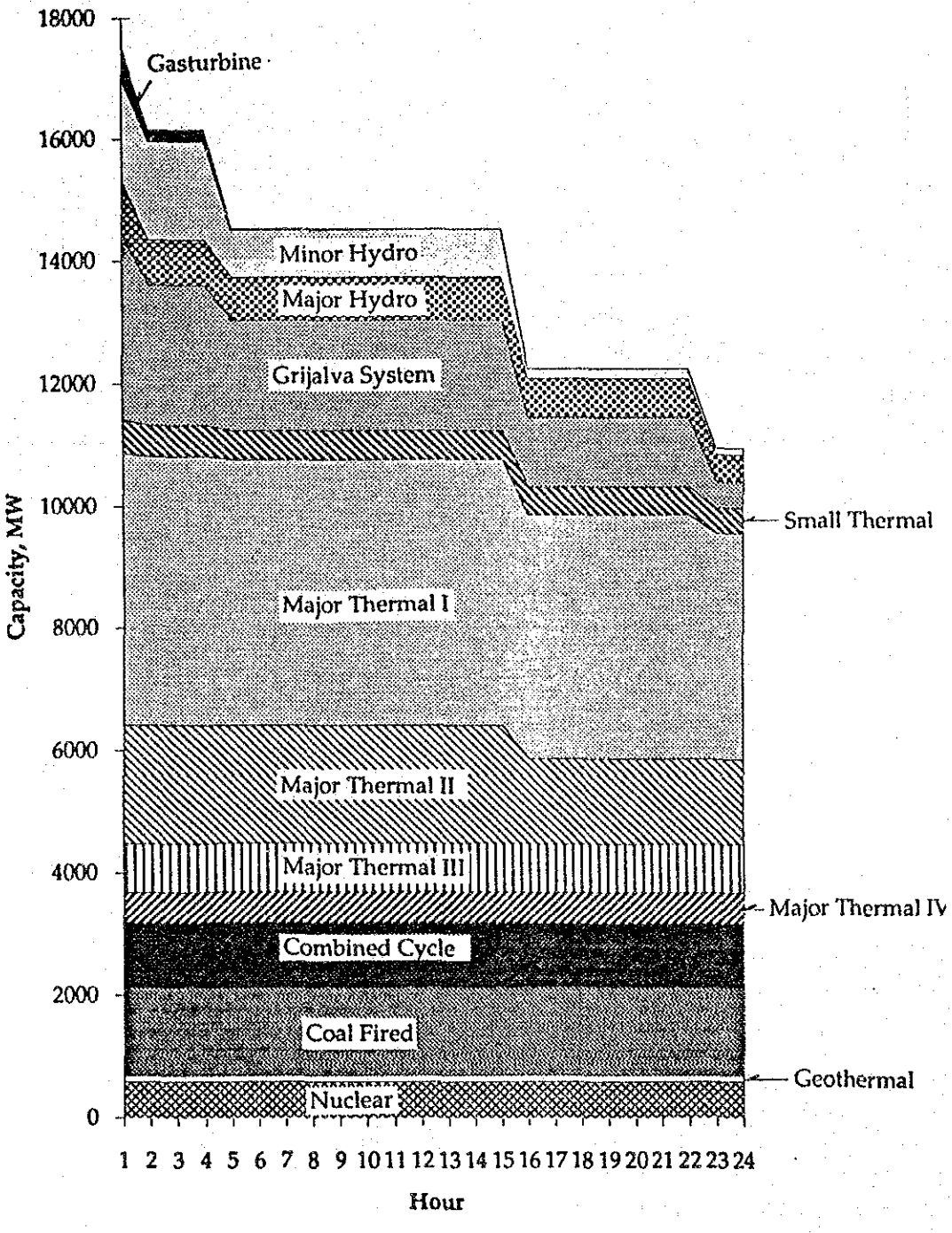
HIGH SCENARIO WITH 80% RELIABILITY



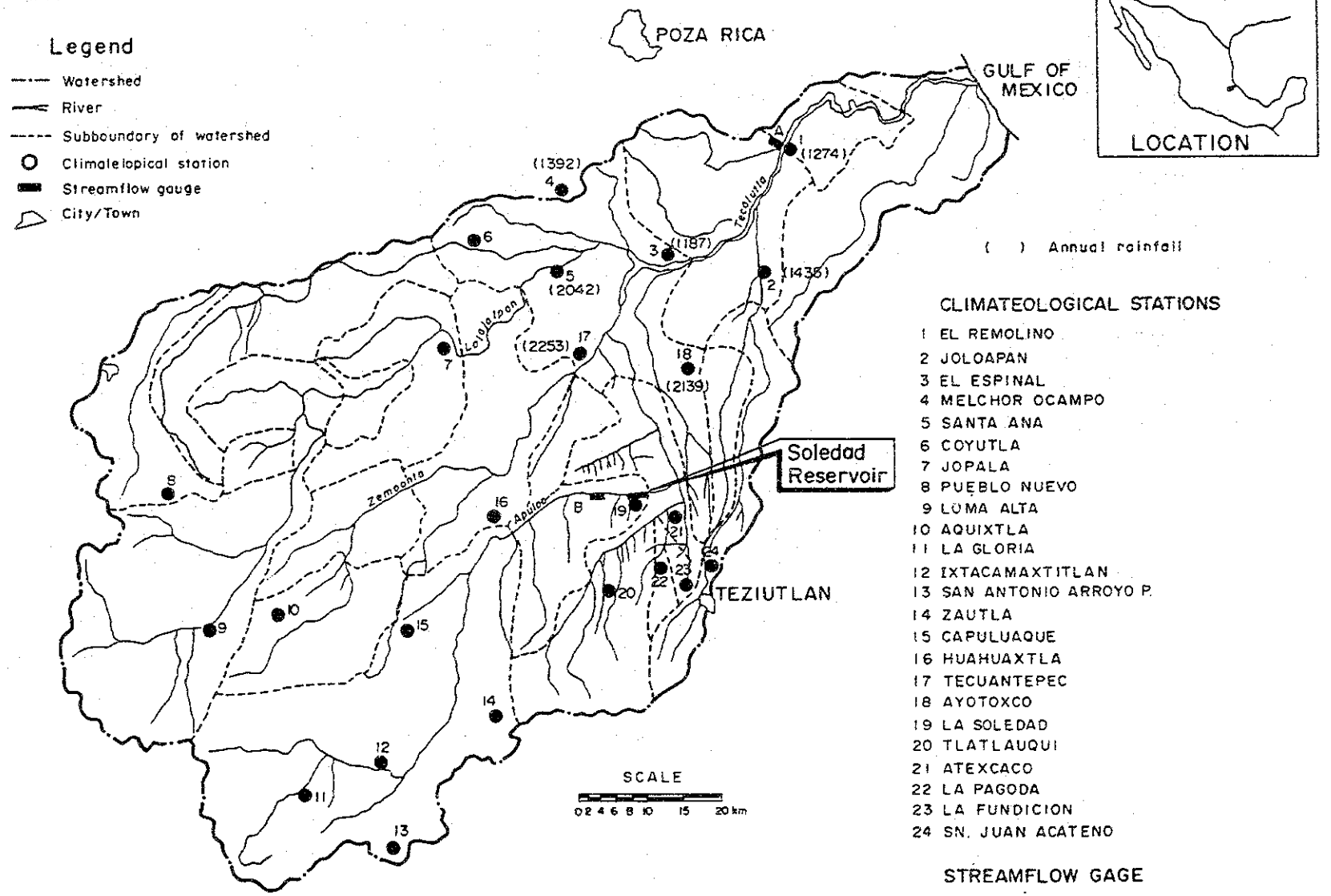
LOW SCENARIO WITH 80% RELIABILITY

FORECAST OF ENERGY SALES FOR THREE ECONOMIC SCENARIOS

FIGURE 2.6



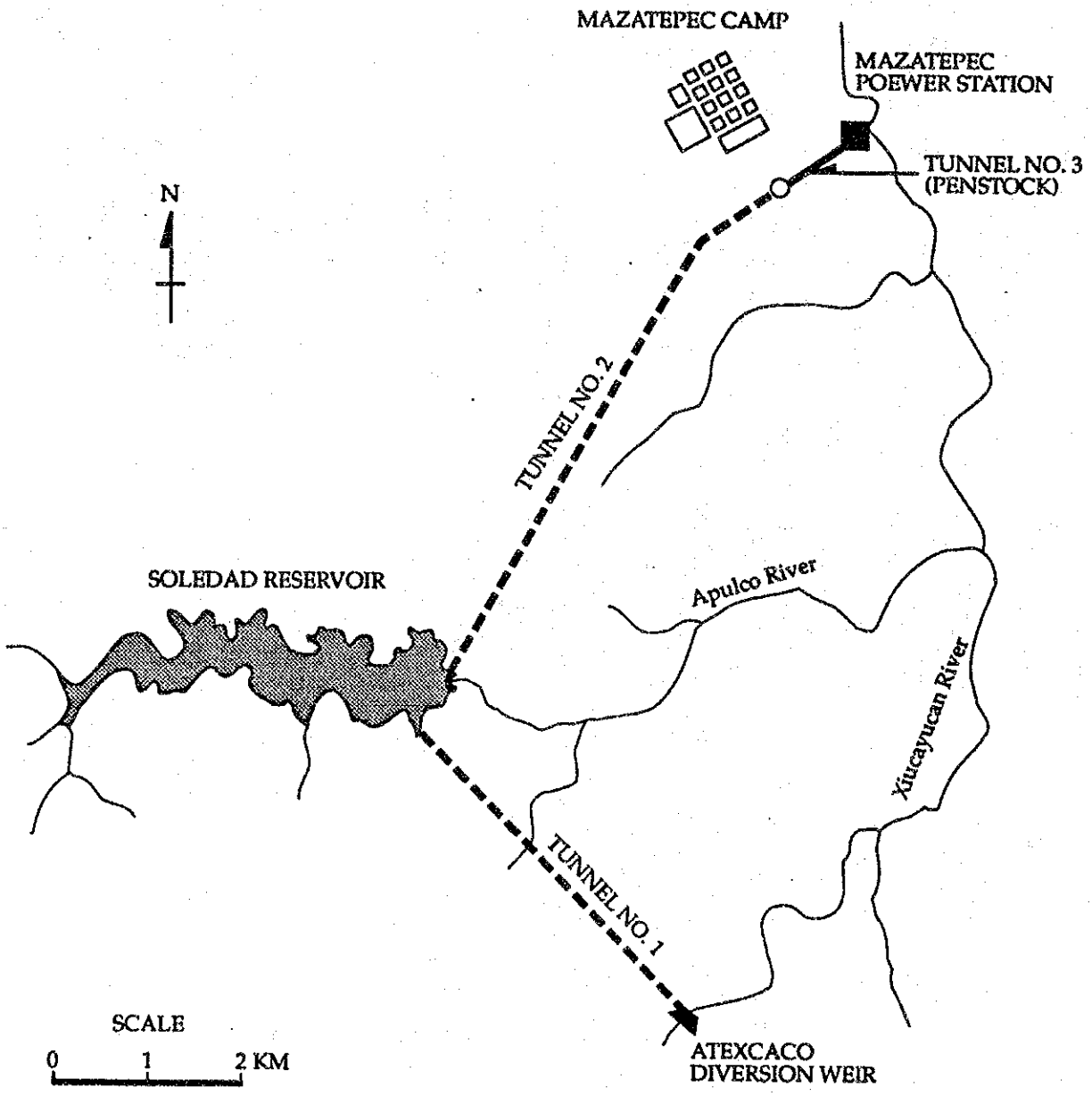
LOAD DURATION CURVE FOR MAY 1993 AND SHARE OF LOAD BY GENERATING SOURCE



LOCATION MAP

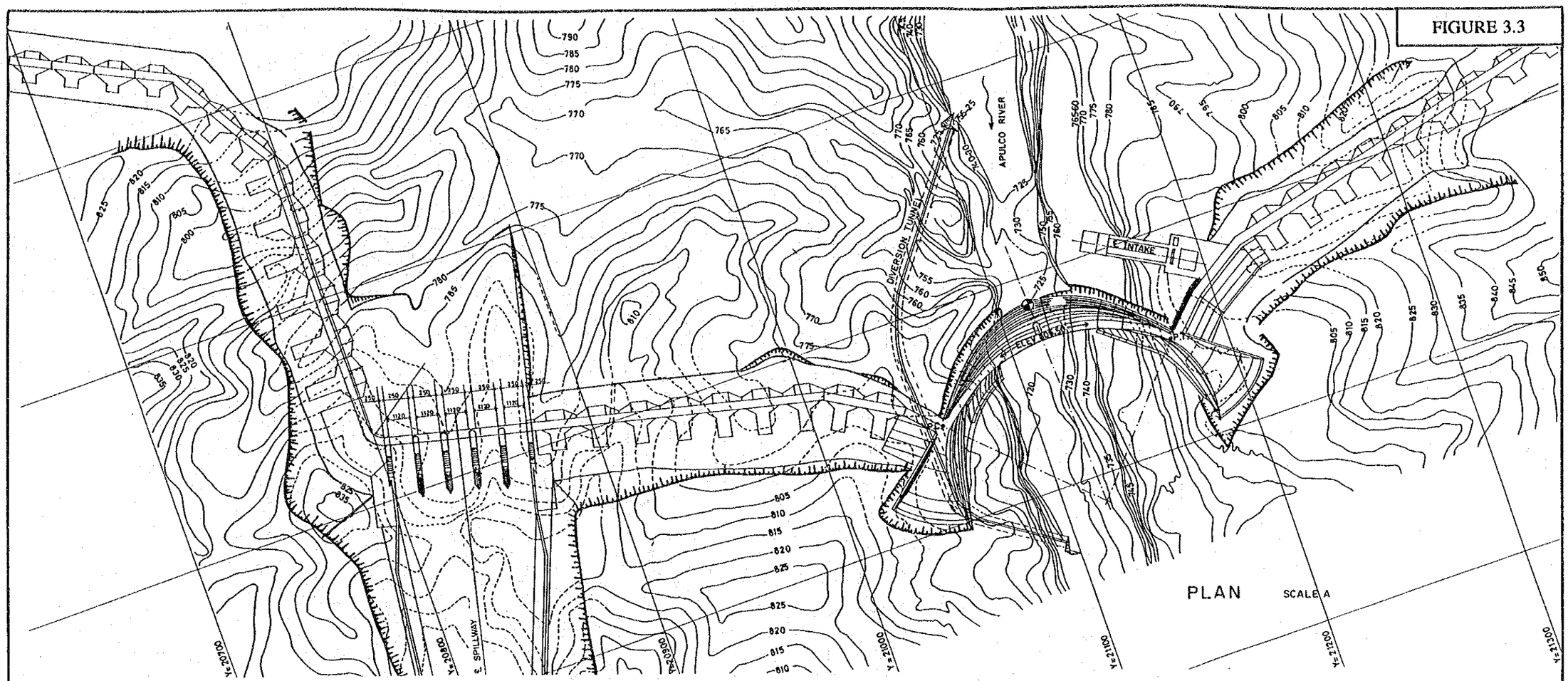
FIGURE 3.1

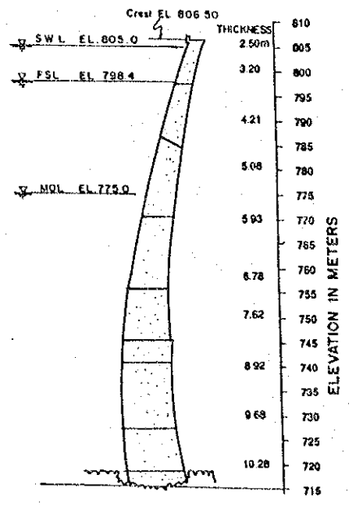
FIGURE 3.2



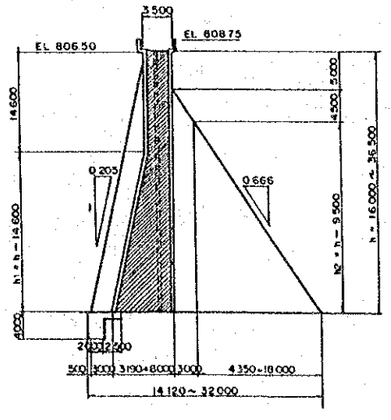
GENERAL LAYOUT OF PROJECT

FIGURE 3.3

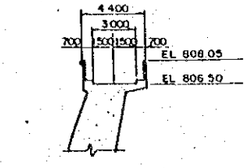




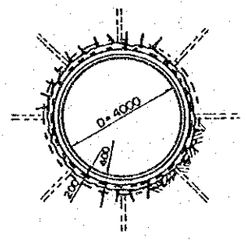
SECTION OF ARCH DAM



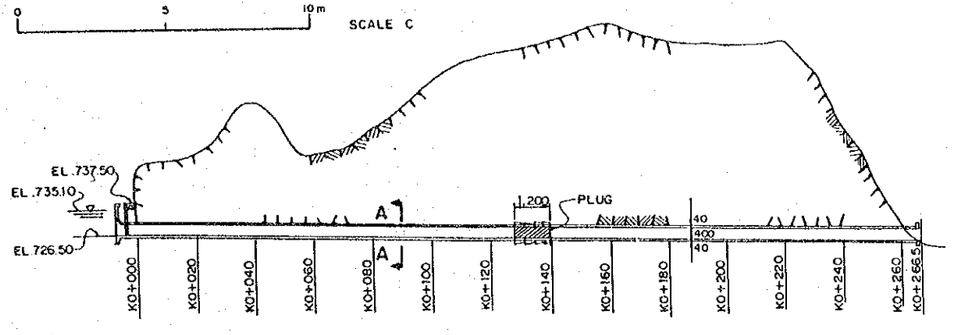
SECTION OF GRAVITY WING WALL



DAM CREST DEATAIL SCALE B



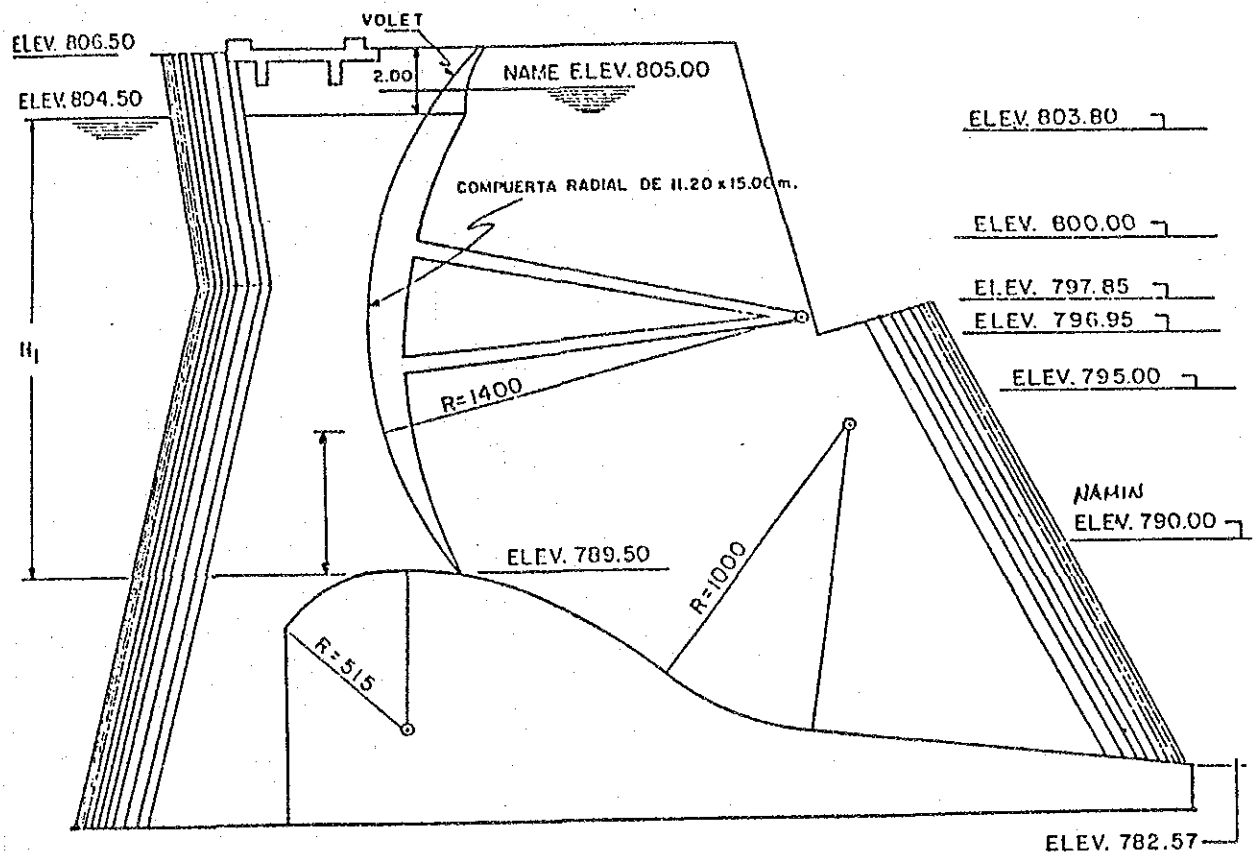
SECTION A-A SCALE C



PROFILE OF DIVERSION TUNNEL SCALE A

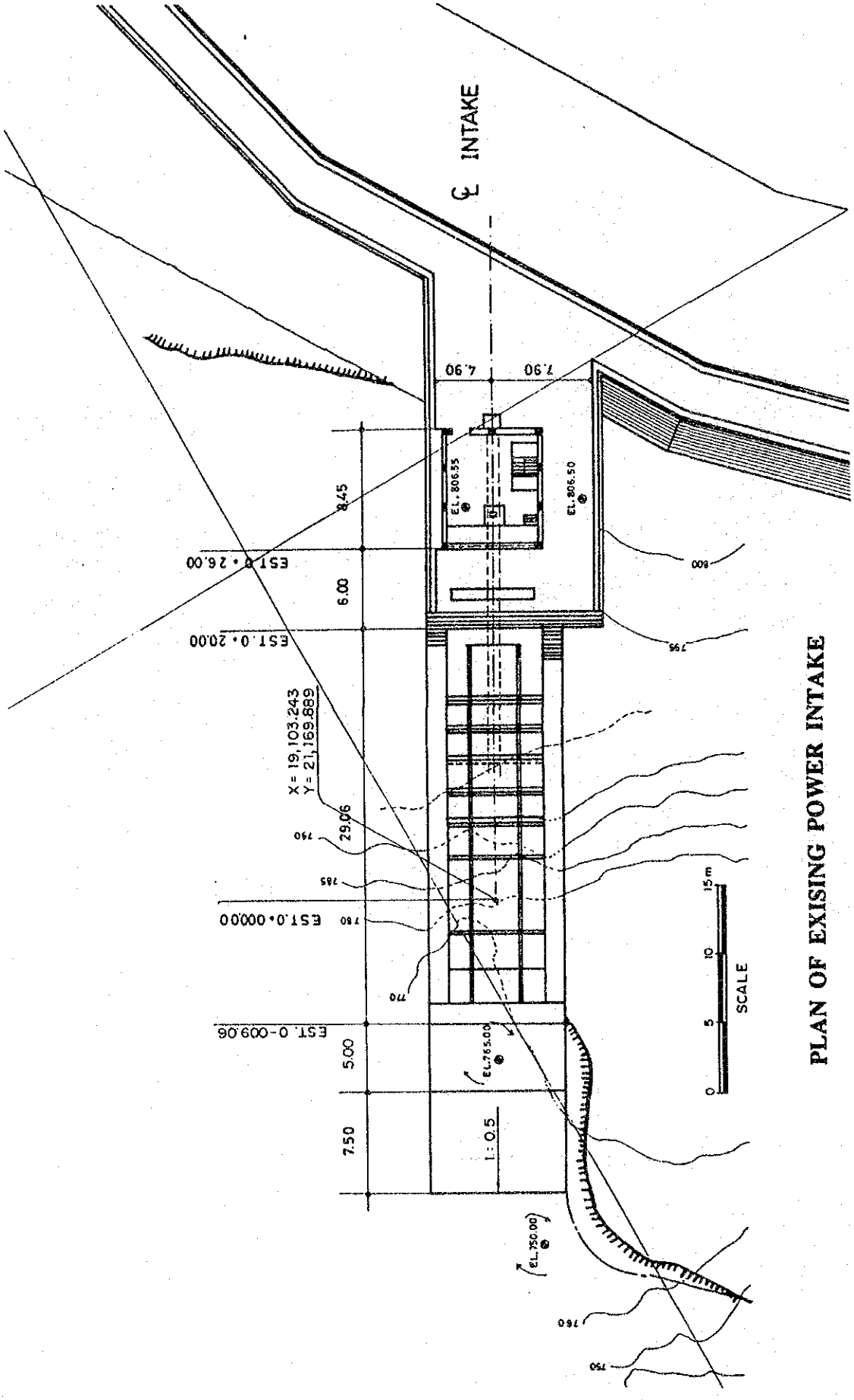
GENERAL LAYOUT OF DAM, SPILLWAY AND INTAKE

FIGURE 3.4



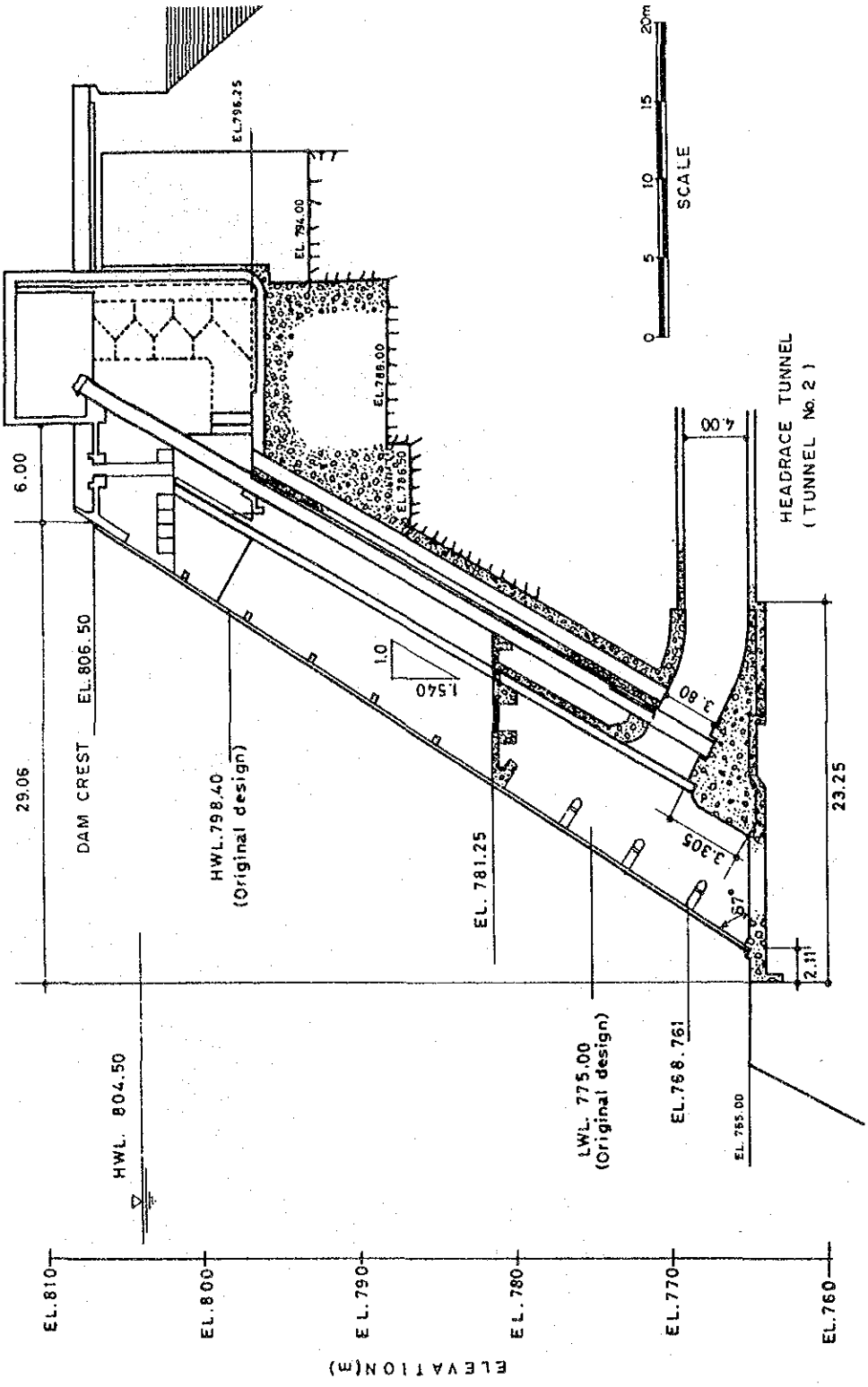
SECTION OF SPILLWAY GATE

FIGURE 3.5



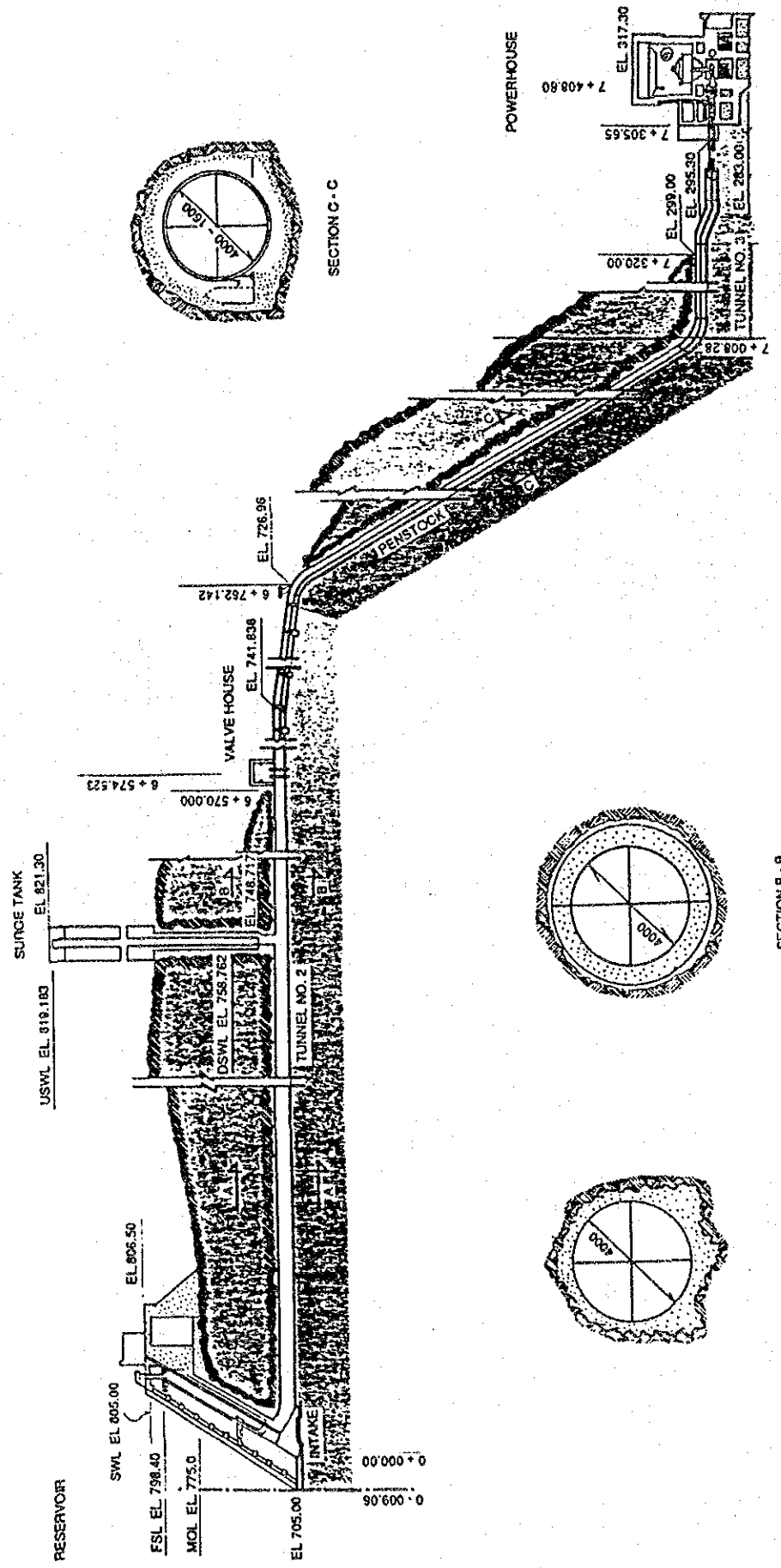
PLAN OF EXISING POWER INTAKE

FIGURE 3.6



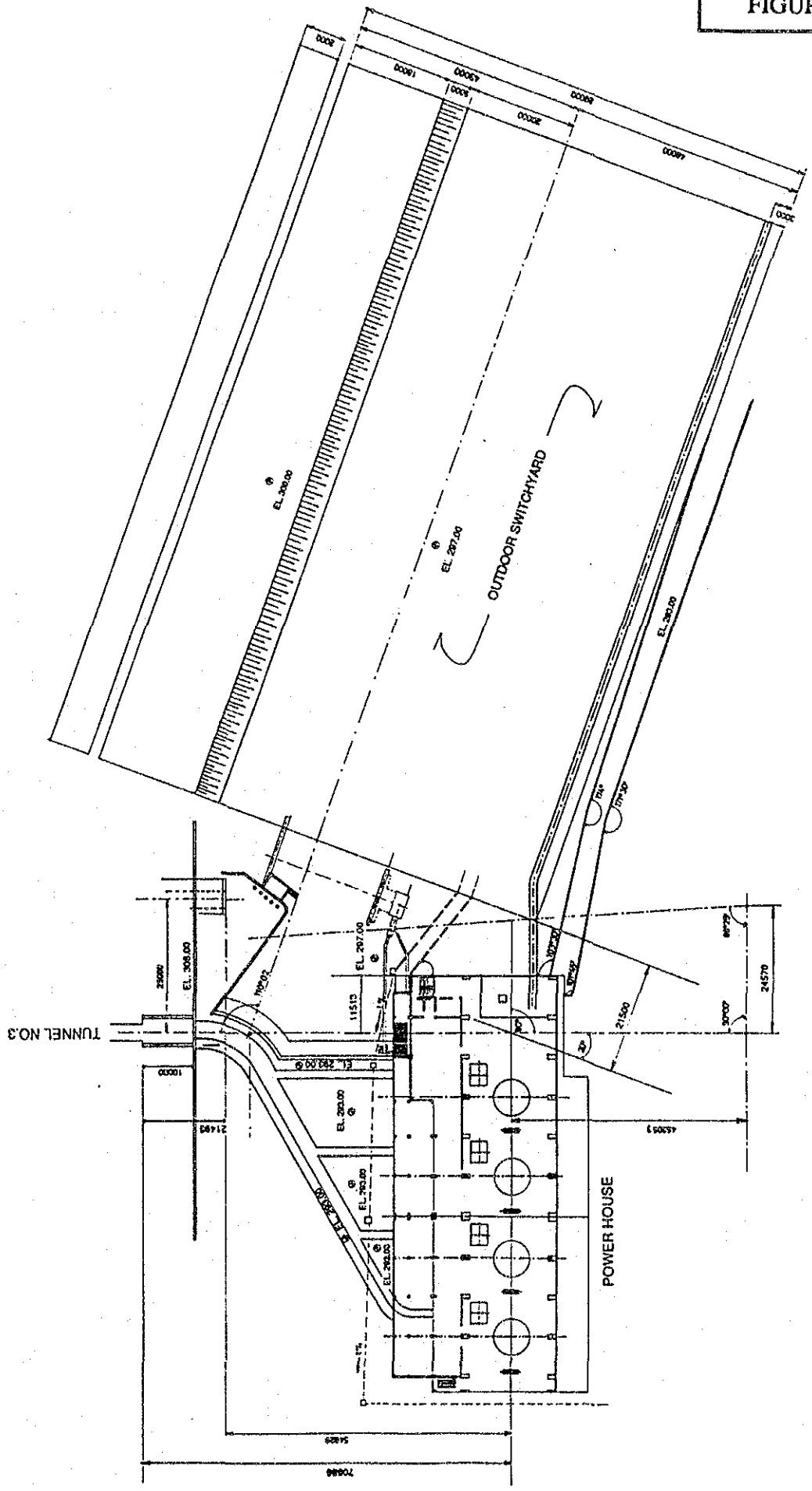
PROFILE OF EXISING POWER INTAKE

FIGURE 3.7



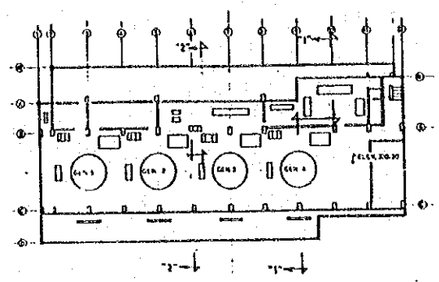
PROFILE OF WATERWAY

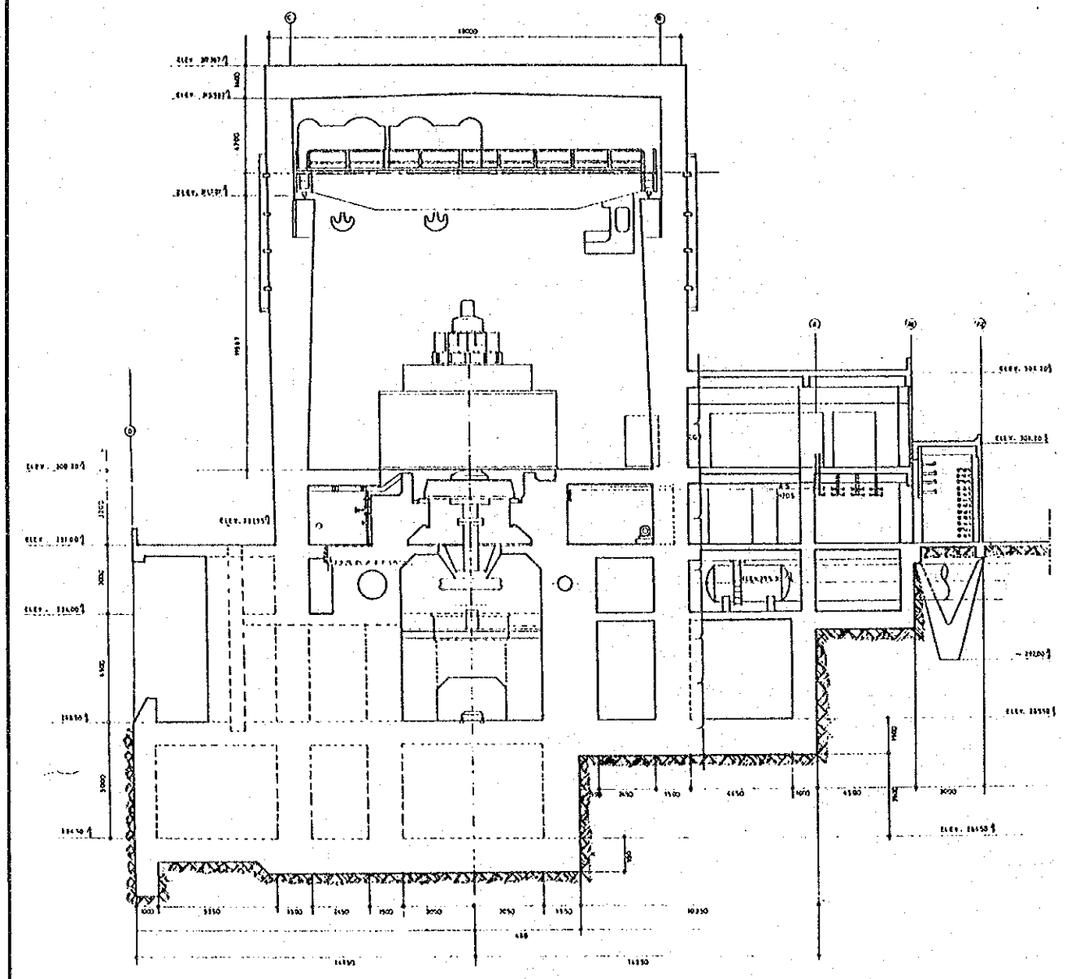
FIGURE 3.8



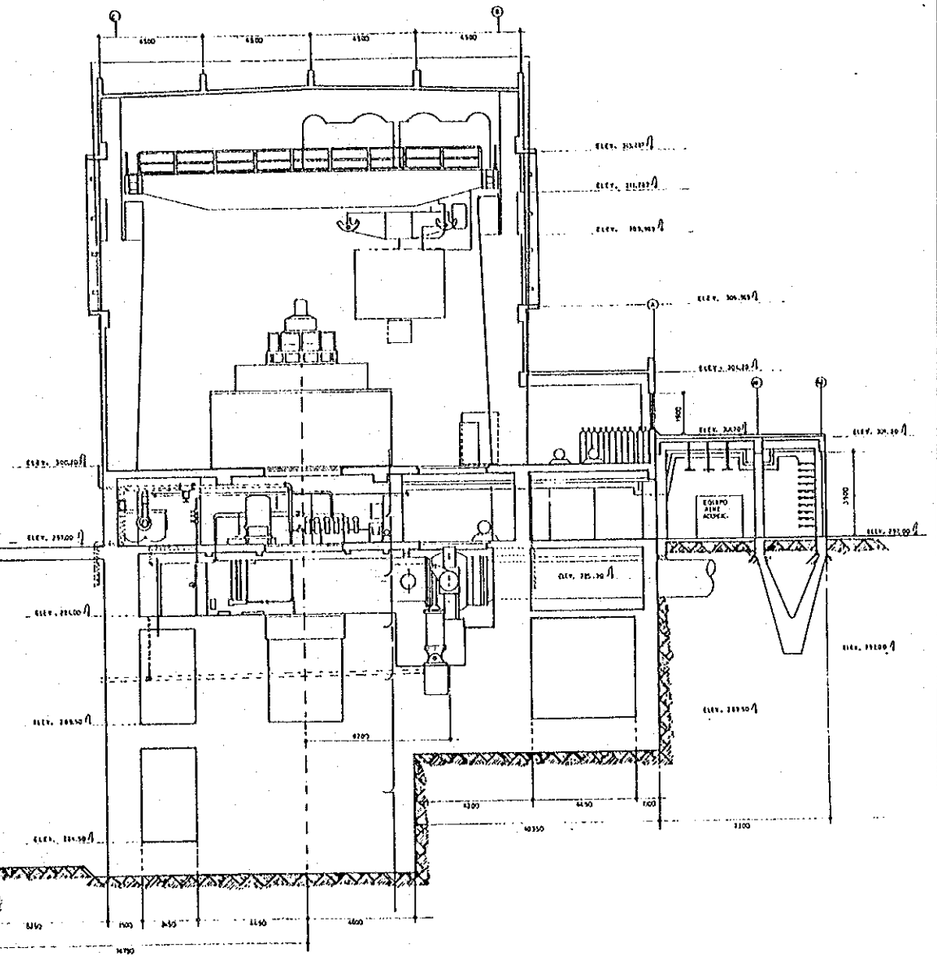
GENERAL LAYOUT OF POWERHOUSE AND OUTDOOR SWITCHYARD

FIGURE 3.9(1/2)





Section 1 - 1

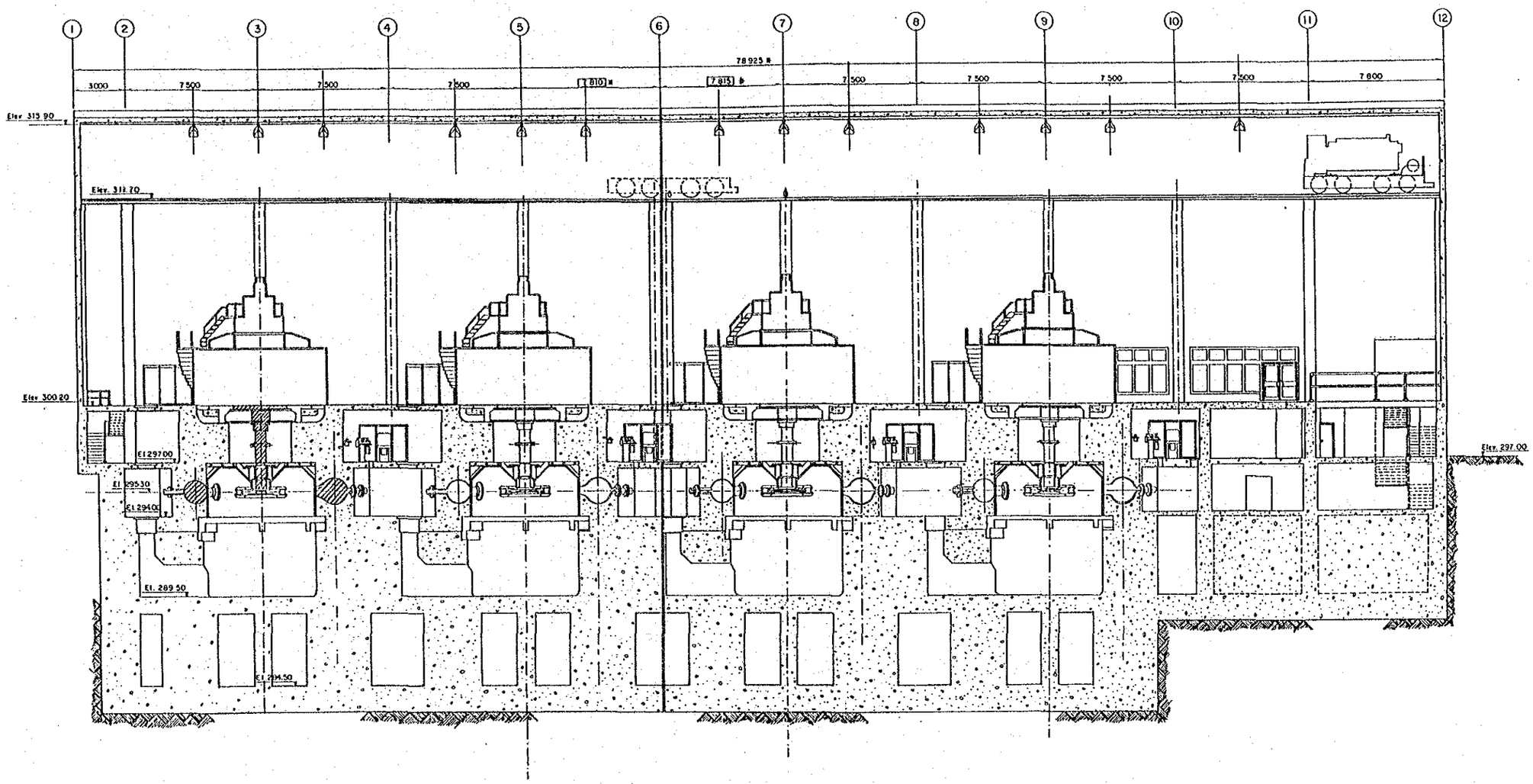


Section 2 - 2

Scale

0 10m

SECTION OF POWERHOUSE (1/2)



Scale

0 10m

SECTION OF POWERHOUSE (2/2)

FIGURE 3.10

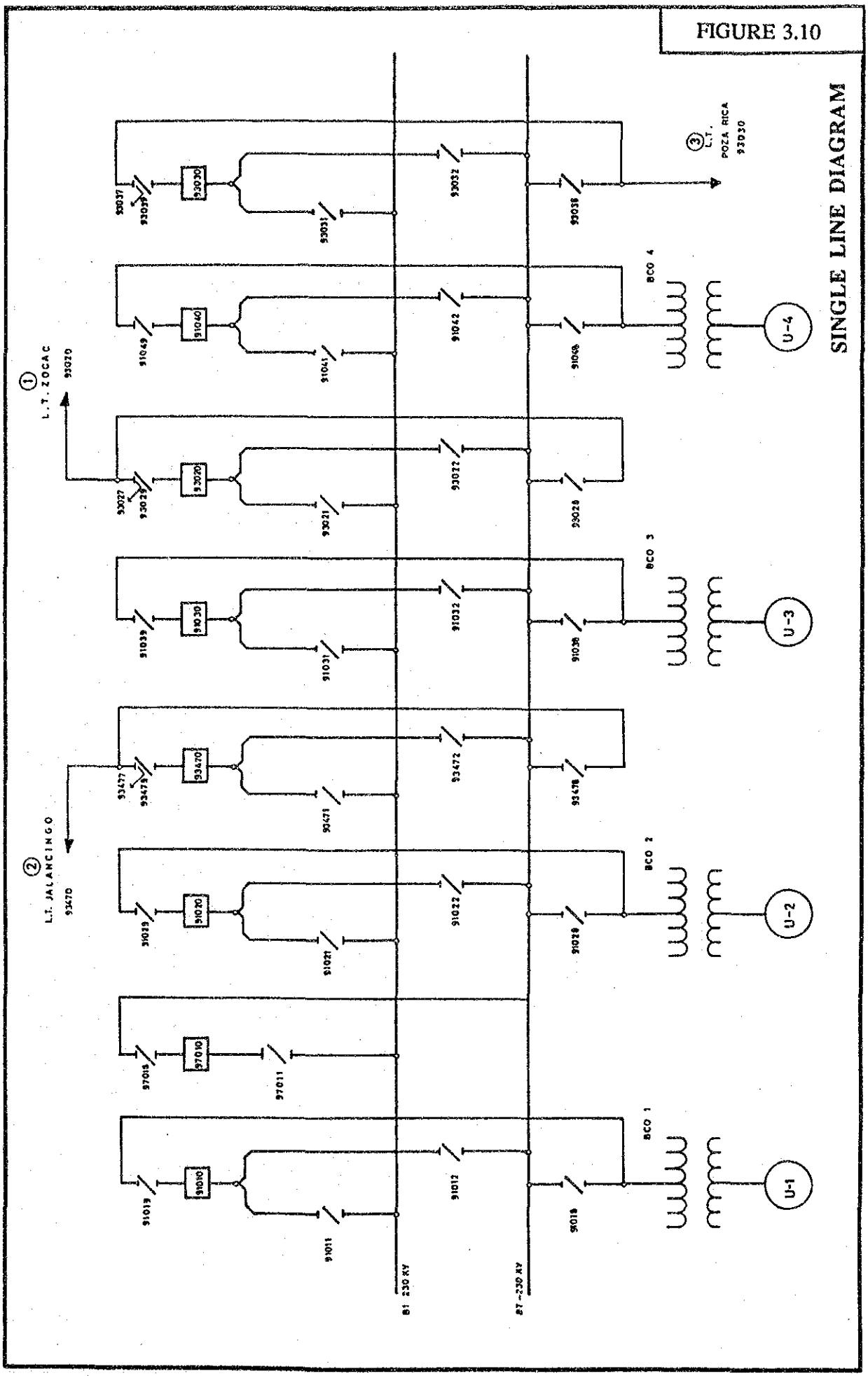
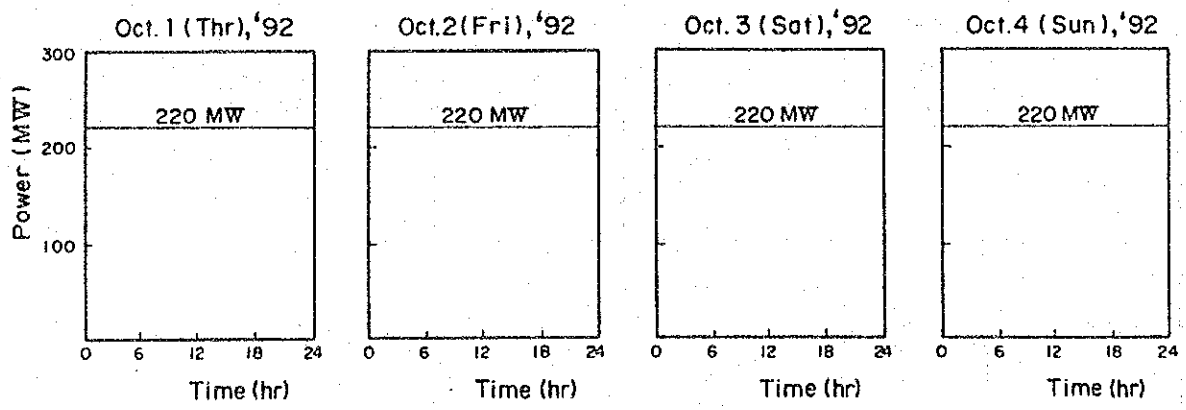
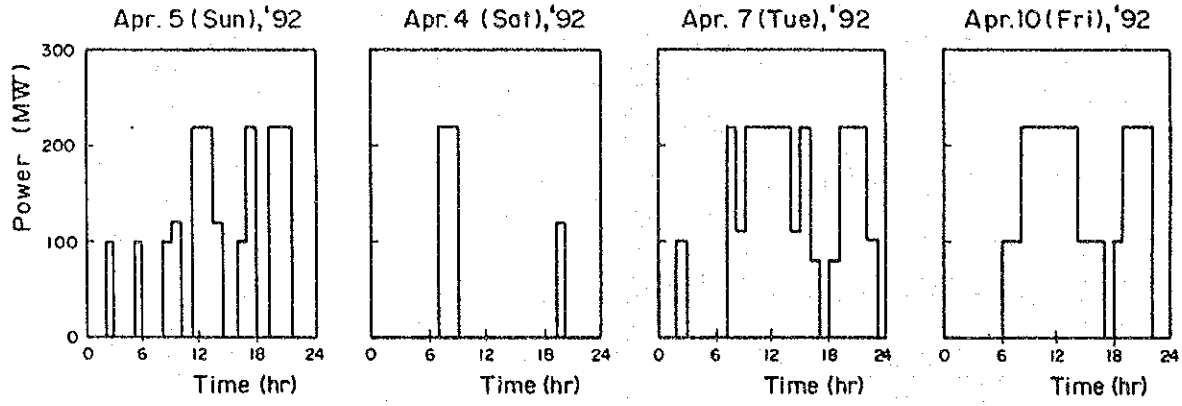

SINGLE LINE DIAGRAM
L.T. ZOCAC
L.T. JALANCINGO
L.T. POZA RICA
BCO 1
BCO 2
BCO 3
BCO 4
U-1
U-2
U-3
U-4
B1 230 KV
B7 230 KV

FIGURE 3.11



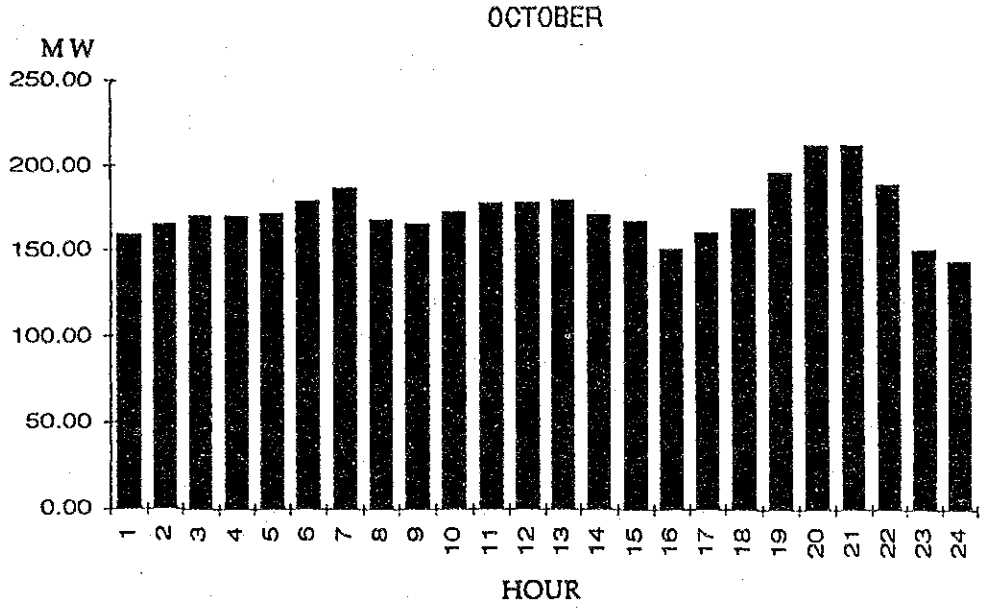
WET SEASON

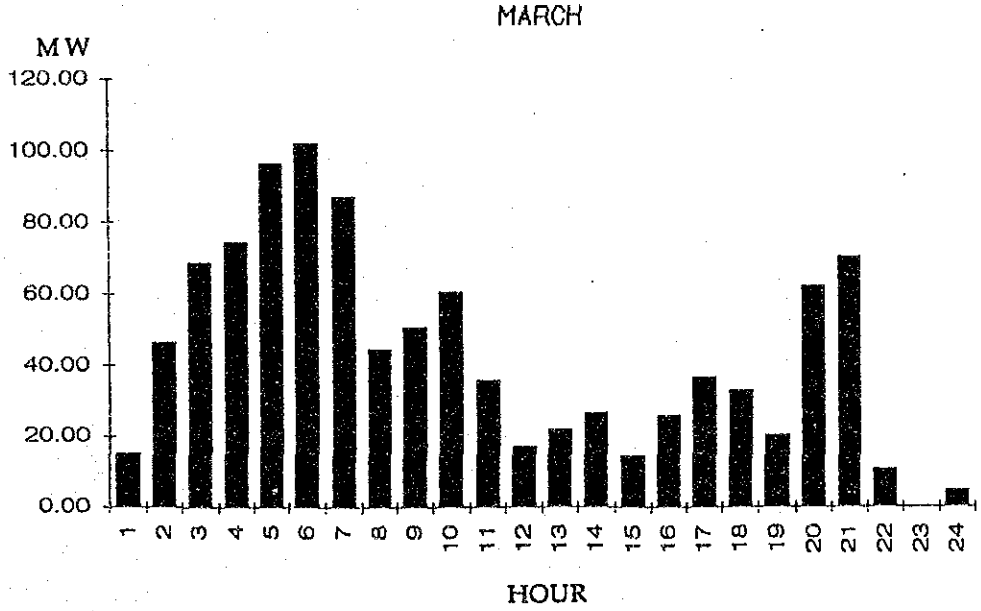


DRY SEASON

POWER GENERATION OF MAZATEPEC POWER STATION

FIGURE 3.12

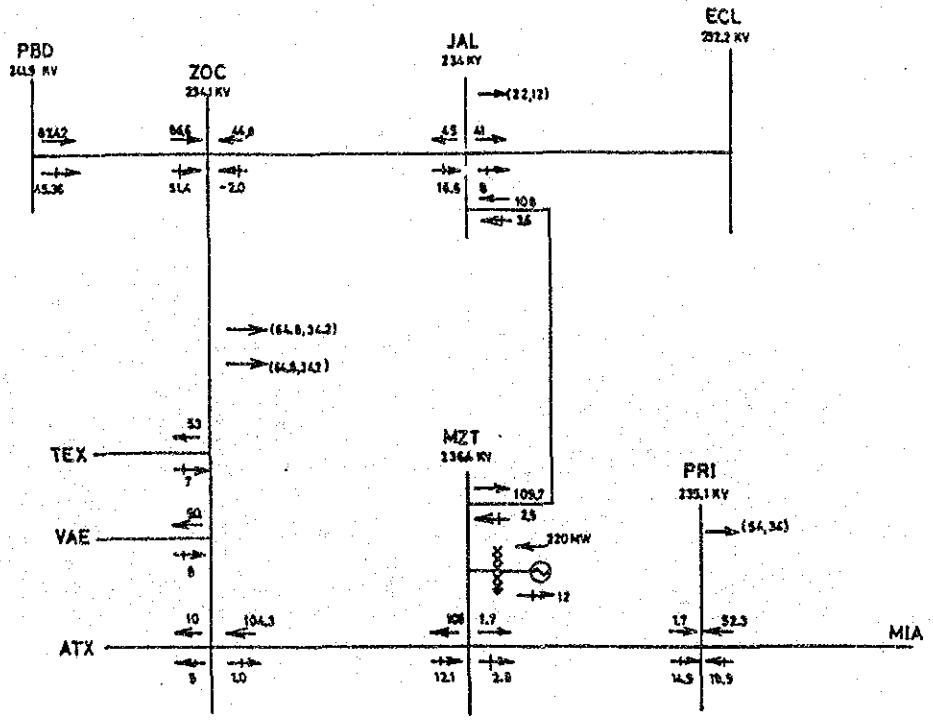




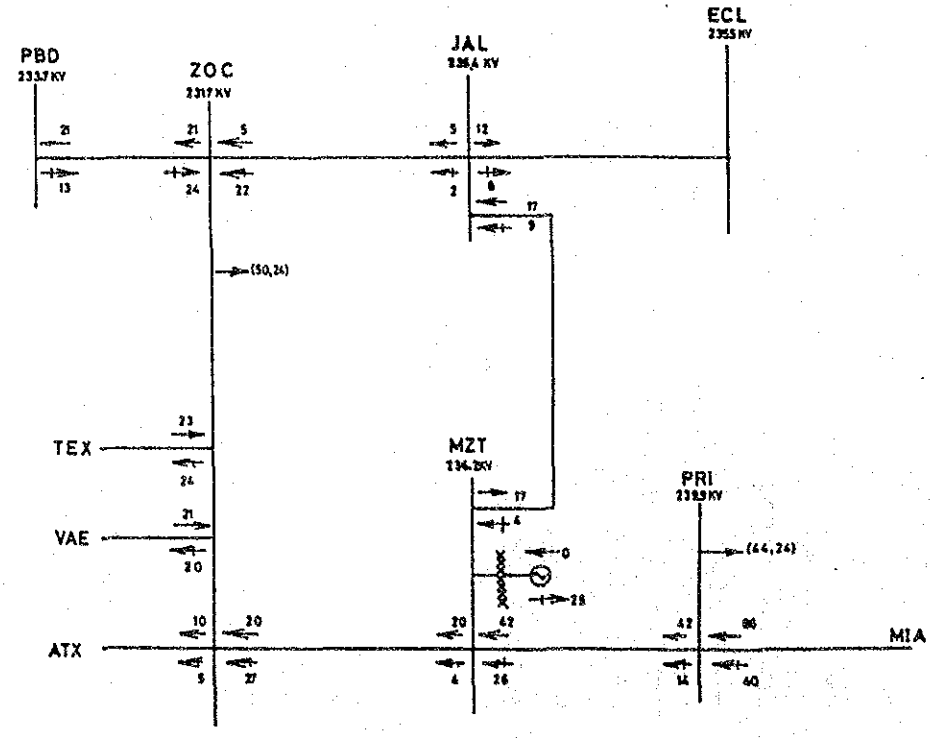
MONTHLY MEAN OUTPUTS OF HOURLY OPERATION

FIGURE 3.13

MAXIMUM DEMAND

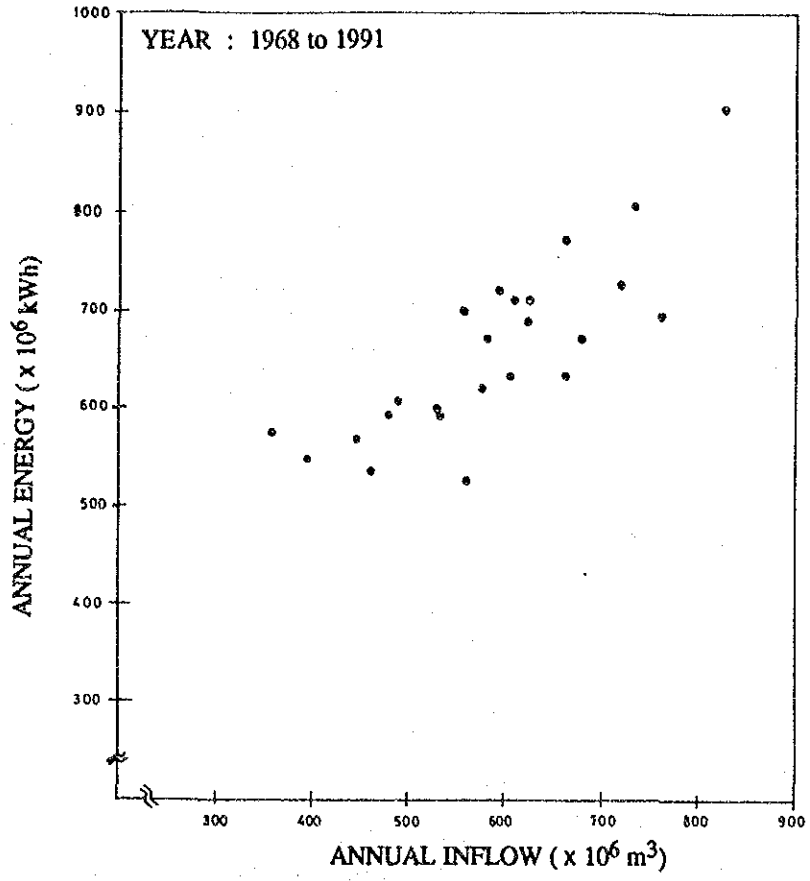


MINIMUM DEMAND



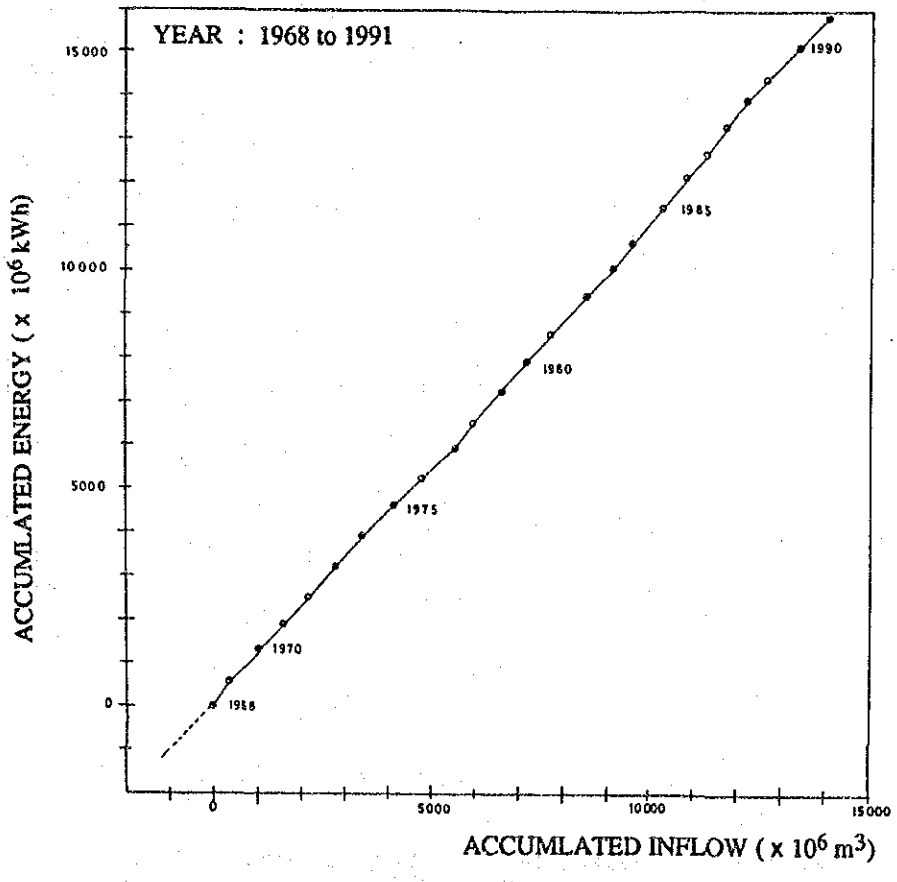
TYPICAL FLOW PATTERN OF 230 KV SYSTEM CONNECTING MAZATEPEC POWER STATION

FIGURE 3.14



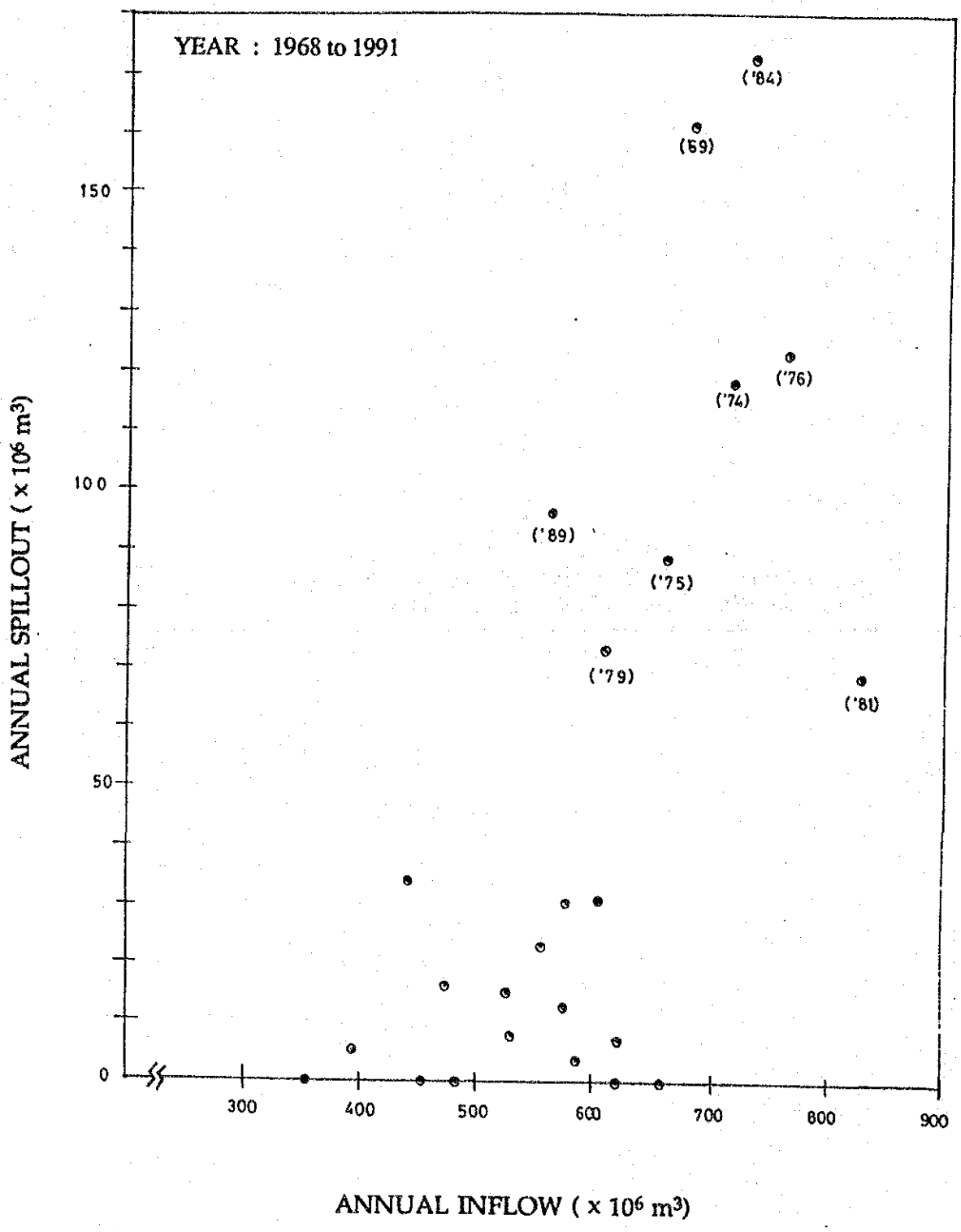
RELATIONSHIP BETWEEN ANNUAL ENERGY PRODUCTION AND ANNUAL INFLOW

FIGURE 3.15



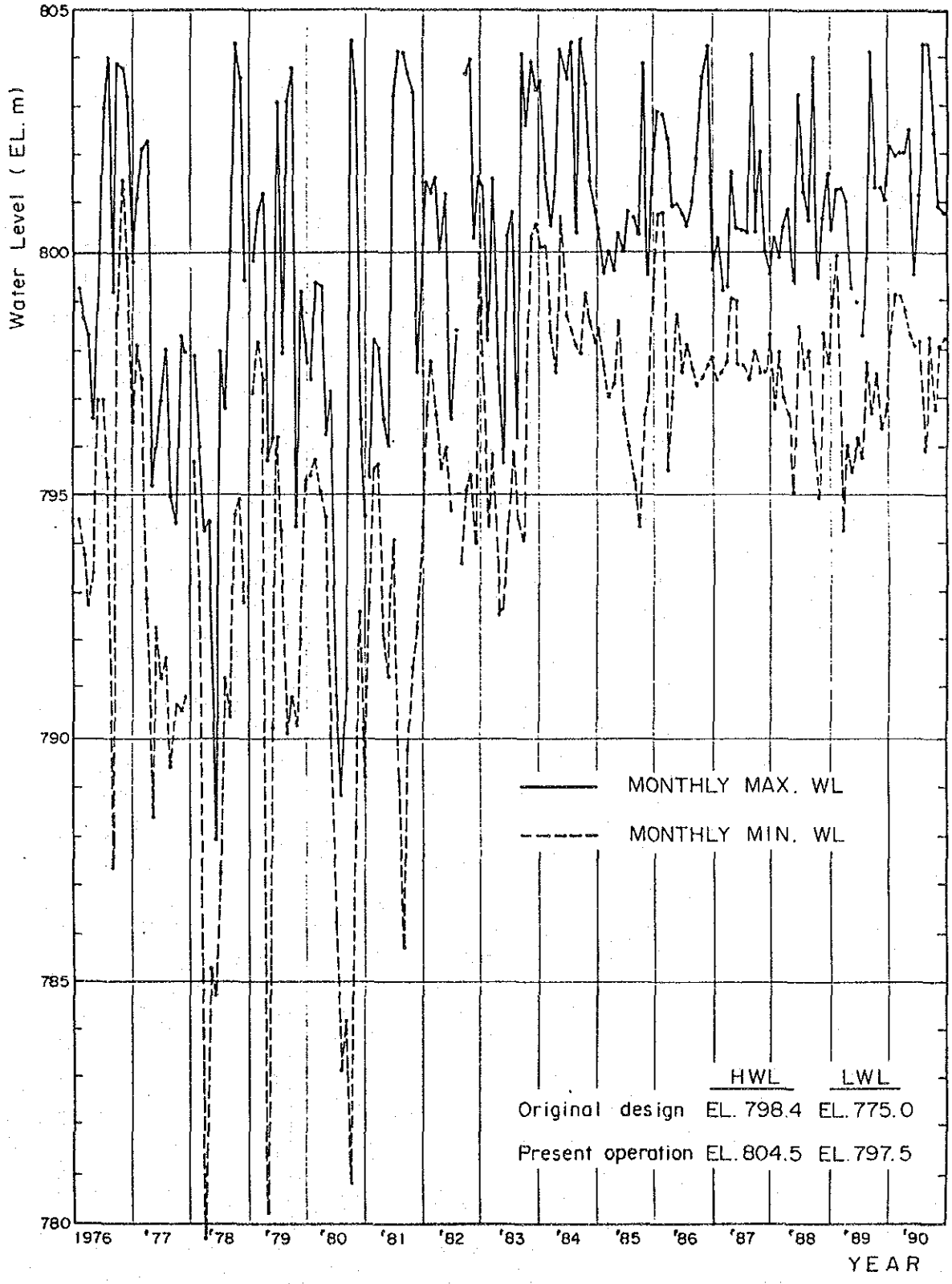
DOUBLE MASS CURVE BETWEEN ANNUAL ENERGY AND ANNUAL INFLOW

FIGURE 3.16

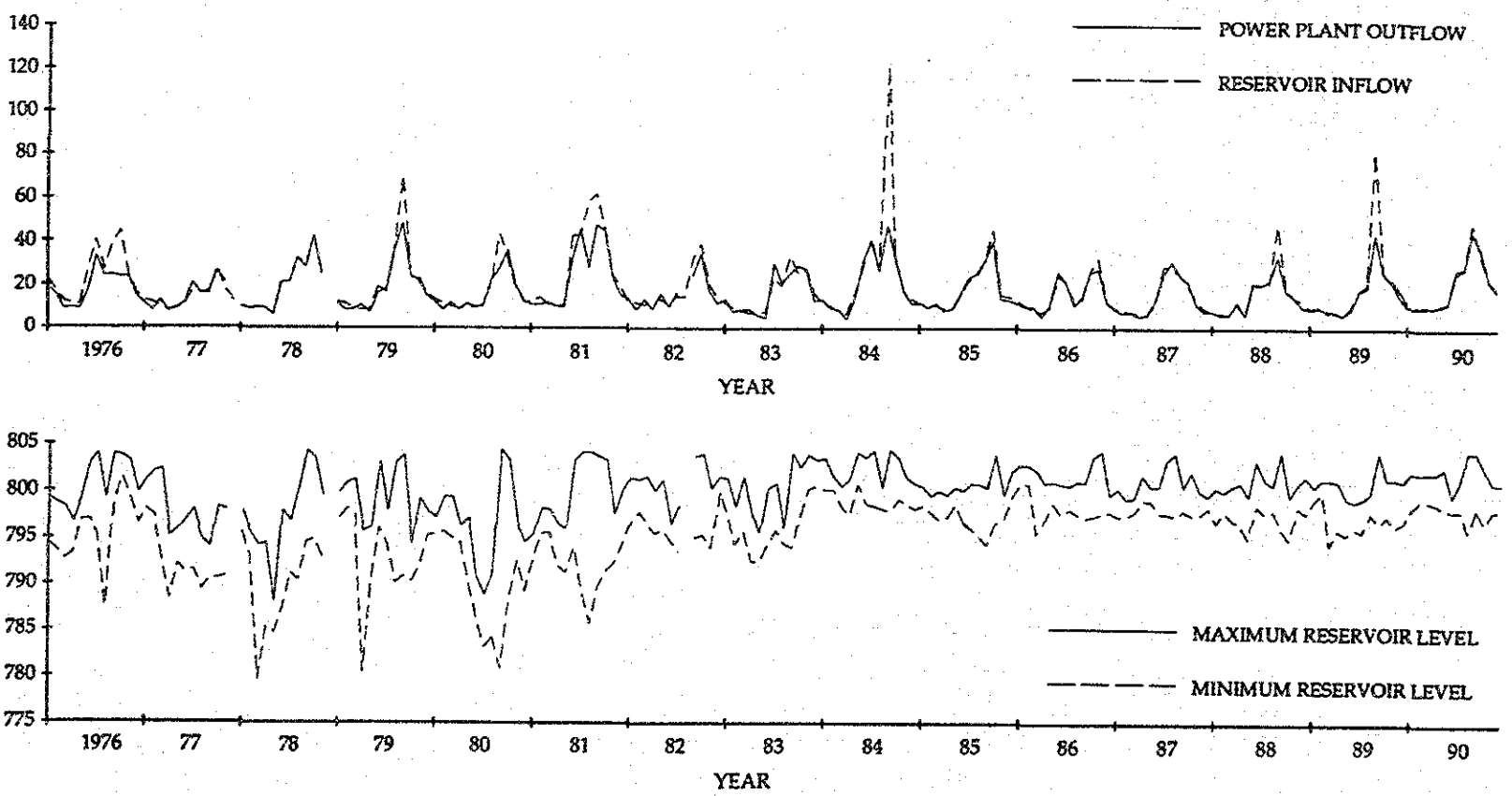


RELATIONSHIP BETWEEN INFLOW AND SPILLOUT

FIGURE 3.17



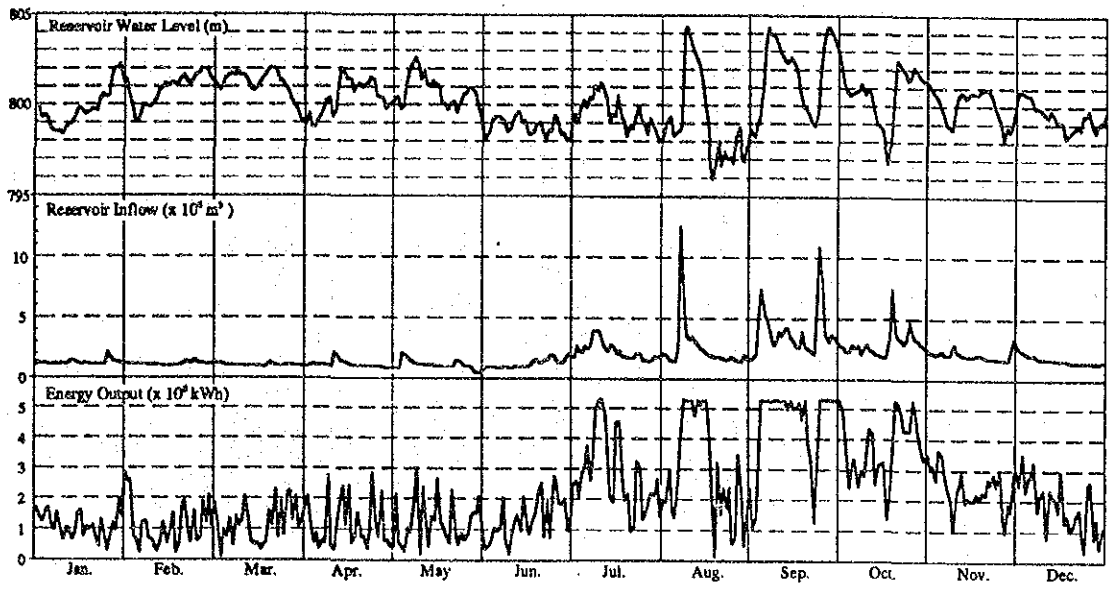
RECORDS OF MAX. AND MIN. WATER LEVEL OF SOLEDAD RESERVOIR



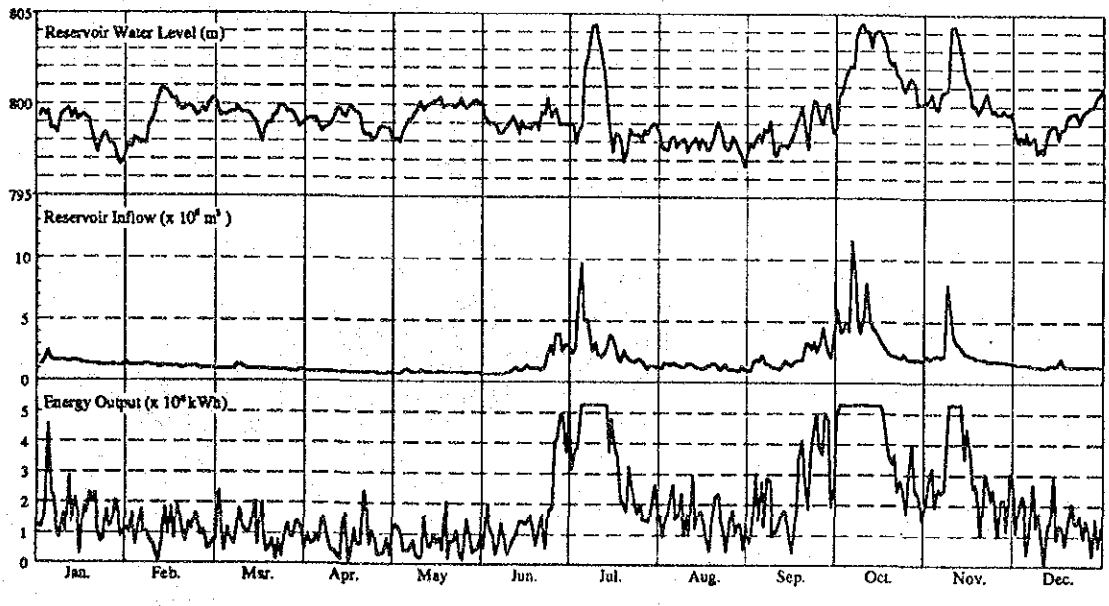
RESERVOIR INFLOW, POWER PLANT OUTFLOW AND RESERVOIR LEVEL

FIGURE 3.18

1990

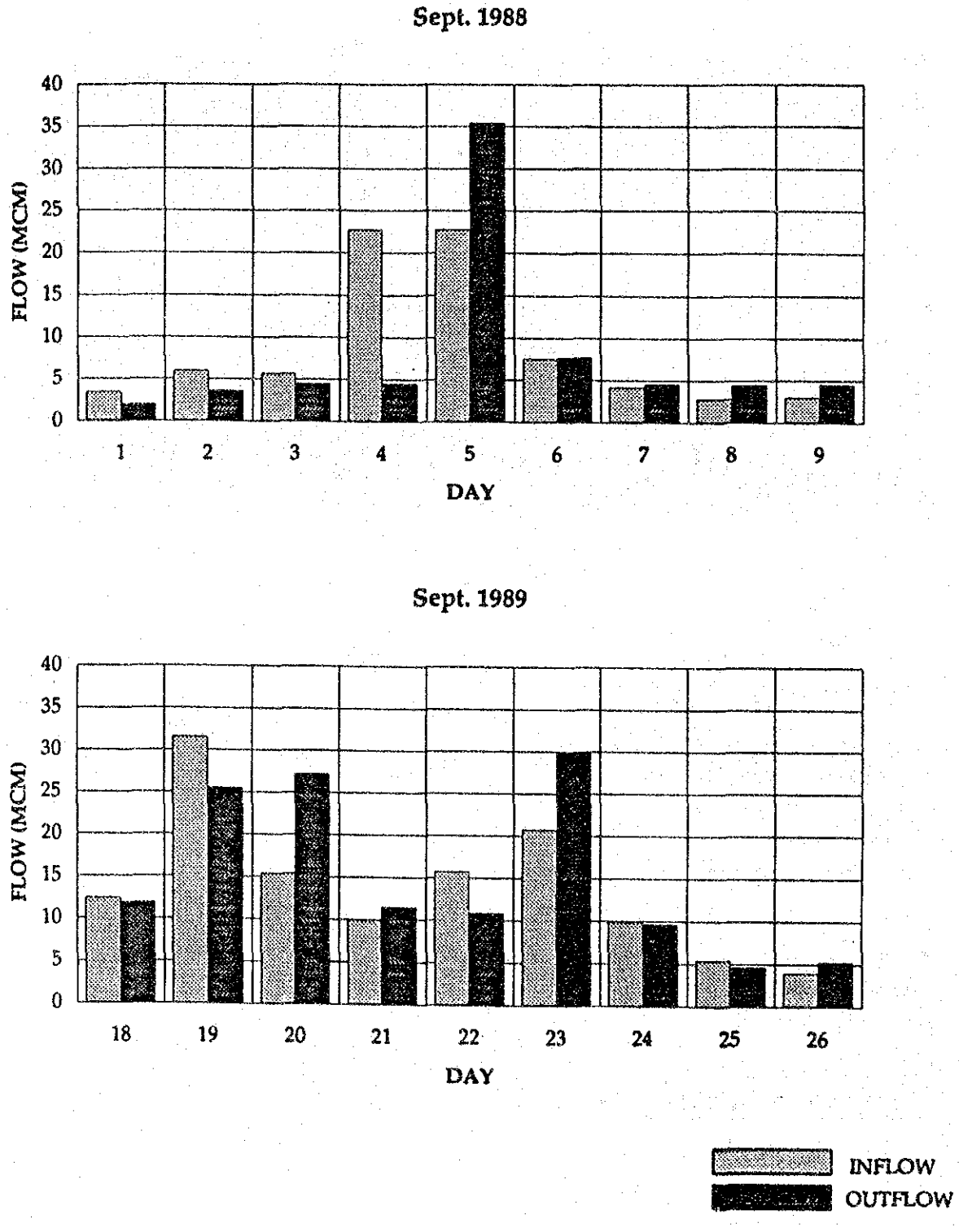


1991



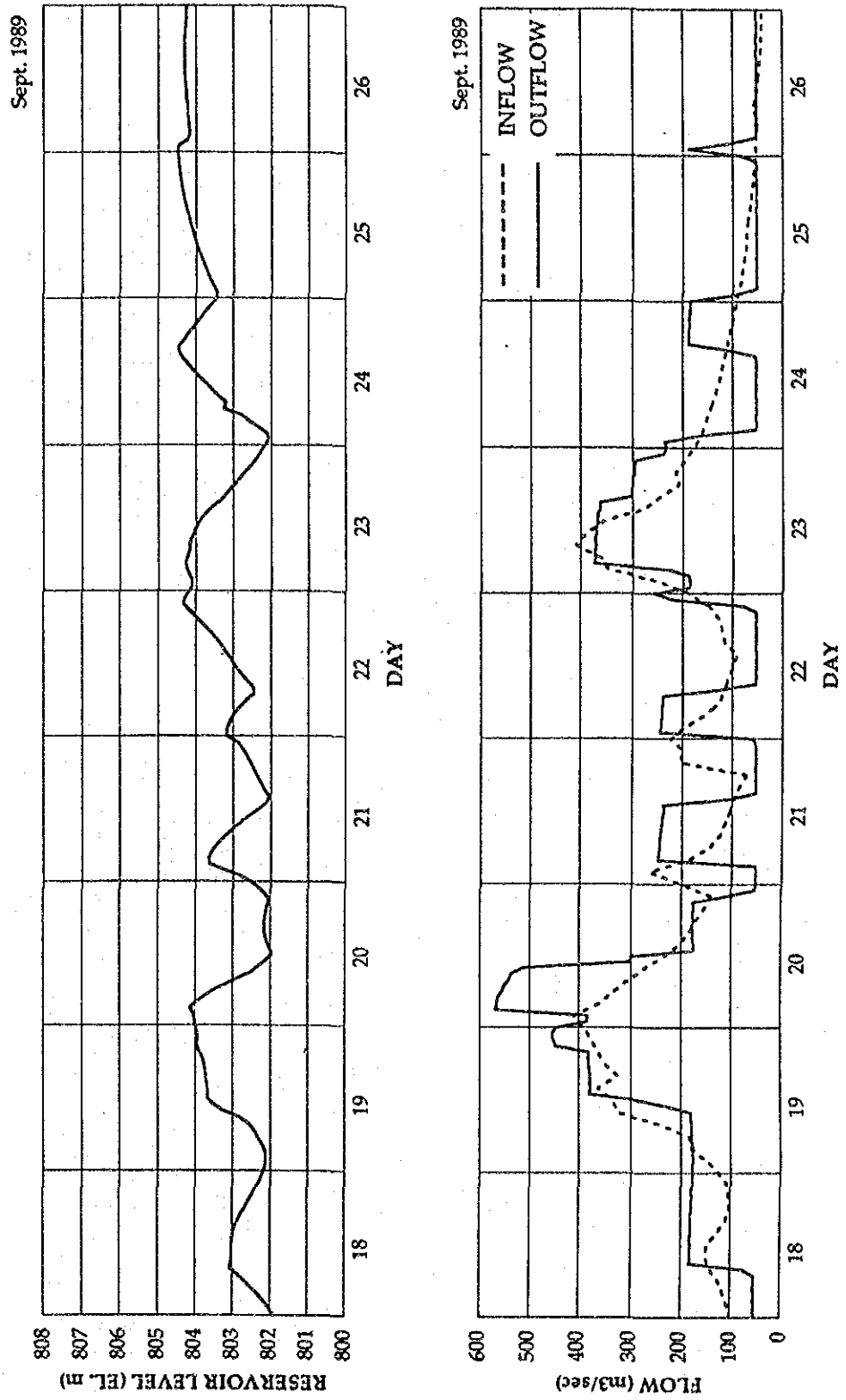
RESERVOIR WATER LEVEL, RESERVOIR INFLOW AND ENERGY OUTPUT IN 1990 AND 1991

FIGURE 3.20

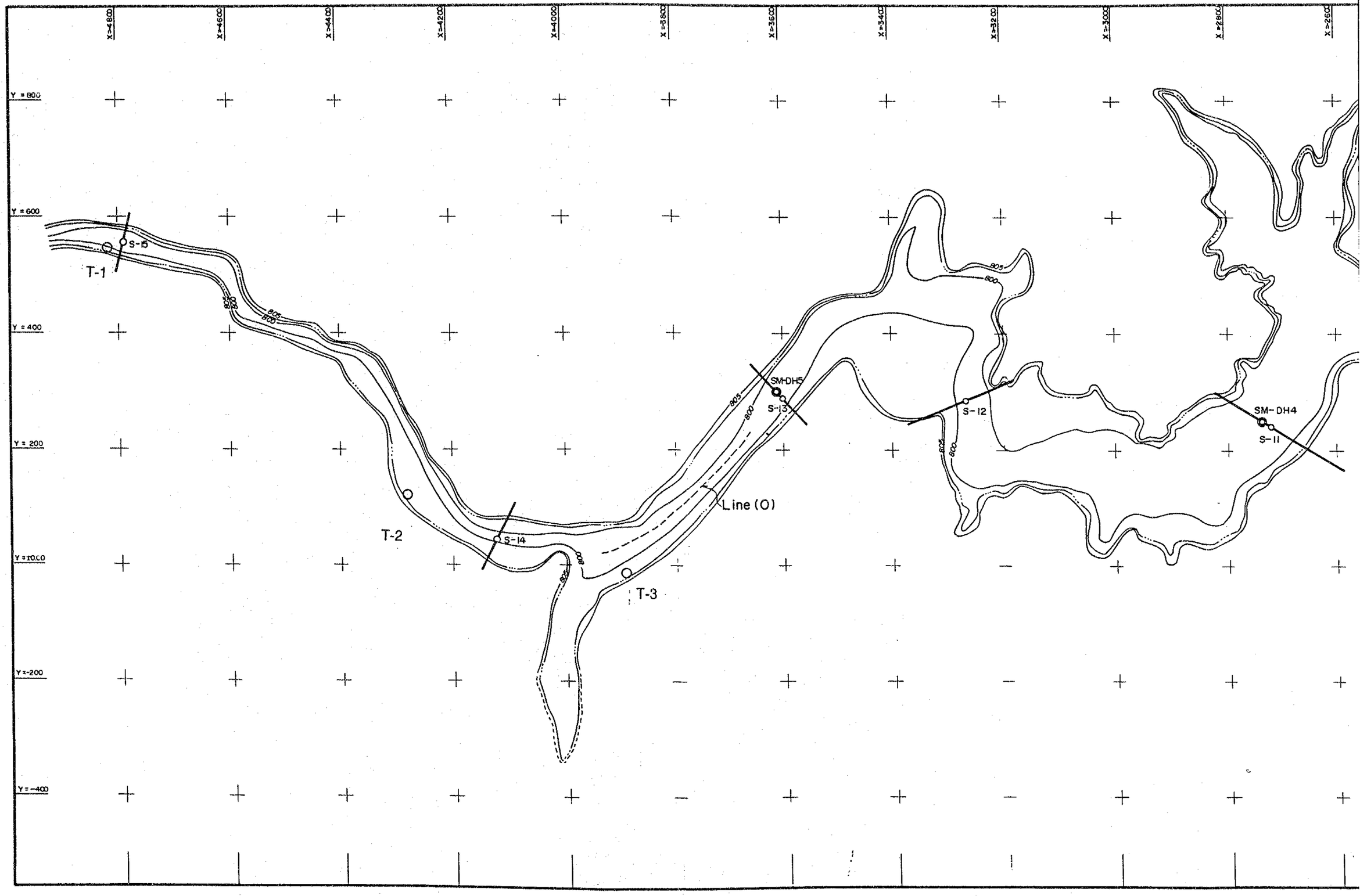


RESERVOIR INFLOW AND OUTFLOW VOLUMES DURING FLOOD TIME

FIGURE 3.21



RESERVOIR LEVEL AND INFLOW AND OUTFLOW DISCHARGES DURING FLOOD TIME IN 1989


X=4800
X=4600
X=4400
X=4200
X=4000
X=3800
X=3600
X=3400
X=3200
X=3000
X=2800
X=2600
Y = 800
Y = 600
Y = 400
Y = 200
Y = ±0.0
Y = -200
Y = -400
S-15
T-1
805
800
SM-DH5
S-13
S-12
SM- DH4
S-11
Line (O)
T-2
S-14
T-3

X=3600 X=3400 X=3200 X=3000 X=2800 X=2600 X=2400 X=2200 X=2000 X=1800 X=1600 X=1400 X=1200

Line (O)

SM-DH5 S-13 S-12 SM-DH4 S-11 S-10 SM-DH3 S-9 S-8

T-4 T-5

805 800 795 790

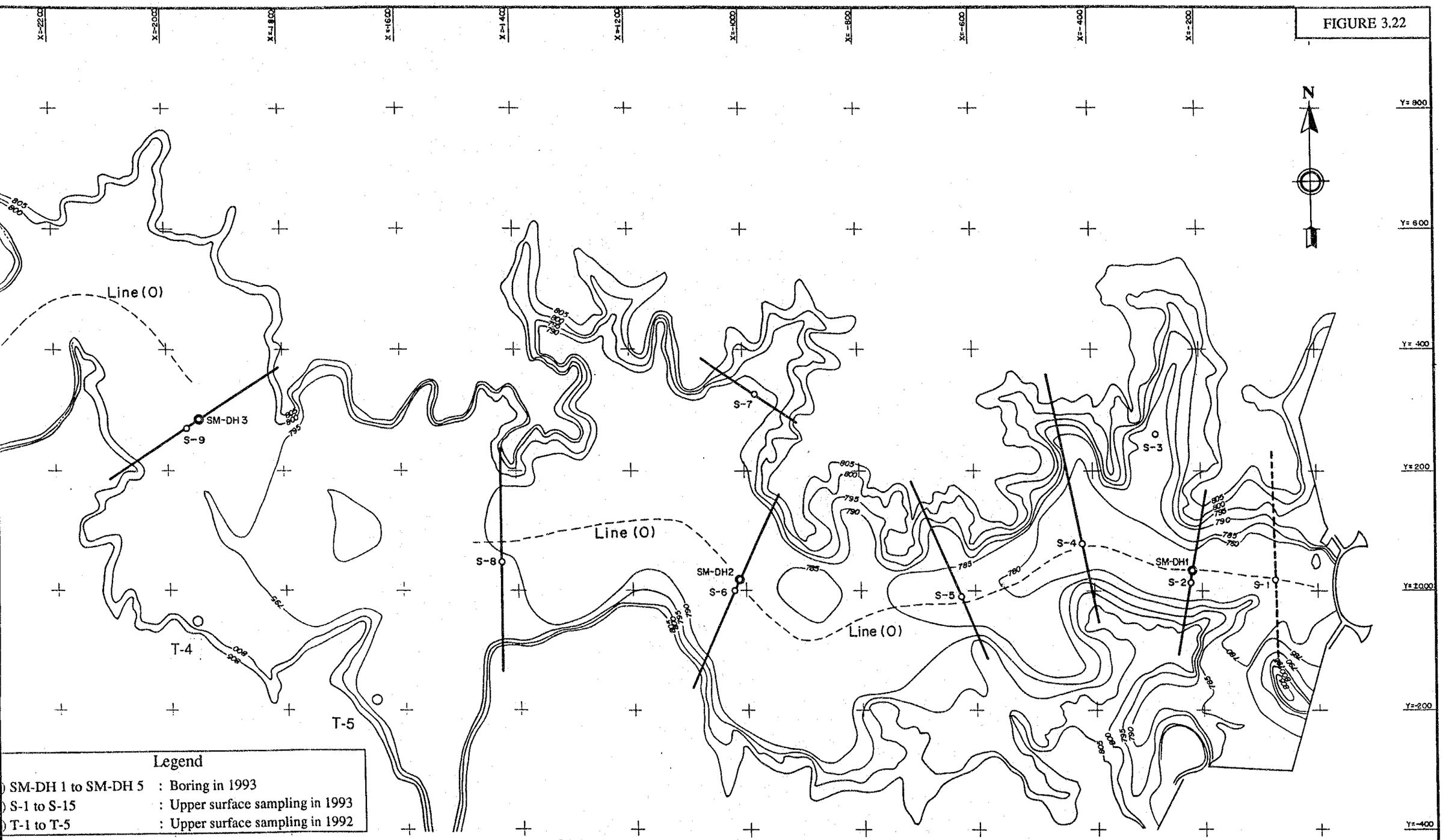
Legend

(1) SM-DH 1 to SM-DH 5	: Boring in 1993
(2) S-1 to S-15	: Upper surface sampling in 1993
(3) T-1 to T-5	: Upper surface sampling in 1992

SCALE

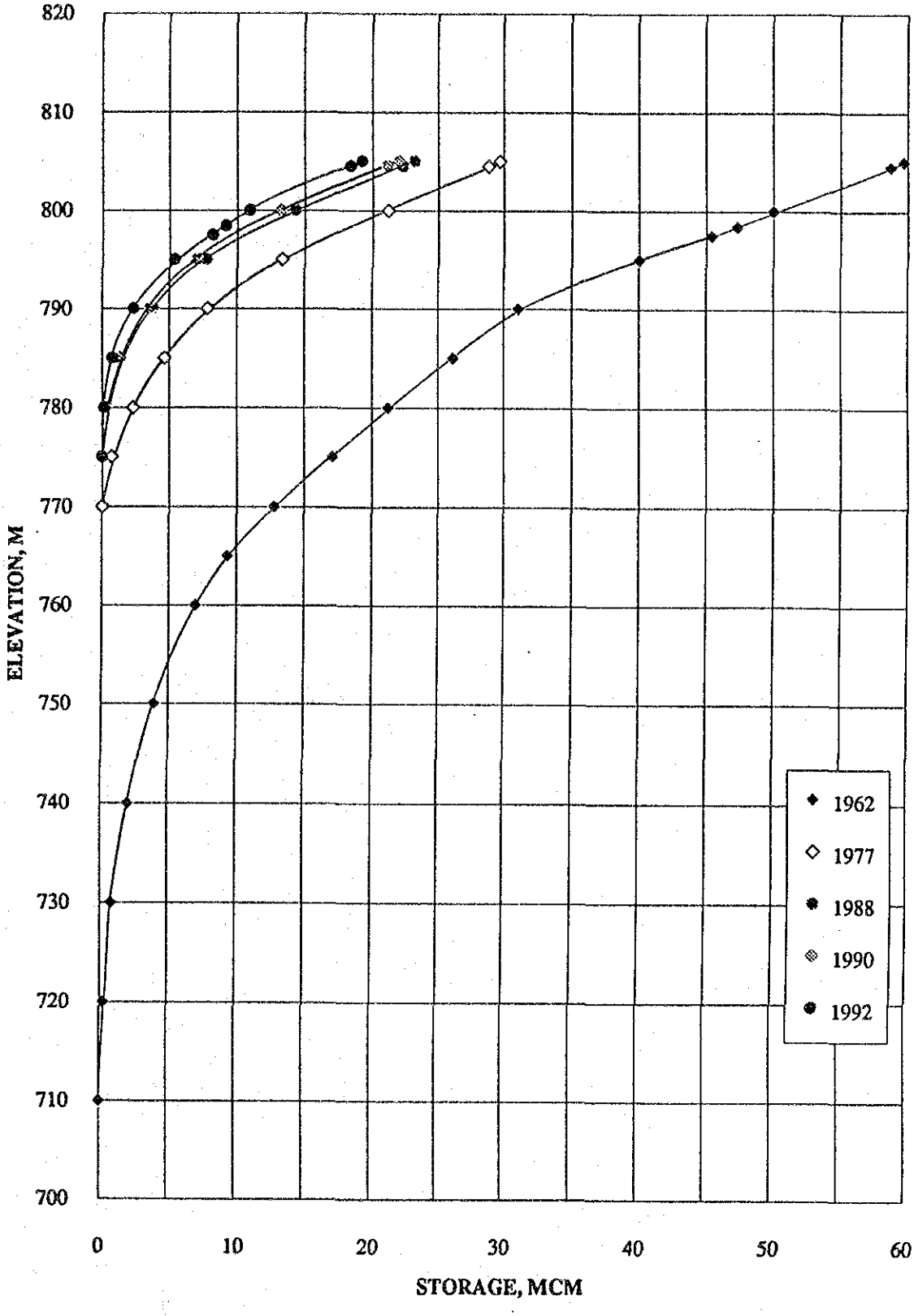
0 20 60 120 200m

FIGURE 3.22

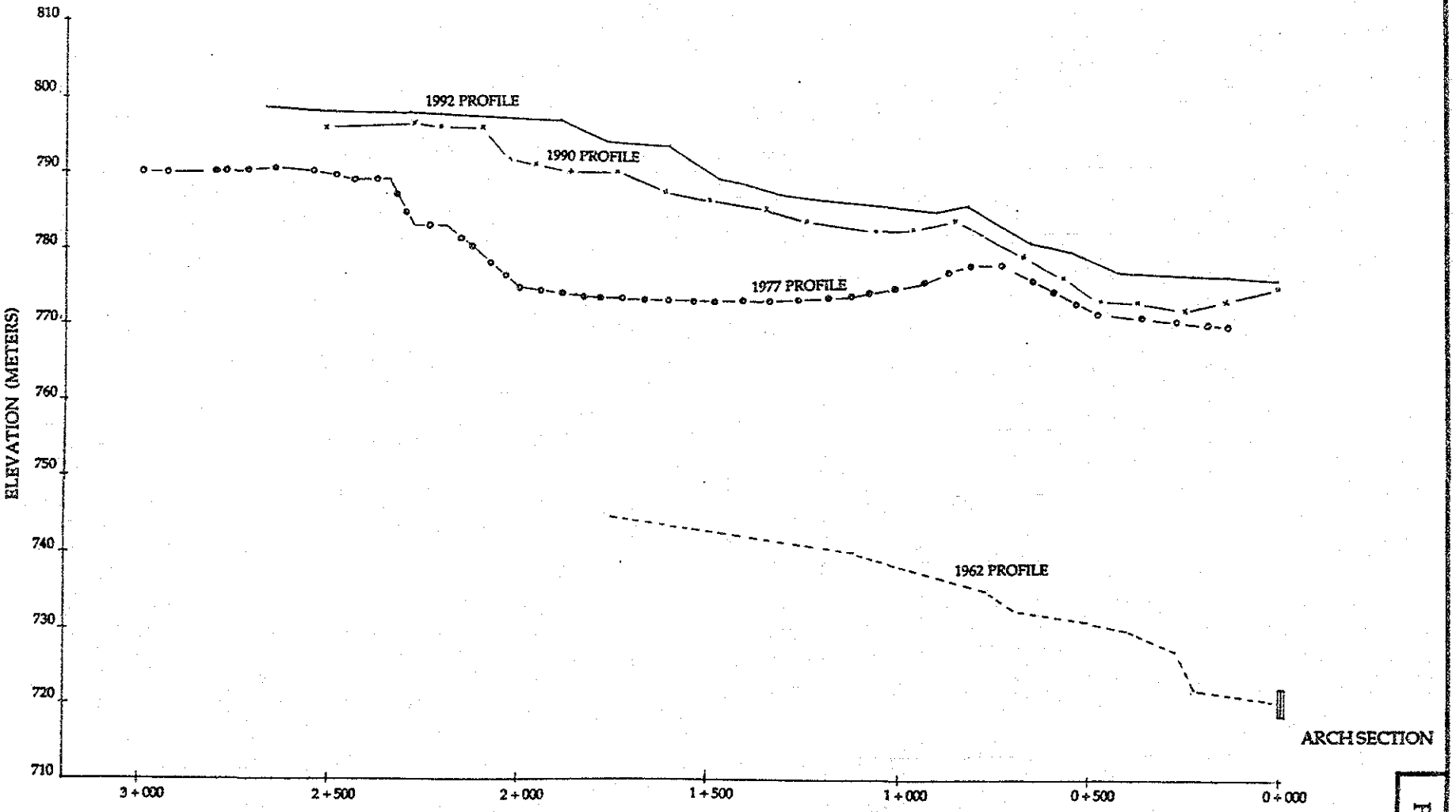


PLAN OF SOLEDAD RESERVOIR AND LOCATION OF SAMPLING AND DRILLING

FIGURE 3.23



CHANGE OF RESERVOIR STORAGE CURVES



RESERVOIR BED PROFILES

FIGURE 3.24

FIGURE 3.25

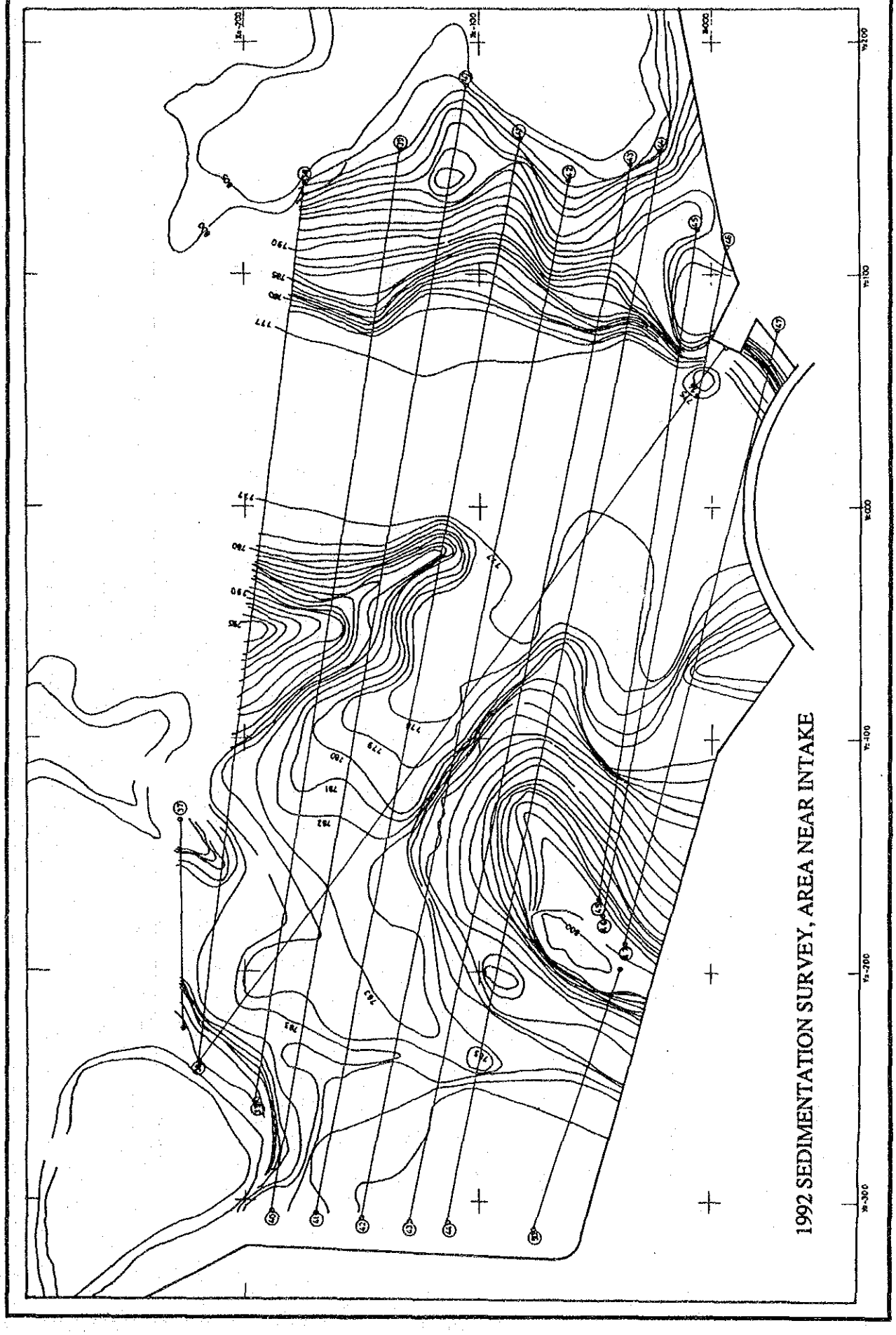
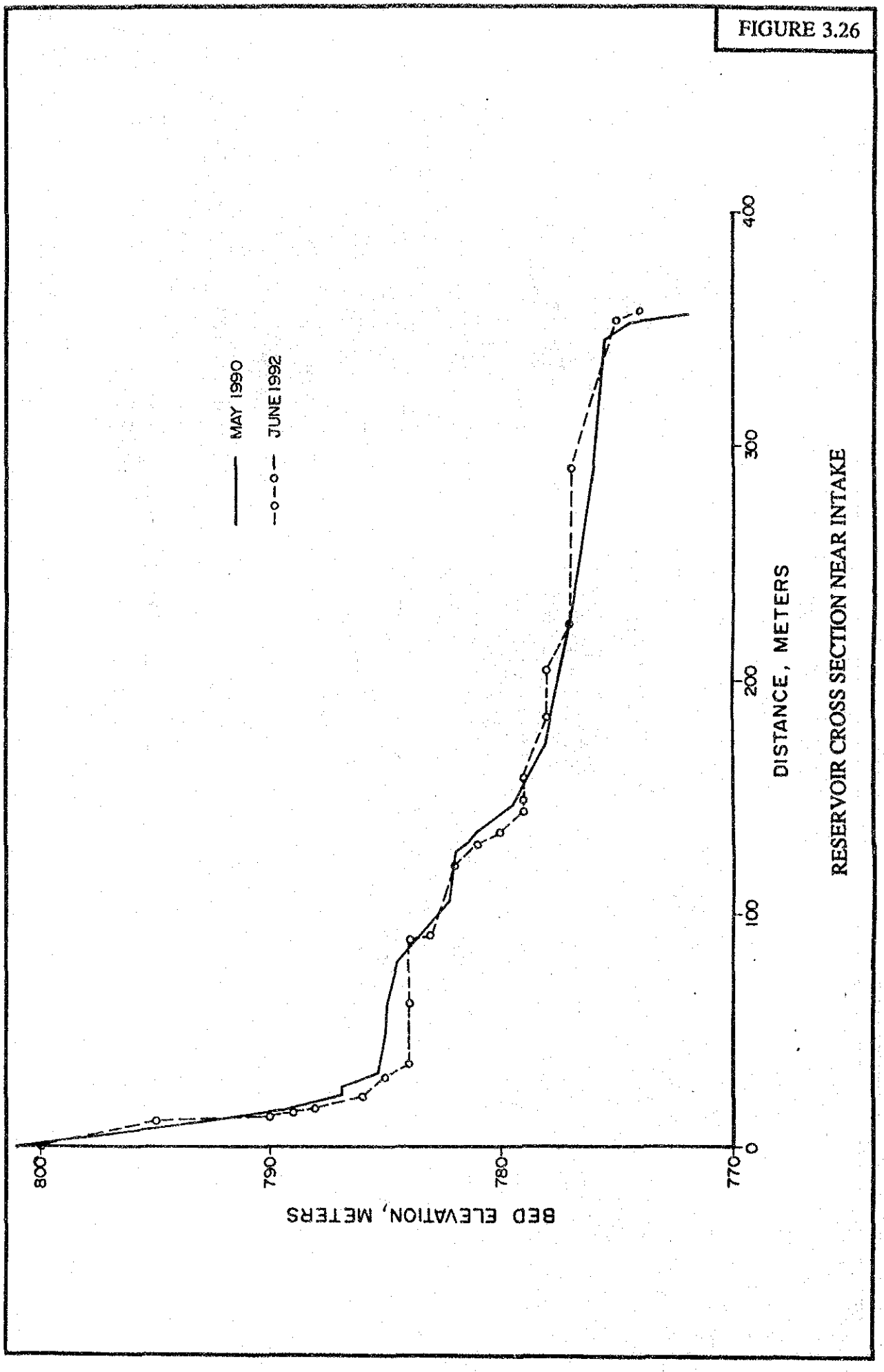
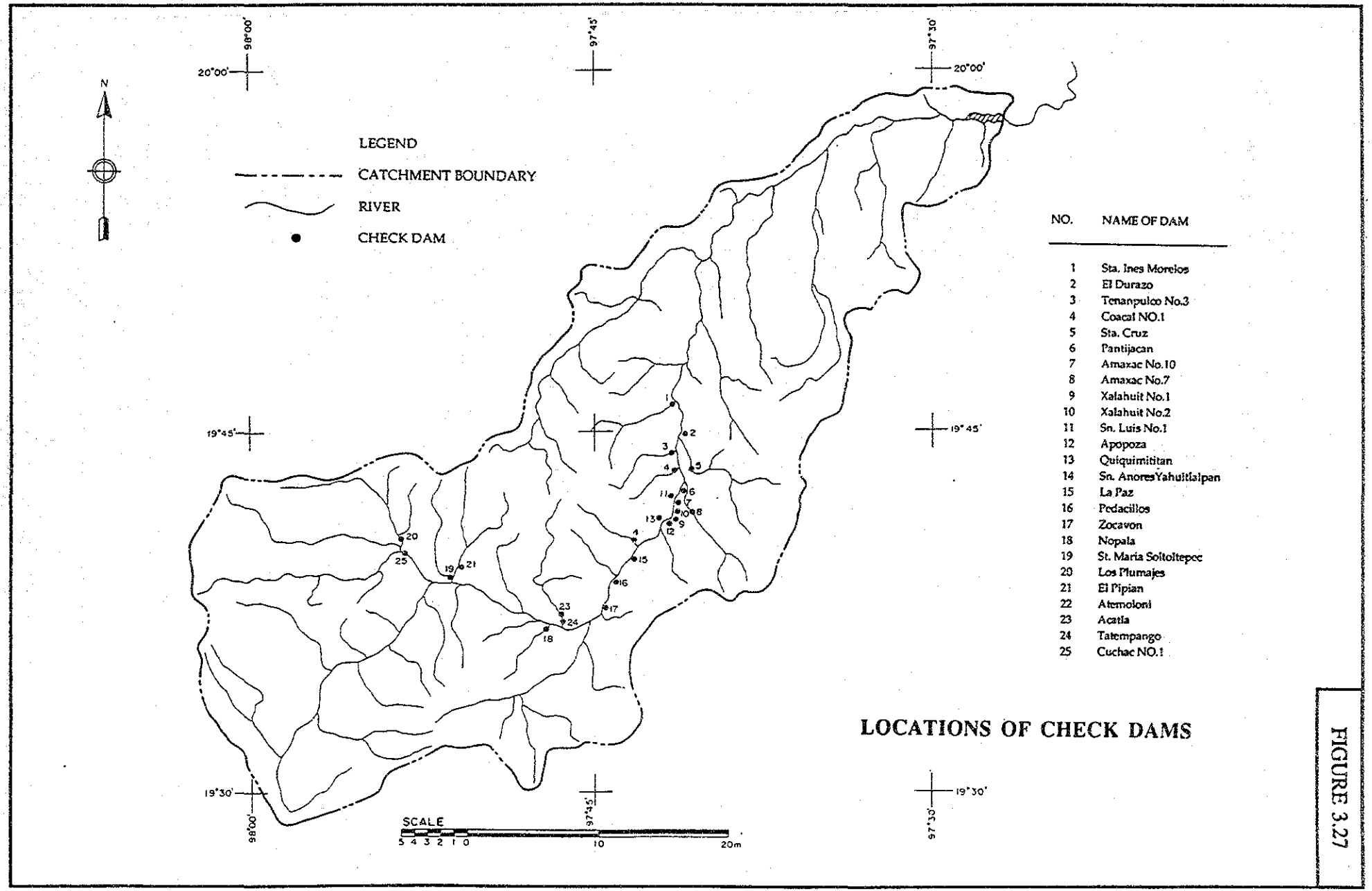


FIGURE 3.26


RESERVOIR CROSS SECTION NEAR INTAKE
MAY 1990
JUNE 1992
BED ELEVATION, METERS
800
790
780
770
DISTANCE, METERS
0
100
200
300
400

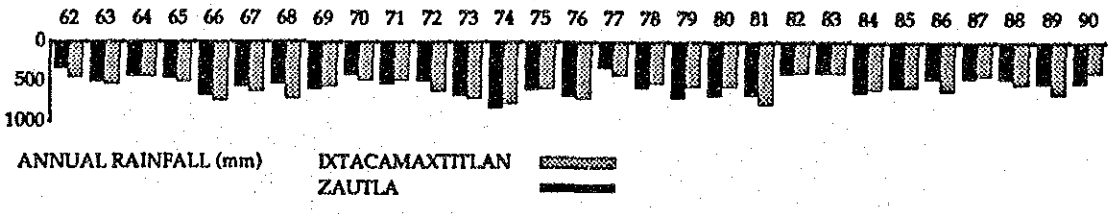


NO.	NAME OF DAM
1	Sta. Ines Morelos
2	El Durazo
3	Tenanpulco No.3
4	Coacal NO.1
5	Sta. Cruz
6	Pantijacan
7	Amaxac No.10
8	Amaxac No.7
9	Xalahuit No.1
10	Xalahuit No.2
11	Sn. Luis No.1
12	Apopoza
13	Quiquimititan
14	Sn. AnoresYahuitlalpan
15	La Paz
16	Pedacillos
17	Zocavon
18	Nopala
19	St. Maria Soltoltepec
20	Los Plumajes
21	El Pipian
22	Atemoloni
23	Acatla
24	Tatempango
25	Cuchac NO.1

LOCATIONS OF CHECK DAMS

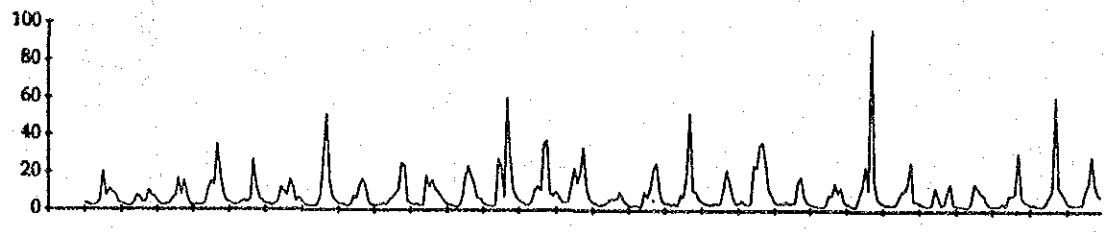
FIGURE 3.27

FIGURE 3.28

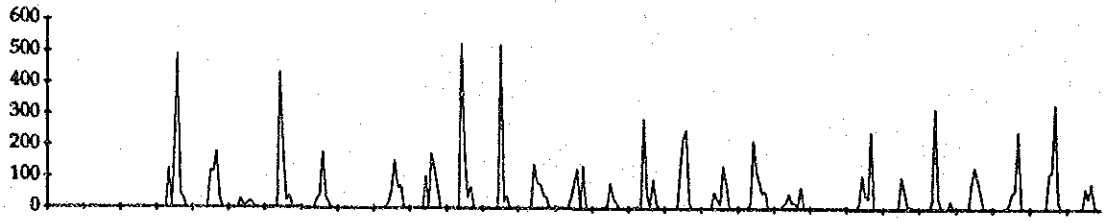


ANNUAL RAINFALL (mm) IXTACAMAXTITLAN ZAUTLA

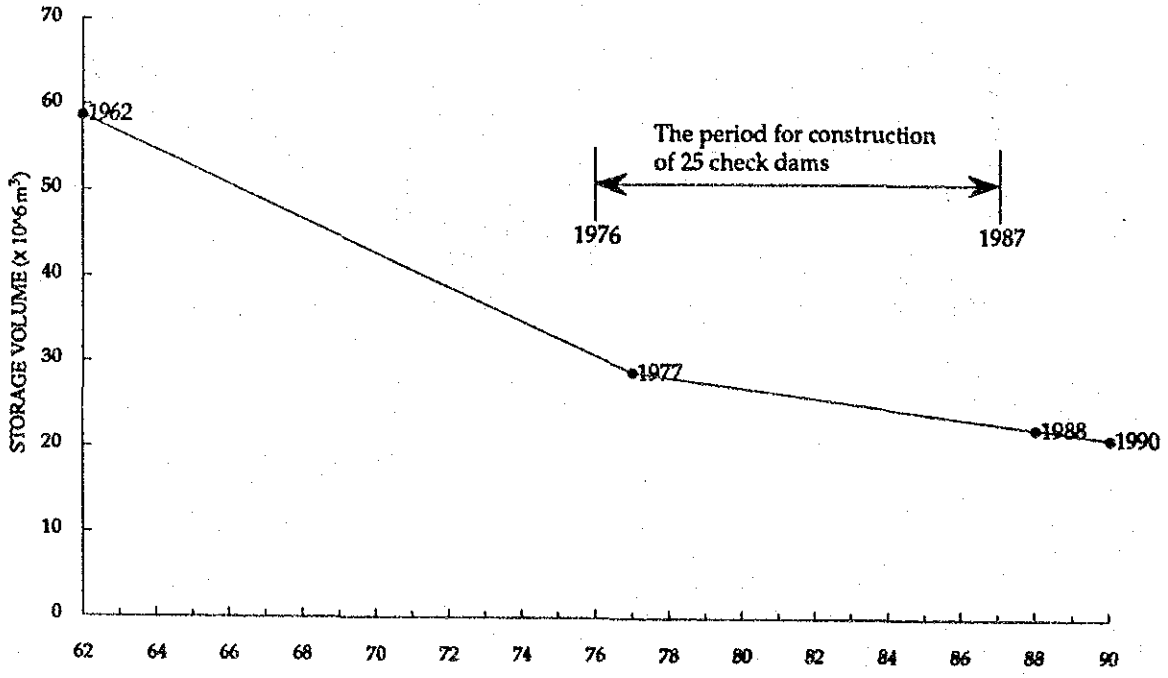
RUNOFF AT BUENOS AIRES (m3/sec)



SUSPENDED SEDIMENT AT BUENOS AIRES (1,000m3)



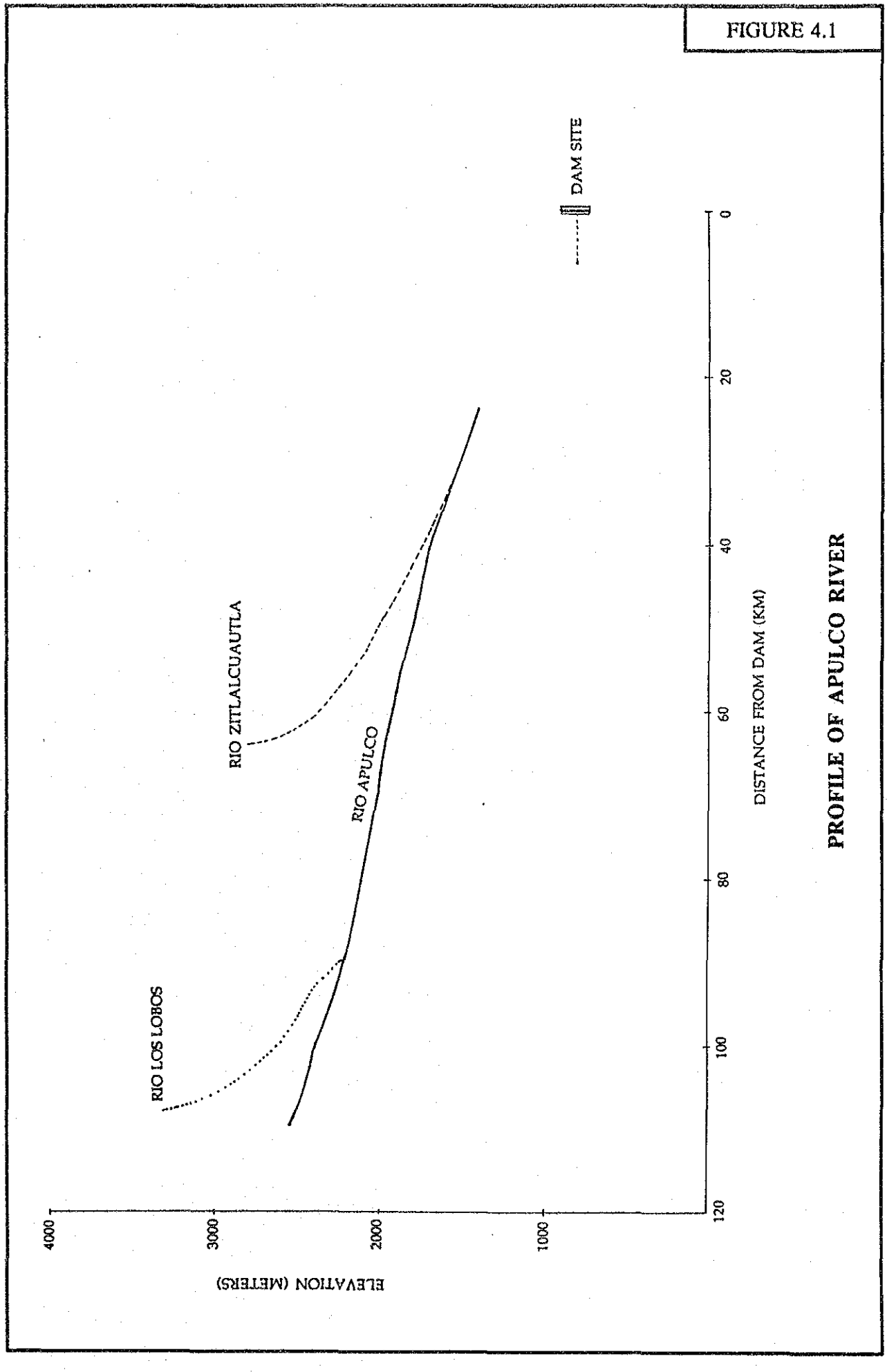
COMPARISON OF RUNOFF, RAINFALL AND SEDIMENT



CHANGE OF RESERVOIR STORAGE VOLUME BELOW EL. 804.5 m

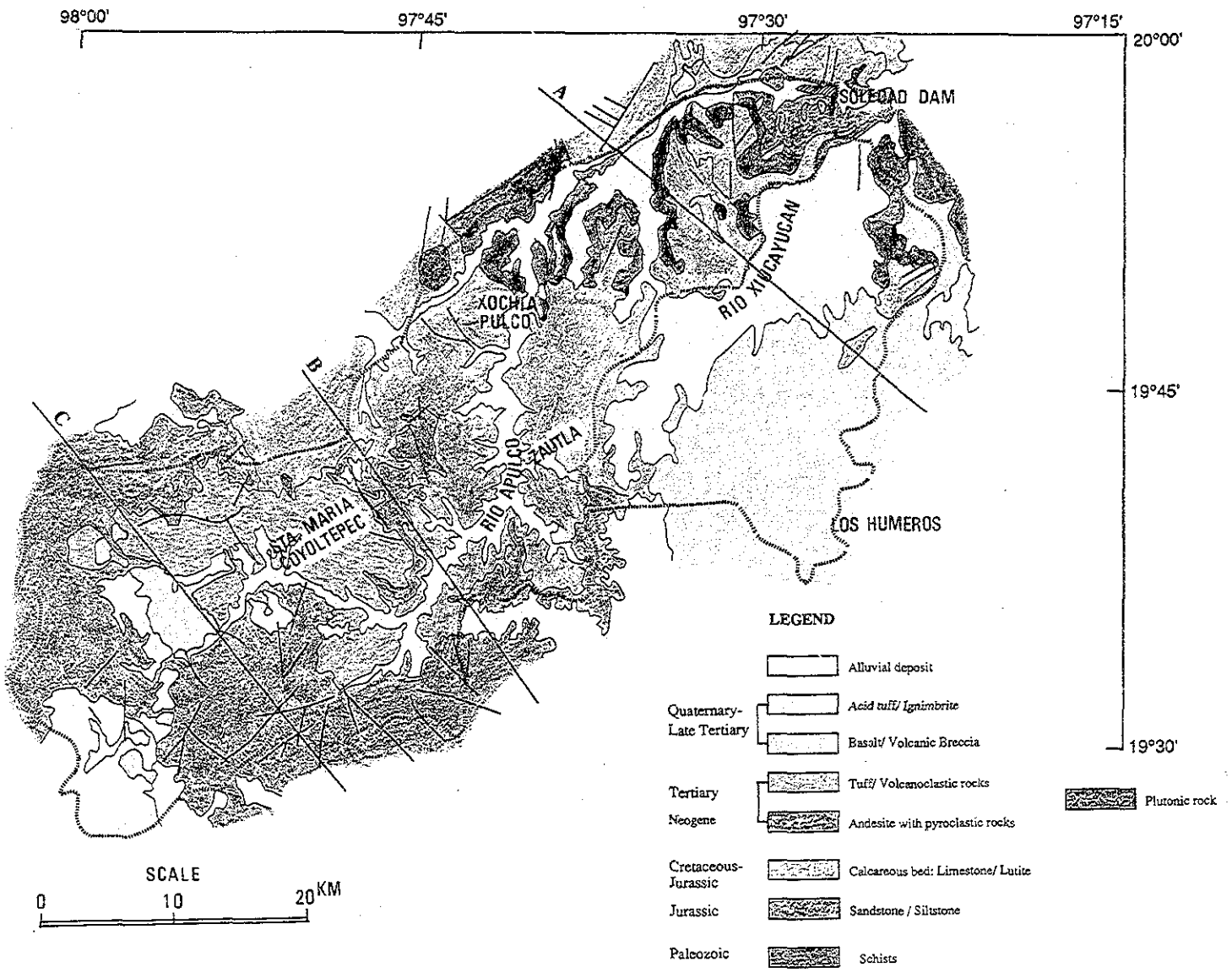
SEDIMENTATION PROCESS AND HYDROLOGICAL CONDITIONS

FIGURE 4.1



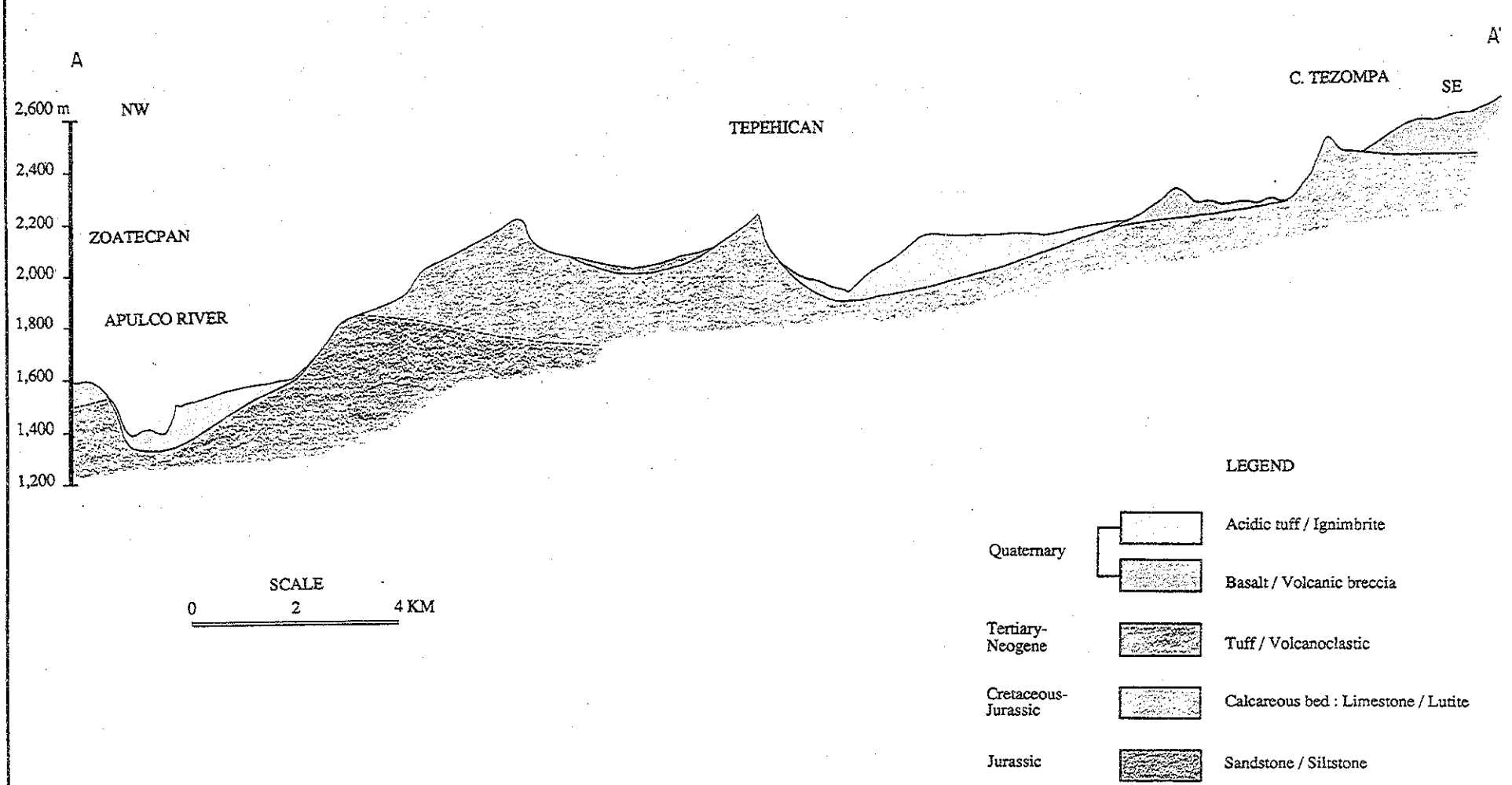
PROFILE OF APULCO RIVER

FIGURE 4.2



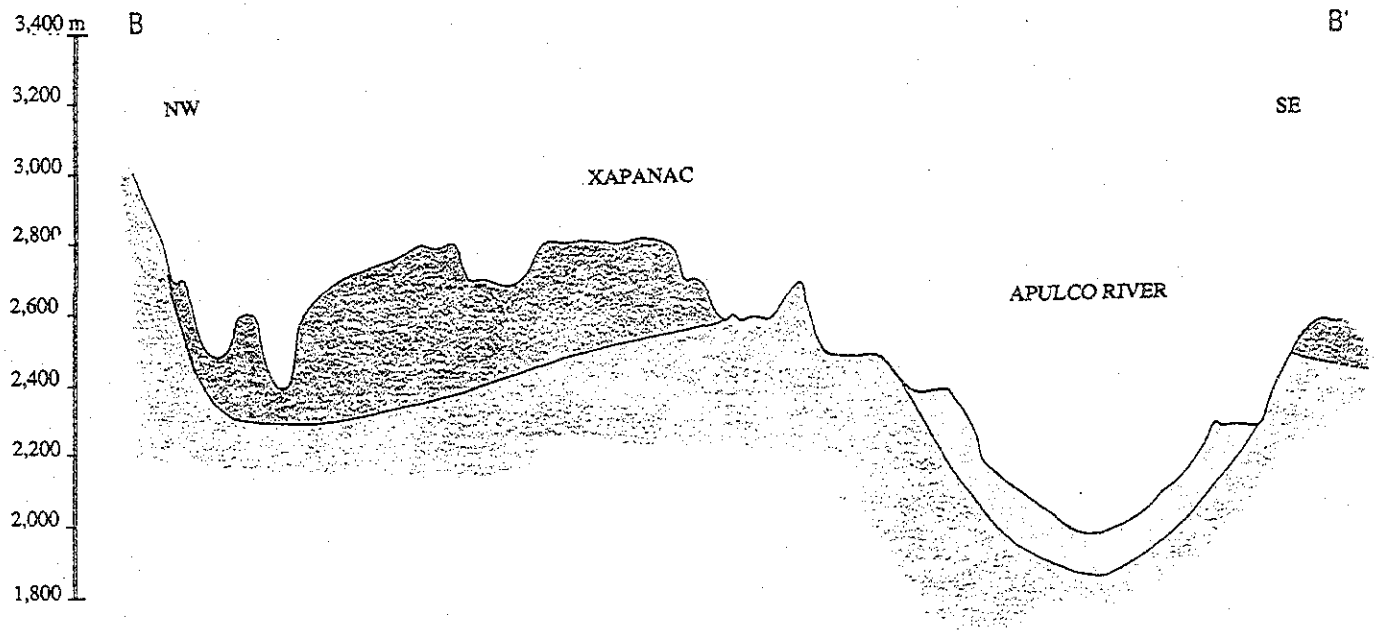
GEOLOGICAL MAP OF CATCHMENT AREA

FIGURE 4.3(1/3)



SCHEMATIC GEOLOGICAL PROFILE (1/3)

FIGURE 4.3(2/3)



SCALE

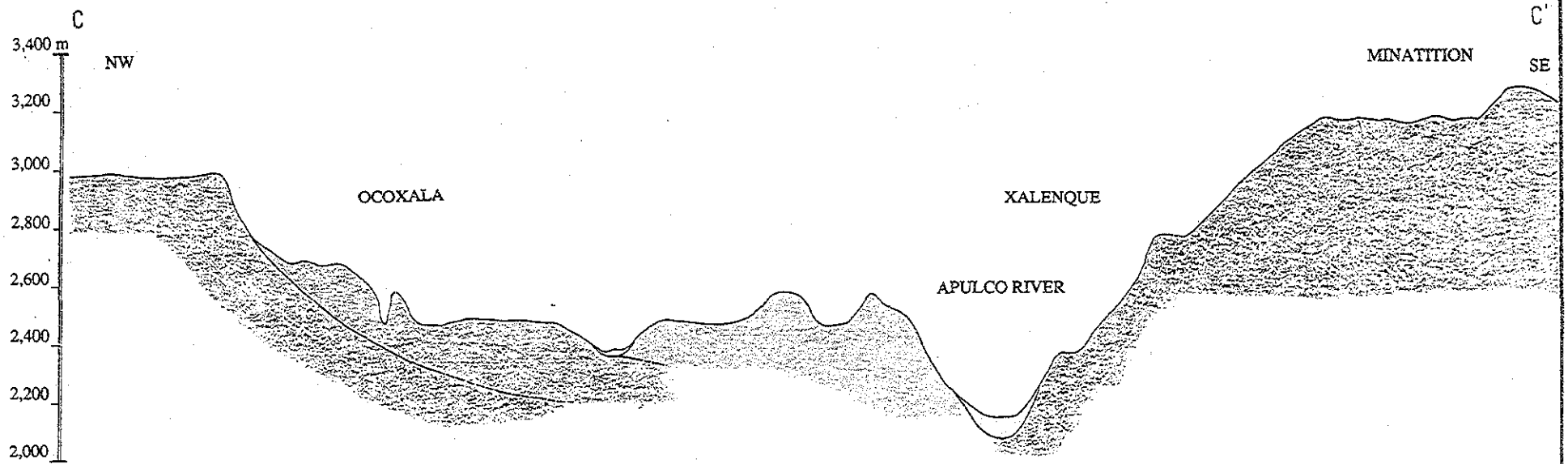
0 2 4 KM

LEGEND

Quaternary		Acidic tuff / Ignimbrite
Tertiary-Neogene		Andesite with pyroclastic rocks
Cretaceous-Jurassic		Limestone / Lutite

SCHEMATIC GEOLOGICAL PROFILE (2/3)

FIGURE 4.3(3/3)



SCALE

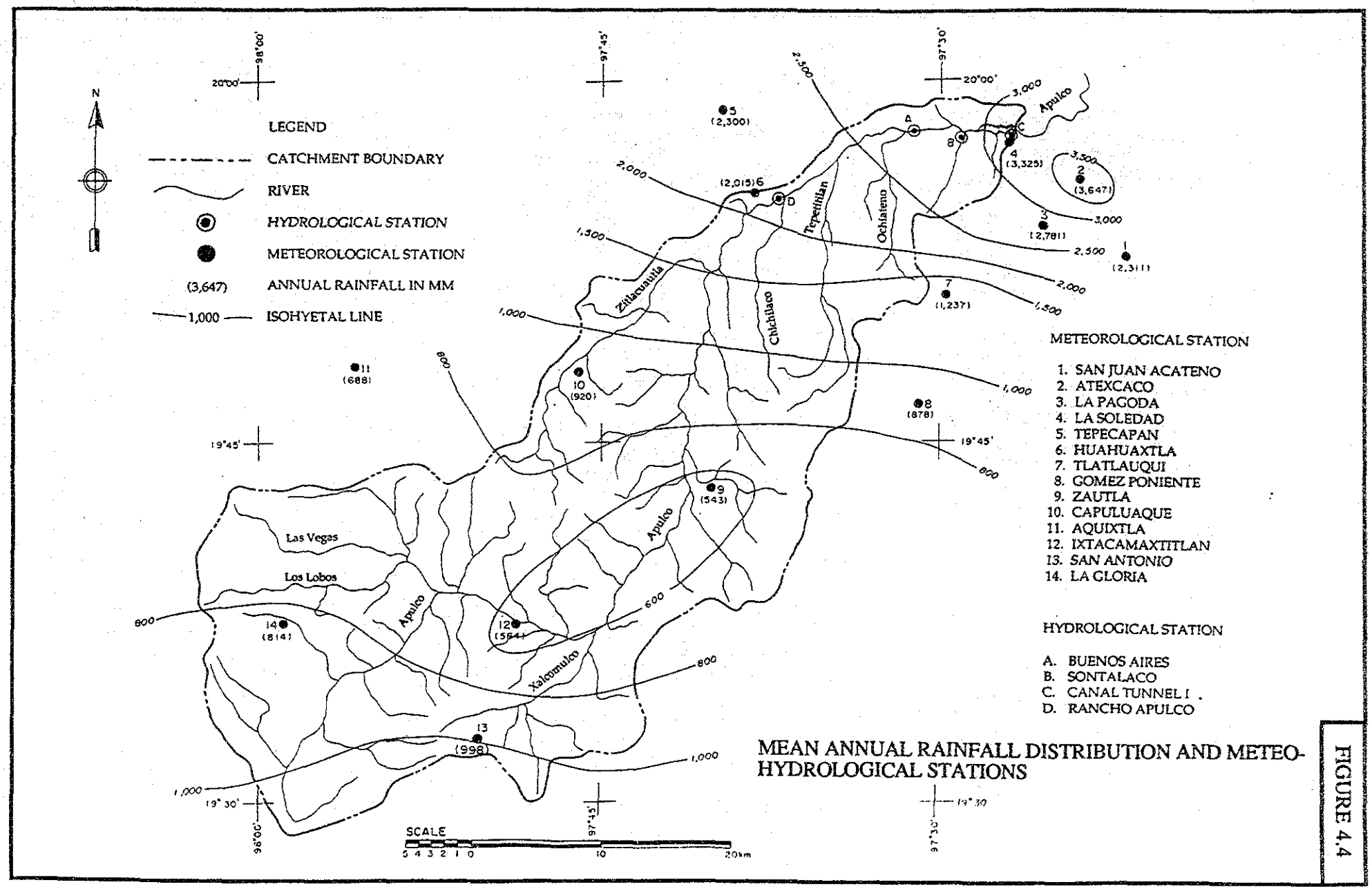
0 2 4 KM

LEGEND

Quaternary
- Acidic tuff / Ignimbrite
- Basalt / Volcanic breccia

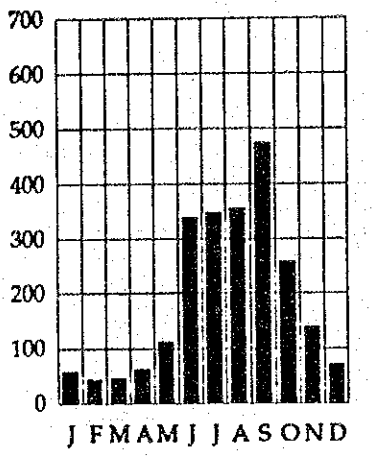
Tertiary-Neogene
- Tuff / Volcanoclastic
- Andesite with pyroclastic rocks

SCHEMATIC GEOLOGICAL PROFILE (3/3)

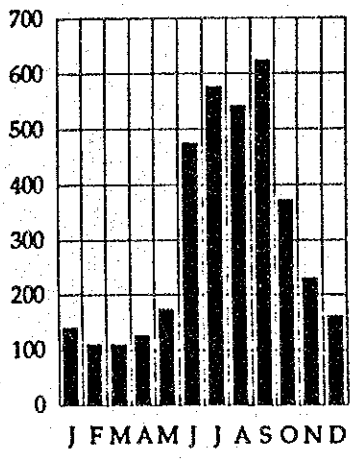


MEAN ANNUAL RAINFALL DISTRIBUTION AND METEO-HYDROLOGICAL STATIONS

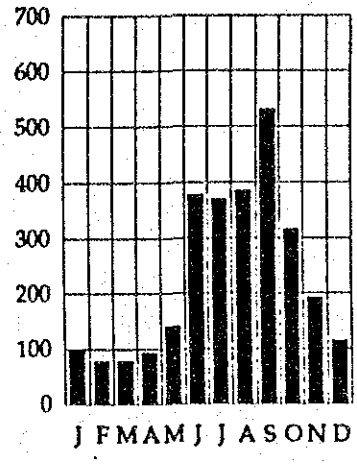
FIGURE 4.4



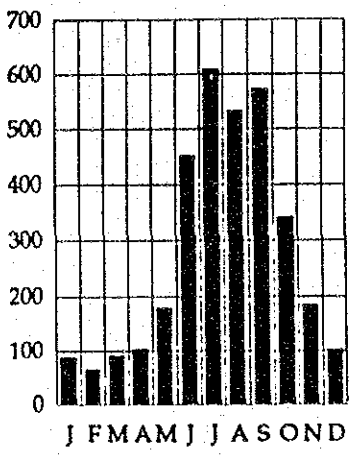
1. SAN JUAN ACATENO



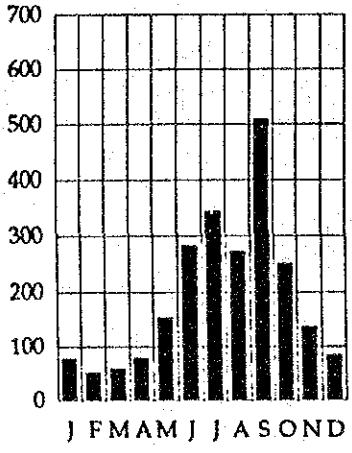
2. ATEXCACO



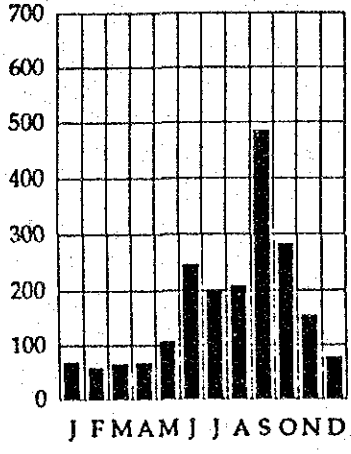
3. LA PAGODA



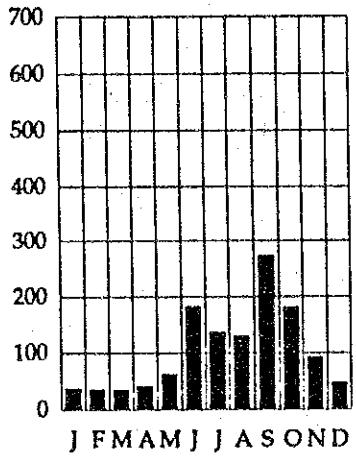
4. LA SOLEDAD



5. TEPECAPAN



6. HUAHUAXTLA



7. TLATLAUQUI

Unit : mm

MEAN MONTHLY RAINFALL (1/2)