

表 3.5 CELESC系統内の年発電電力量の需給状況 (1979年-1989年)

Specifications	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1. Own Generation	367,561,796	446,635,955	407,319,367	413,524,210	482,321,337	404,018,524	332,552,353	281,293,982	411,467,634	375,335,322	385,738,503
1.1 Hydro	367,267,816	446,510,755	407,286,767	413,502,860	482,312,487	404,007,224	332,551,913	281,293,962	411,467,634	375,335,322	385,738,503
1.2 Thermal	293,980	125,200	32,600	31,390	24,870	11,100	440	0	0	0	0
2. Energy Received	2,692,784,105	3,071,754,933	3,350,406,634	3,626,847,634	3,877,353,402	4,489,566,318	3,079,090,790	5,340,419,090	5,765,990,767	6,208,555,667	6,674,854,706
2.1 Electrical	2,660,581,383	3,048,002,453	3,329,473,906	3,615,488,199	3,868,328,202	4,489,566,318	4,827,021,795	4,687,024,806	4,535,966,870	4,708,000,863	4,651,851,594
2.2 Inapu	0	0	0	0	0	0	0	0	0	0	0
2.3 Hidroelétrica Xauxere	23,348,448	20,454,880	20,992,728	11,359,260	9,027,200	0	0	0	0	0	0
2.4 Cte de Papel Chupoco	4,097,000	0	0	0	0	0	0	0	0	0	0
2.5 Copel (PR) - Porto Uniao	4,535,914	3,297,600	0	0	0	0	0	0	0	2,501,100	3,943,200
2.6 Copel (PR) - Inapoa	0	0	0	0	0	0	0	0	0	0	3,788,400
2.7 Cce (RS)	231,360	0	0	0	0	0	0	0	0	0	0
2.8 Fabrica de Papel Primo Tedesco	0	0	0	0	0	0	0	0	0	1,539,200	12,643,200
3. Energy Required	3,069,355,901	3,518,920,888	3,757,726,001	4,040,381,669	4,359,682,759	4,893,584,642	5,411,643,143	5,691,713,052	6,178,458,401	6,583,890,989	7,060,613,209
4. Energy surplus	156,402,998	183,857,744	188,426,726	162,751,951	41,684,703	70,531,831	85,204,356	90,616,666	98,677,350	99,223,674	102,981,432
4.1 Cia Docas de Imbituba	17,068,496	18,893,476	19,263,713	6,586,774	0	0	0	0	0	0	0
4.2 Empresa Forca e Luz Joao Cesa	1,489,548	1,731,948	2,256,551	2,057,376	2,098,320	2,148,600	2,532,072	2,510,496	2,621,856	3,201,312	3,398,496
4.3 Empresa Forca e Luz Anaruangus	17,151,080	20,493,750	13,622,568	0	0	0	0	0	0	0	0
4.4 Forca e Luz Criciuna	113,182,632	132,804,828	142,312,556	142,273,450	0	0	0	0	0	0	0
4.5 Forca e Luz Guardense	313,908	0	0	0	0	0	0	0	0	0	0
4.6 Forca e Luz Nova Veneza	654,884	1,018,484	1,107,364	1,156,248	1,342,664	1,394,000	1,583,200	1,688,400	1,943,600	2,185,200	2,385,600
4.7 Forca e Luz Sao Bento	0	0	0	0	0	0	0	0	0	0	0
4.8 Forca e Luz Unsuanganga	6,552,450	8,915,258	9,863,974	10,378,103	12,261,600	16,313,440	21,451,104	22,960,416	24,110,064	22,497,696	25,192,344
4.9 Hidroelétrica Xauxere	0	0	0	0	25,982,119	50,675,791	59,637,980	63,457,354	69,951,830	71,339,466	72,004,992
5. Consumption Total	2,676,177,965	3,149,874,274	3,380,061,559	3,579,526,149	3,993,766,172	4,472,742,119	4,979,502,421	5,181,642,907	5,685,205,225	6,008,591,491	6,456,704,745
5.1 Residential	450,987,677	515,169,978	600,596,205	642,423,998	763,322,924	817,736,973	883,842,452	952,642,306	1,104,761,931	1,188,218,444	1,326,651,573
5.2 Industrial	1,551,169,144	1,827,352,839	1,895,016,379	1,995,513,189	2,155,807,371	2,496,113,014	2,840,959,152	2,947,883,116	3,113,514,044	3,281,996,744	3,506,689,574
5.3 Commercial	320,005,627	364,900,153	378,974,287	386,785,497	441,787,213	463,363,780	472,902,392	466,123,733	537,254,354	555,211,189	593,415,110
5.4 Rural	55,216,742	75,279,404	102,135,761	118,057,486	150,707,100	175,960,052	206,667,634	227,020,792	259,776,249	272,985,549	293,534,735
5.5 Rural Cooperation	106,252,511	135,312,172	152,612,319	168,871,584	170,197,731	187,091,440	213,765,688	239,702,041	256,455,170	273,643,649	291,489,190
5.6 Public Power	59,298,299	73,214,206	78,301,995	70,800,593	75,196,075	79,435,366	89,117,816	84,162,817	99,659,808	115,441,201	116,778,687
5.7 Public Illumination	105,898,954	123,800,496	131,092,593	140,983,679	167,100,603	173,661,362	187,295,976	173,697,543	205,022,568	214,256,009	216,328,040
5.8 Public Service	22,121,204	28,483,152	33,373,194	48,566,014	61,047,024	71,201,265	76,896,278	83,268,865	89,696,387	98,131,414	103,466,385
5.9 Own Use	5,227,811	6,341,874	7,958,886	7,544,109	8,600,131	8,178,827	8,075,090	7,141,694	9,062,714	8,706,892	8,361,651
6. Losses, Diff.	227,774,934	184,658,870	189,237,716	298,103,569	324,241,884	350,310,692	346,936,366	349,453,479	394,625,826	476,075,824	500,927,032
7. Max Demand (kWh)	564,700	700,800	700,800	758,100	824,200	894,800	967,600	1,003,500	1,081,300	1,132,400	1,228,400
8. No. of Clients	477,930	527,656	589,448	670,029	735,064	777,720	819,911	868,834	910,792	960,092	1,013,717
8.1 Residential	375,096	413,154	456,841	504,549	557,091	589,215	620,115	654,448	687,857	727,937	772,528
8.2 Industrial	6,989	7,312	7,764	8,076	8,899	11,319	13,414	17,038	18,490	19,430	20,837
8.3 Commercial	49,348	53,040	57,020	60,578	65,103	65,682	66,307	70,499	73,321	75,837	78,623
8.4 Rural	41,266	48,497	61,434	89,562	96,226	105,043	110,798	116,751	120,372	125,268	129,749
8.5 Public Power	4,857	5,303	5,936	6,368	6,746	7,350	8,095	8,844	9,455	10,205	10,567
8.6 Public Illumination	176	180	185	190	213	221	215	212	270	216	216
8.7 Public Service	198	230	268	412	467	511	541	590	592	644	672
8.8 Own Consumer	0	0	0	294	319	379	426	452	458	501	525
9. No. of Supply Points	19	22	15	15	15	6	6	6	5	5	5
Annual Load Factor (%)	61.87	62.44	61.21	60.84	60.38	62.43	63.85	63.95	65.23	66.20	65.61

表 5.1 各発電計画区域内の人口

(1) a. Salto Pilão: Lontras

	1970	%	1980	%	1989	%	Rate of Annual Increase (%)	
							1970-80	1980-89
Urban	1,678	23.95	3,789	51.73	4,884	63.54	8.48	2.76
Rural	5,328	76.05	3,535	48.27	2,779	36.46	-4.01	-2.63
Total	7,006	100.00	7,324	100.00	7,663	100.00	0.44	0.44

b. Rio do Sul

	1970	%	1980	%	1989	%	Rate of Annual Increase (%)	
							1970-80	1980-89
Urban	21,528	78.18	33,362	92.06	41,881	94.95	4.47	2.55
Rural	6,010	21.82	2,878	7.94	2,227	5.05	-7.09	-2.80
Total	27,538	100.00	36,240	100.00	44,108	100.00	2.78	2.20

(2) Dalbergia

	1970	%	1980	%	1989	%	Rate of Annual Increase (%)	
							1970-80	1980-89
Urban	4,180	19.90	8,230	34.99	11,472	44.44	7.01	3.76
Rural	16,828	80.10	15,292	65.01	14,342	55.56	-0.95	-0.71
Total	21,008	100.00	23,522	100.00	25,814	100.00	1.13	1.04

Note: the above figure includes population of Dalbergia and Ibirama

(3) Benedito Novo

	1970	%	1980	%	1989	%	Rate of Annual Increase (%)	
							1970-80	1980-89
Urban	1,638	14.08	3,767	35.17	4,667	47.03	8.68	2.41
Rural	9,999	85.92	6,945	64.83	5,257	52.97	-3.58	-3.05
Total	11,637	100.00	10,712	100.00	9,924	100.00	-0.82	-0.84

Source: (1) "IBGE" Foundation,
Demographic Census of Santa Catarina - 1970 - 1980
(2) "SEPLAN"/SC estimatives - 1989

表 5.2 上流域の水需要

Sub-basin	Irrigated Area (1)	Irrigation (2)		Urban Supply (3)	Rural (4)	Industrial (5)	Totals		
		Dec to Mar	Oct/Nov Apr/May				Jul/Sep	Oct/Nov Apr/May	Dec/Mar
Salto Pilão	(ha)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)	(m3/s)
Itajai do Sul	1,034	1.675	0.186	0.024	0.083	0.028	0.135	0.321	1.810
Itajai do Oeste	8,238	13.345	1.483	0.041	0.111	0.072	0.224	1.707	13.568
Itajai-Açu	435	0.705	0.078	0.103	0.007	0.051	0.161	0.239	0.866
Total	9,707	15.725	1.747	0.168	0.201	0.151	0.520	2.267	16.244
Dalbergia									
Itajai do Norte	680	1.102	0.122	0.028	0.099	0.026	0.153	0.275	1.255
Total	680	1.102	0.122	0.028	0.099	0.026	0.153	0.275	1.255
Benedito Novo									
Benedito Novo	1,165	1.887	0.210	0.003	0.019	-	0.022	0.232	1.909
Total	1,165	1.887	0.210	0.003	0.019	-	0.022	0.232	1.909

Source:

(1) Municipal Agricultural Production (IBGE) - 1989

(2) "CASAN" report, September/1990

(3) "FATMA" - Program of environmental recovery of "Itajai" basin, 1990

表 5.3 農薬と汚染源

a. General Use of Agricultural Chemicals in the Upper Itajai River Basin

	Nitrogen (Kg/ha-year)	Phosphorus (Kg/ha-year)	Potassium (Kg/ha-year)
Rice	90	60	20
Tabacco	45	150	60
Onion	37.5	70	35

b. Agricultural Chemicals used in the Project Area

	(Unit: ton/year)		
	Salto Pilao	Dalbergia	Benedito Novo
Nitrogen	2.179	354	113
Phosphorus	4.050	1.011	97
Potassium	1.691	400	34

c. Sources of Pollution

	(Unit: kg DBO/day)		
	Salto Pilao	Dalbergia	Benedito Novo
Industry	2,780	11,406	-
Rural	107,100	20,790	6,026
Urban	4,500	1,035	322
Total	114,380	33,231	6,348

DBO: Dissolved Biological Oxygen

表 5.4 河川維持用水

(1) Monthly minimum discharge (MMD)

Scheme	MMD (m ³ /s)	Recorded period
Salto Pilão	10.2	1941~1987
Dalbergia	2.4	1935~1987
Benedito Novo	2.1	1934~1987

(2) Available river flow

Scheme	MMD	RMF	MED	(Unit: m ³ /s)	
				FD	Available river flow
Salto Pilão	10.2	8.2	109.9	50.3	59.6
Dalbergia	2.4	1.9	52.7	19.3	33.4
Benedito Novo	2.1	1.7	14.5	8.4	6.1

Note; MED; Monthly mean discharge
 FD ; Firm discharge
 RMF: MMD x 0.8 = Required maintenance flow
 Available river flow: MED - FD

表 5.5 水没面積と補償面積

Scheme	Water Level (m)	Submerged Area (km2)	Compensation Area * (km2)	Relocation of Houses (Units)		Road Construction in the Reservoir Area				
				Reservoir Area	Construction Areas	Realignment (m)	New Bridge (s) (m)	New Road (m)	Culvert(s) (unit)	Submerged Road (m)
Salto Pilão										
Axis A	330	4.43	2.590	87	0	590	40	1900	2	630
Axis B	330	4.59	2.880	87	0	590	40	1900	2	630
Axis C	319	0.40	0.334	9	0	-	-	-	-	-
Dalbergia										
Axis A	232	0.28	0.193	5	12	-	-	-	-	950
Axis B	227	0.37	0.248	5	12	-	-	-	-	1250
Axis C	215	0.29	0.156	8	12	-	-	-	-	-
Benedito Novo										
Axis A	290	0.229	0.307	93	19	440	50	980	3	490
Axis B	287	0.092	0.166	15	13	440	50	980	3	490
Axis C	277	0.029	0.028	13	10	200	50	-	0	250

* See Table 5.6 for details

表 5.6 影響区域の詳細

SCHEME	COMPENSATION AREA (km2)			Total	DAM, ROAD & POWER HOUSE (km2)			DISTRIBUTION OR TRANSMISSION LINE (m)		
	Agriculture	Forest	Others		Agriculture	Forest	Others	Agriculture	Forest	Others
Salto Pilão										
Axis A	1.450	0.090	1.050	2.590				5,200	1,800	-
Axis B	1.450	0.270	1.160	2.880				5,200	1,800	-
Axis C	0.150	0.100	0.084	0.334				5,200	1,800	-
Dalbergia										
Axis A	0.005	0.056	0.132	0.193				1,800	-	-
Axis B	-	0.065	0.183	0.248				1,800	-	-
Axis C	0.007	0.040	0.109	0.156				1,800	-	-
Benedito Novo										
Axis A	0.016	0.005	0.286	0.307				-	-	18,000
Axis B	0.011	0.003	0.152	0.166				-	-	18,000
Axis C	0.005	0.011	0.012	0.028				-	-	18,000

表 6.1 各ダム軸案に対する保証電力量に対するコスト

1. Salto Pilão (1) Hydropower Scheme

Dam axis	Construction cost (x1000 US\$)	Secondary energy (MWh)	Guaranteed energy (MWh)	CUEG (US\$/MWh)
Axis-A	143,809	65,425	686,366	20.2
Axis-B	126,072	66,350	689,467	17.5
Axis-C	128,278	63,078	654,863	18.8

Note: CUEG; Unit Cost of Guaranteed Energy

2. Dalbergia Hydropower Scheme

Dam axis	Construction cost (x1000 US\$)	Secondary energy (MWh)	Guaranteed energy (MWh)	CUEG (US\$/MWh)
Axis-A	85,309	13,399	111,793	75.8
Axis-B	68,995	12,850	106,407	64.2
Axis-C	67,794	10,626	91,627	73.5

3. Benedito Novo Hydropower Scheme

Dam axis	Construction cost (x1000 US\$)	Secondary energy (MWh)	Guaranteed energy (MWh)	CUEG (US\$/MWh)
Axis-A	32,196	12,802	72,562	43.0
Axis-B	33,343	12,549	71,008	45.6
Axis-C	31,071	11,681	65,747	45.9

表 7.1 Salto Pilao (1) 水力発電計画の工事費 (1 / 3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
I. Direct Cost				
1. River Diversion Works				
(1) Diversion tunnel				
(a) Portal excavation, common	cu.m	5	55,300	277
(b) Portal excavation, rock	cu.m	20	37,000	740
(c) Tunnel excavation	cu.m	90	68,300	6,147
(d) Backfill	cu.m	4	2,800	11
(e) Portal concrete	cu.m	170	2,920	496
(f) Lining concrete	cu.m	170	23,700	4,029
(g) Reinforcing bar	ton	1,300	414	538
(h) Steel support	ton	2,500	224	560
(i) Diversion closure gate	ton	6,000	9	54
(j) Plug concrete	cu.m	100	1,140	114
(2) Primary cofferdam	cu.m	6	21,300	128
(3) Secondary cofferdam				
(a) Excavation, common	cu.m	5	50,500	253
(b) Excavation, rock	cu.m	20	6,540	131
(c) Concrete	cu.m	100	32,300	3,230
(4) Downstream cofferdam	cu.m	6	36,100	217
(5) Miscellaneous works	L.S			844
Sub-total of Item 1				17,768
2. Dam and Spillway				
(1) Excavation, common	cu.m	5	86,100	431
(2) Excavation, rock	cu.m	20	24,300	486
(3) Backfill	cu.m	4	7,600	30
(4) Mass concrete	cu.m	100	66,500	6,650
(5) Structural concrete	cu.m	170	4,050	689
(6) Reinforcing bar	ton	1,300	125	163
(7) Spillway bridge	L.S			35
(8) Bridge for maintenance	L.S			7
(9) Curtain grouting	L.S			337
(10) Consolidation grouting	L.S			45
(11) Spillway gate	ton	6,000	1,095	6,570
(12) Sand scouring gate	ton	6,000	140	840
(13) Miscellaneous works	L.S			444
Sub-total of Item 2				16,725
3. Intake and Sand Trap Basin				
(1) Excavation, common	cu.m	5	126,300	632
(2) Excavation, rock	cu.m	20	190,600	3,812
(3) Backfill	cu.m	4	18,200	73
(4) Mass concrete	cu.m	100	11,400	1,140
(5) Structural concrete	cu.m	170	29,400	4,998
(6) Reinforcing bar	ton	1,300	380	494
(7) Intake gate	ton	6,000	196	1,176
(8) Trashrack	ton	3,500	133	466
(9) Sand flush gate	ton	6,000	4	24
(10) Rim grouting	L.S			205
(11) Miscellaneous works	L.S			568
Sub-total of Item 3				13,586

(to be continued)

表 7.1 Salto Pilao (1) 水力発電計画の工事費 (2 / 3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
4. Headrace Tunnel				
(1) Tunnel excavation	cu.m	90	216,870	19,518
(2) Lining concrete	cu.m	170	57,260	9,734
(3) Reinforcing bar	ton	1,300	2,020	2,626
(4) Steel support	ton	2,500	315	788
(5) Consolidation grouting	L.S			154
(6) Work adit	L.S			1,586
(7) Miscellaneous works	L.S			1,641
Sub-total of Item 4				36,047
5. Surge Tank				
(1) Open excavation, common	cu.m	5	99,600	498
(2) Open excavation, rock	cu.m	20	64,600	1,292
(3) Shaft excavation	cu.m	130	19,000	2,470
(4) Lining concrete	cu.m	190	3,300	627
(5) Structural concrete	cu.m	170	850	145
(6) Reinforcing bar	ton	1,300	195	254
(7) Consolidation grouting	L.S			22
(8) Surge tank gate	ton	6,000	65	390
(9) Miscellaneous works	L.S			265
Sub-total of Item 5				5,962
6. Penstock				
(1) Open excavation, rock	cu.m	20	10,400	208
(2) Shaft excavation	cu.m	130	8,650	1,125
(3) Backfill	cu.m	4	8,600	34
(4) Open concrete	cu.m	170	1,450	247
(5) Backfill concrete	cu.m	200	2,640	528
(6) Reinforcing bar	ton	1,300	15	20
(7) Consolidation grouting	L.S			106
(8) Steel liner	ton	3,800	1,710	6,498
(9) Work adit	L.S			446
(10) Miscellaneous works	L.S			438
Sub-total of Item 6				9,649
7. Power Station & Tailrace				
(1) Excavation, common	cu.m	5	216,700	1,084
(2) Excavation, rock	cu.m	20	65,700	1,314
(3) Backfill	cu.m	4	6,000	24
(4) Concrete	cu.m	190	24,300	4,617
(5) Backfill concrete	cu.m	100	700	70
(6) Reinforcing bar	ton	1,300	830	1,079
(7) Superstructure	cu.m	190	15,600	2,964
(8) Draft tube gate	ton	6,000	20	120
(9) Generating equipment	L.S			26,990
(10) T/L & S/S	L.S			3,417
(11) Tailrace bridge	L.S			13
(12) Miscellaneous works	L.S			410
Sub-total of Item 7				42,102

(to be continued)

表 7. 1 Salto Pilao (1) 水力発電計画の工事費 (3 / 3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
8. Access Road				
(1) New construction road	Km	360,000	3.5	1,260
(2) Improvement of existing road	Km	180,000	1.5	270
(3) Bridge	m	5,700	10	57
(4) Miscellaneous works	L.S			79
Sub-total of Item 8				1,666
Total of Item I				143,506
II. Compensation Cost				
1. Land				
(1) Agricultural land	sq.Km	220,000	0.15	33
(2) Forest	sq.Km	80,000	0.10	8
(3) Grass land	sq.Km	195,328	0.067	13
(4) Reforestation	sq.Km	150,000	0.017	3
Sub-total of Item 1				57
2. House				
(1) Wooden house	Nos.	9	12,672	114
Total of Item II				171
III. Administration Cost				7,175
IV. Engineering Service Cost				4,100
V. Physical Contingency (15 %)				23,243
Grand Total				178,195

表 7.2 工事費の年支出額

(Unit: x thousand US\$)

Year/Scheme	Salto Pilão (1)	Dalbergia	Benedito Novo
1st	55,398	30,202	17,392
2nd	19,900	23,036	16,076
3rd	54,231	35,807	23,061
4th	48,666	13,152	-
Total	178,195	102,197	56,529

表 7.3 Dalbergia 水力発電計画の工事費 (1/3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
I. Direct Cost				
1. River Diversion Works				
(1) Diversion tunnel				
(a) Portal excavation, common	cu.m	5	41,500	208
(b) Portal excavation, rock	cu.m	20	41,300	826
(c) Tunnel excavation	cu.m	90	9,330	840
(d) Backfill	cu.m	4	2,100	8
(e) Portal concrete	cu.m	170	3,000	510
(f) Lining concrete	cu.m	170	3,390	576
(g) Reinforcing bar	ton	1,300	110	143
(h) Steel support	ton	2,500	45	113
(i) Diversion closure gate	ton	6,000	7.5	45
(j) Plug concrete	cu.m	100	550	55
(2) Primary cofferdam	cu.m	6	2,000	12
(3) Secondary cofferdam				
(a) Excavation, common	cu.m	5	20,900	105
(b) Excavation, rock	cu.m	20	2,540	51
(c) Concrete	cu.m	100	18,700	1,870
(4) Downstream cofferdam	cu.m	6	11,700	70
(5) Miscellaneous works	L.S			269
Sub-total of Item 1				5,700
2. Dam and Spillway				
(1) Excavation, common	cu.m	5	250,700	1,254
(2) Excavation, rock	cu.m	20	118,000	2,360
(3) Backfill	cu.m	4	16,200	65
(4) Mass concrete	cu.m	100	109,700	10,970
(5) Structural concrete	cu.m	170	3,750	638
(6) Reinforcing bar	ton	1,300	390	507
(7) Riverbed protection	cu.m	70	1,650	116
(8) Spillway bridge	L.S			35
(9) Bridge for maintenance	L.S			7
(10) Curtain grouting	L.S			473
(11) Consolidation grouting	L.S			141
(12) Spillway gate	ton	6,000	680	4,080
(13) Sand scouring gate	ton	6,000	120	720
(14) Miscellaneous works	L.S			828
Sub-total of Item 2				22,193
3. Intake and Sand Trap Basin				
(1) Excavation, common	cu.m	5	51,300	257
(2) Excavation, rock	cu.m	20	39,100	782
(3) Backfill	cu.m	4	4,440	18
(4) Structural concrete	cu.m	170	9,210	1,566
(5) Reinforcing bar	ton	1,300	120	156
(6) Intake gate	ton	6,000	60	360
(7) Trashrack	ton	3,500	50	175
(8) Sand flush gate	ton	6,000	4	24
(9) Miscellaneous works	L.S			139
Sub-total of Item 3				3,476
				(to be continued)

表 7.3 Dalbergia 水力発電計画の工事費 (2 / 3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
4. Headrace Tunnel				
(1) Tunnel excavation	cu.m	110	149,340	16,427
(2) Lining concrete	cu.m	180	35,820	6,448
(3) Reinforcing bar	ton	1,300	1,060	1,378
(4) Steel support	ton	2,500	110	275
(5) Consolidation grouting	L.S			106
(6) Work adit	L.S			1,982
(7) Miscellaneous works	L.S			1,232
Sub-total of Item 4				27,848
5. Surge Tank				
(1) Open excavation, common	cu.m	5	39,700	199
(2) Open excavation, rock	cu.m	20	2,900	58
(3) Shaft excavation	cu.m	130	11,600	1,508
(4) Lining concrete	cu.m	190	2,700	513
(5) Structural concrete	cu.m	170	670	114
(6) Reinforcing bar	ton	1,300	160	208
(7) Consolidation grouting	L.S			24
(8) Surge tank gate	ton	6,000	45	270
(9) Miscellaneous works	L.S			131
Sub-total of Item 5				3,025
6. Penstock				
(1) Open excavation, common	cu.m	5	27,300	137
(2) Open excavation, rock	cu.m	20	9,500	190
(3) Shaft excavation	cu.m	130	5,100	663
(4) Backfill	cu.m	4	34,900	140
(5) Open concrete	cu.m	170	1,540	262
(6) Backfill concrete	cu.m	200	1,810	362
(7) Reinforcing bar	ton	1,300	16	21
(8) Consolidation grouting	L.S			95
(9) Steel liner	ton	3,800	645	2,451
(10) Work adit	L.S			280
(11) Miscellaneous works	L.S			216
Sub-total of Item 6				4,816
7. Power Station & Tailrace				
(1) Excavation, common	cu.m	5	24,500	123
(2) Excavation, rock	cu.m	20	5,500	110
(3) Backfill	cu.m	4	5,000	20
(4) Embankment	cu.m	6	22,000	132
(5) Concrete	cu.m	190	14,600	2,774
(6) Backfill concrete	cu.m	100	620	62
(7) Reinforcing bar	ton	1,300	350	455
(8) Superstructure	cu.m	190	5,600	1,064
(9) Draft tube gate	ton	6,000	6	36
(10) Generating equipment	L.S			7,363
(11) T/L & S/S	L.S			654
(12) Miscellaneous works	L.S			184
Sub-total of Item 7				12,976
				(to be continued)

表 7.3 Dalbergia 水力発電計画の工事費 (3 / 3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
8. Access Road				
(1) New construction road	Km	360,000	1.85	666
(2) Improvement of existing road	Km	180,000	0.15	27
(3) Bridge	m	5,700	20	114
(4) Miscellaneous works	L.S			40
Sub-total of Item 8				847
Total of Item I				80,880
II. Compensation Cost				
1. Land				
(1) Forest	sq.Km	120,000	0.065	8
(2) Grass land	sq.Km	601,625	0.183	110
Sub-total of Item 1				118
2. House				
(1) Wooden house	Nos.	12,946	5	65
Total of Item II				183
III. Administration Cost				4,044
IV. Engineering Service Cost				3,760
V. Physical Contingency (15 %)				13,330
Grand Total				102,197

表 7.4 Benedito Novo 水力発電計画の工事費 (1 / 3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
I. Direct Cost				
1. River Diversion Works				
(1) Diversion tunnel				
(a) Portal excavation, common	cu.m	5	5,500	28
(b) Portal excavation, rock	cu.m	20	6,000	120
(c) Tunnel excavation	cu.m	100	4,200	420
(d) Backfill	cu.m	4	1,700	7
(e) Portal concrete	cu.m	170	1,500	255
(f) Lining concrete	cu.m	180	1,600	288
(g) Reinforcing bar	ton	1,300	55	72
(h) Steel support	ton	2,500	30	75
(i) Diversion closure gate	ton	6,000	5.5	33
(j) Plug concrete	cu.m	100	320	32
(2) Primary cofferdam	cu.m	6	3,000	18
(3) Secondary cofferdam				
(a) Excavation, common	cu.m	5	6,400	32
(b) Excavation, rock	cu.m	20	900	18
(c) Concrete	cu.m	100	3,930	393
(4) Miscellaneous works	L.S			88
Sub-total of Item 1				1,878
2. Dam and Spillway				
(1) Excavation, common	cu.m	5	43,000	215
(2) Excavation, rock	cu.m	20	25,500	510
(3) Mass concrete	cu.m	100	50,300	5,030
(4) Structural concrete	cu.m	170	2,800	476
(5) Reinforcing bar	ton	1,300	85	111
(6) Riverbed protection	cu.m	70	2,050	144
(7) Spillway bridge	L.S			14
(8) Bridge for maintenance	L.S			3
(9) Curtain grouting	L.S			87
(10) Consolidation grouting	L.S			27
(11) Spillway gate	ton	6,000	650	3,900
(12) Sand scouring gate	ton	6,000	70	420
(13) Miscellaneous works	L.S			331
Sub-total of Item 2				11,267
3. Intake and Sand Trap Basin				
(1) Excavation, common	cu.m	5	83,200	416
(2) Excavation, rock	cu.m	20	31,100	622
(3) Backfill	cu.m	4	20,640	83
(4) Mass concrete	cu.m	100	2,540	254
(5) Structural concrete	cu.m	170	18,800	3,196
(6) Reinforcing bar	ton	1,300	235	306
(7) Intake gate	ton	6,000	120	720
(8) Trashrack	ton	3,500	72	252
(9) Sand flush gate	ton	6,000	4	24
(10) Miscellaneous works	L.S			244
Sub-total of Item 3				6,116
				(to be continued)

表 7. 4 Benedito Novo 水力発電計画の工事費 (2 / 3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
4. Headrace Tunnel				
(1) Tunnel excavation	cu.m	140	21,520	3,013
(2) Lining concrete	cu.m	192	6,100	1,171
(3) Reinforcing bar	ton	1,300	155	202
(4) Steel support	ton	2,500	51	128
(5) Consolidation grouting	L.S			66
(6) Work adit	L.S			118
(7) Miscellaneous works	L.S			229
Sub-total of Item 4				4,926
5. Surge Tank				
(1) Open excavation, common	cu.m	5	20,000	100
(2) Open excavation, rock	cu.m	20	6,300	126
(3) Shaft excavation	cu.m	130	3,300	429
(4) Lining concrete	cu.m	190	990	188
(5) Structural concrete	cu.m	170	80	14
(6) Reinforcing bar	ton	1,300	55	72
(7) Consolidation grouting	L.S			18
(8) Miscellaneous works	L.S			47
Sub-total of Item 5				994
6. Penstock				
(1) Open excavation, common	cu.m	5	7,150	36
(2) Open excavation, rock	cu.m	20	5,860	117
(3) Shaft excavation	cu.m	130	3,000	390
(4) Backfill	cu.m	4	10,600	42
(5) Open concrete	cu.m	170	1,050	179
(6) Backfill concrete	cu.m	200	1,290	258
(7) Reinforcing bar	ton	1,300	10	13
(8) Consolidation grouting	L.S			84
(9) Steel liner	ton	3,800	350	1,330
(10) Work adit	L.S			201
(11) Miscellaneous works	L.S			122
Sub-total of Item 6				2,772
7. Power Station & Tailrace				
(1) Excavation, common	cu.m	5	9,600	48
(2) Excavation, rock	cu.m	20	4,000	80
(3) Backfill	cu.m	4	700	3
(4) Embankment	cu.m	6	5,100	31
(5) Concrete	cu.m	190	9,000	1,710
(6) Backfill concrete	cu.m	100	1,300	130
(7) Reinforcing bar	ton	1,300	220	286
(8) Superstructure	cu.m	190	4,600	874
(9) Draft tube gate	ton	6,000	4	24
(10) Generating equipment	L.S			5,650
(11) T/L & S/S	L.S			2,657
(12) Miscellaneous works	L.S			114
Sub-total of Item 7				11,607
				(to be continued)

表 7.4 Benedito Novo 水力発電計画の工事費 (3 / 3)

Work Item	Unit	Unit Price (US\$)	Quantity	Amount (thousand US\$)
8. Relocation Road				
(1) Excavation, common	cu.m	5	71,600	358
(2) Excavation, rock	cu.m	20	46,200	924
(3) Slope Protection	sq.m	3.3	11,400	38
(4) Bridge	m	5,700	20	114
(5) Miscellaneous works	L.S			72
Sub-total of Item 8				1,505
9. Access Road				
(1) New construction road	Km	360,000	1.4	504
(2) Improvement of existing road	Km	180,000	0	0
(3) Bridge	m	5,700	0	0
(4) Miscellaneous works	L.S			25
Sub-total of Item 9				529
Total of Item I				41,593
II. Compensation Cost				
1. Land				
(1) Agricultural land	sq.Km	675,000	0.005	3
(2) Forest	sq.Km	400,000	0.011	4
(3) Urban area	sq.Km	7,700,000	0.012	92
Sub-total of Item 1				100
2. House				
(1) Brick house	Nos.	37,586	7	263
(2) Wooden house	Nos.	13,300	6	80
Sub-total of Item 2				343
3. Existing Power Station	KW	500	3,120	1,560
Total of Item II				2,003
III. Administration Cost				2,080
IV. Engineering Service Cost				3,480
V. Physical Contingency (15 %)				7,373
Grand Total				56,529

付 図

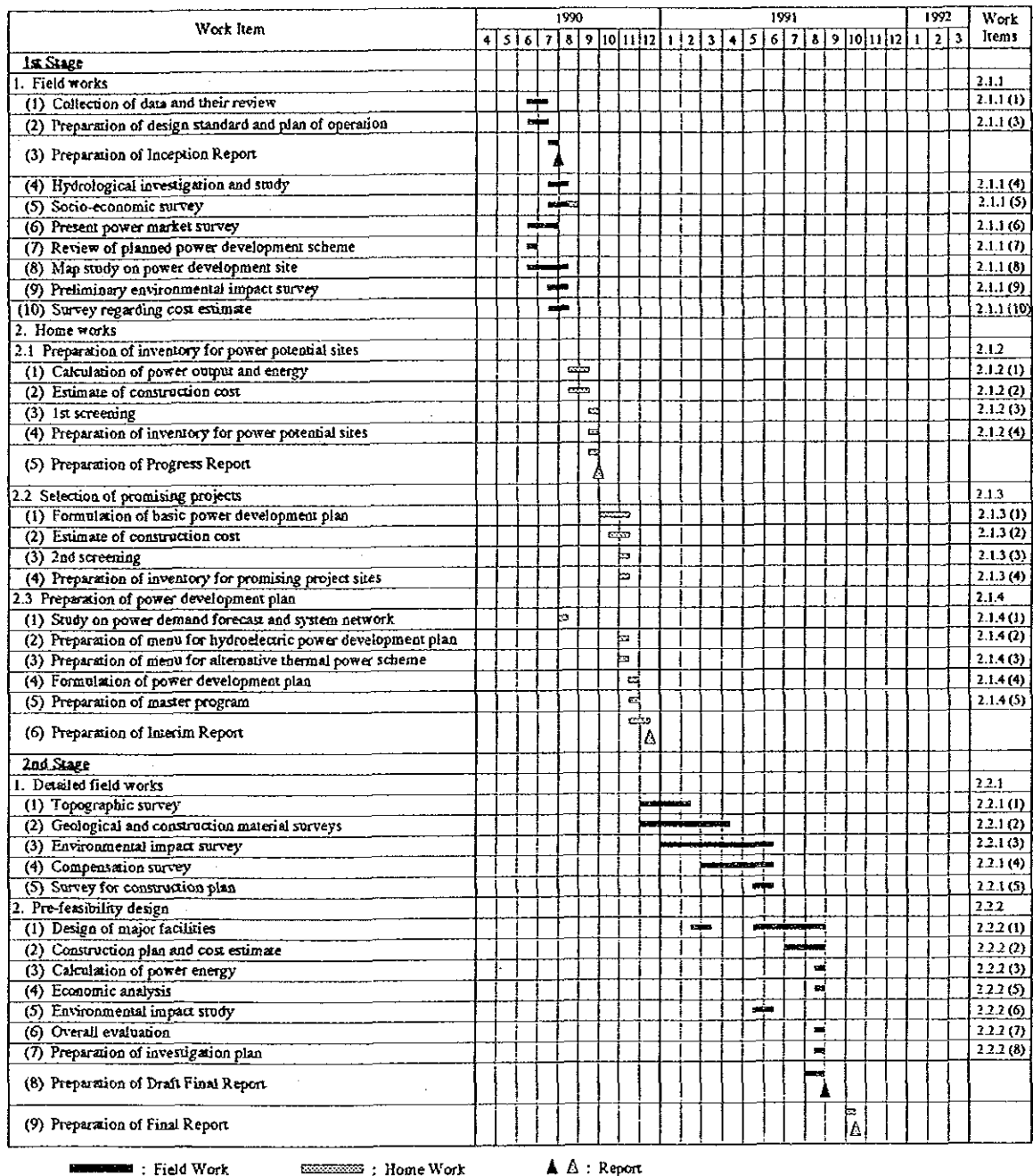


图 1.1 全体作業実施過程

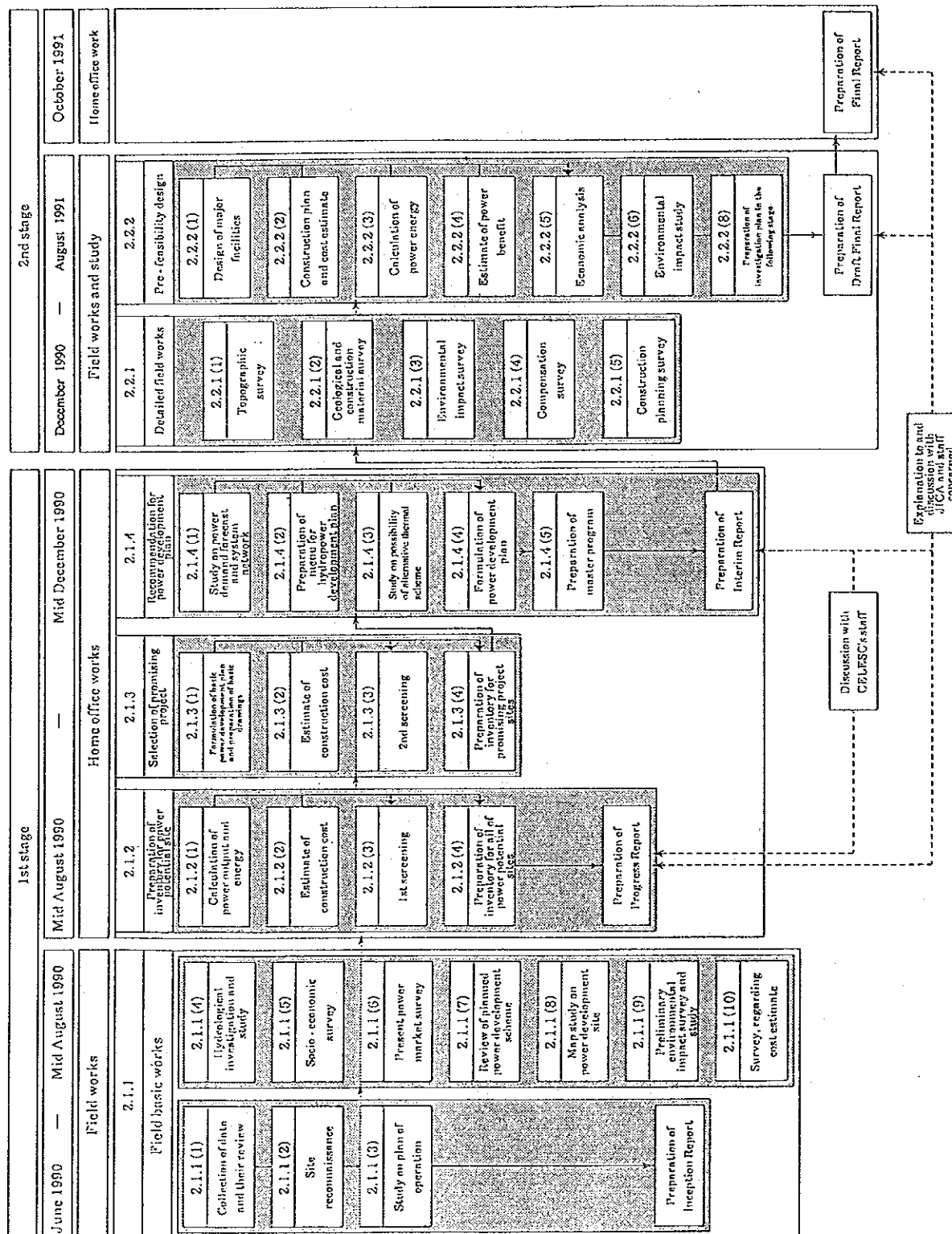


図 1.2 全体作業の流れ図

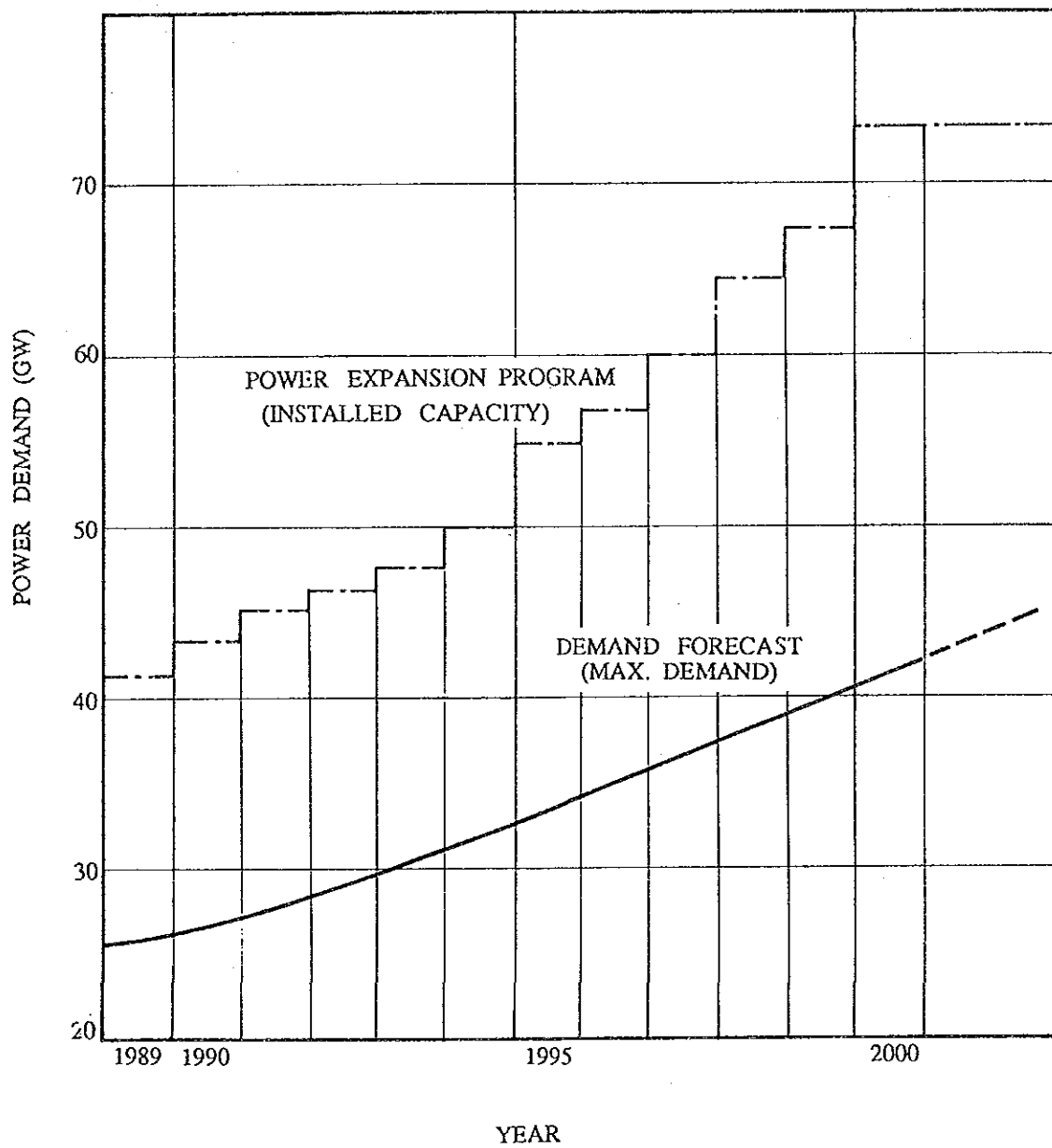


図 3.1 電力需要予測と供給曲線

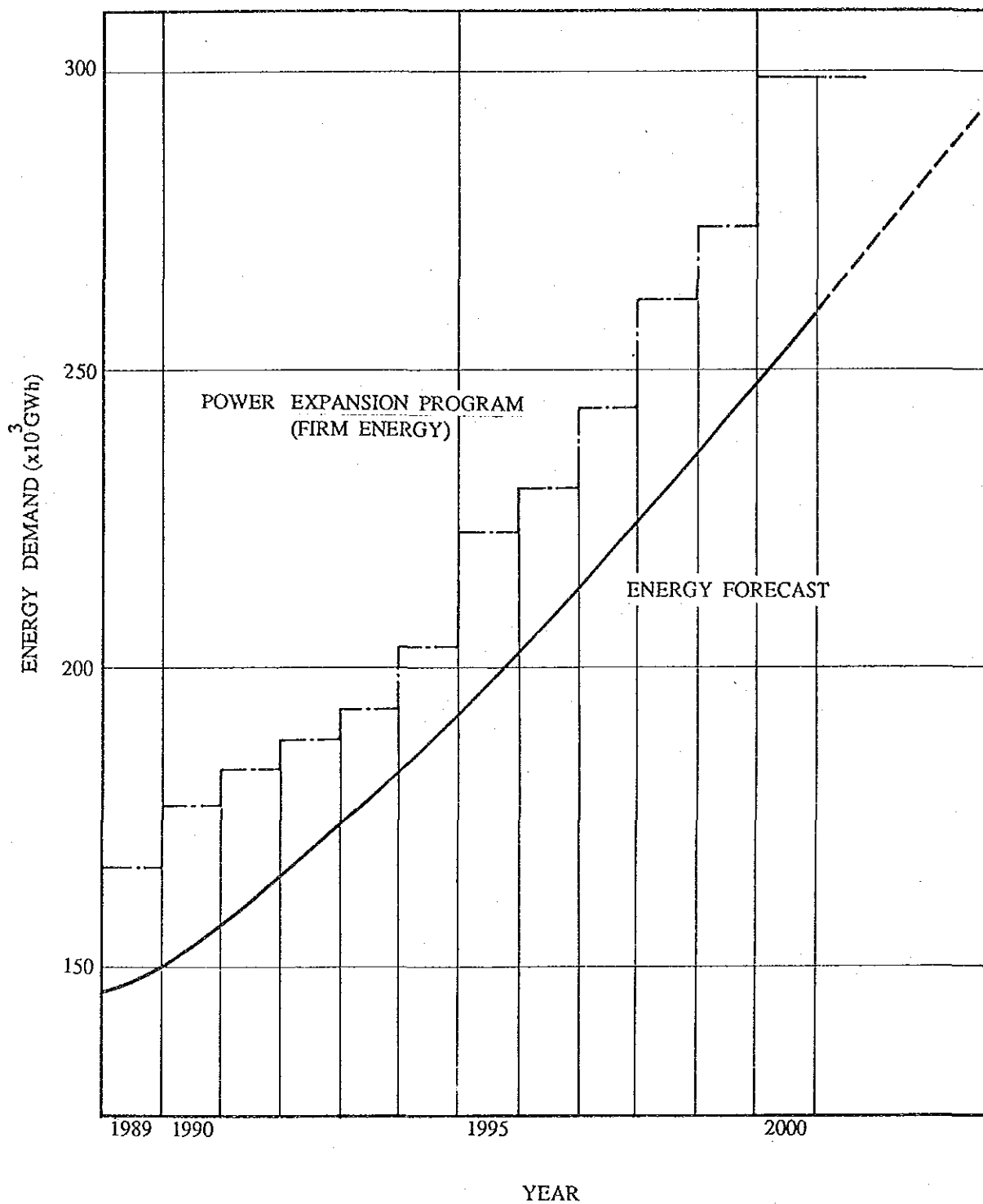
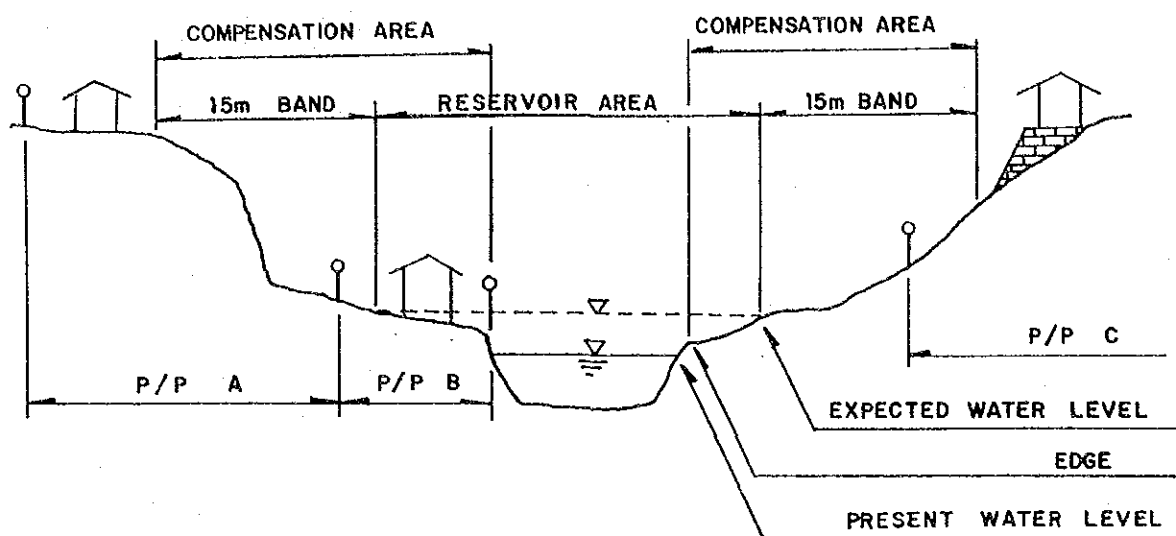


図 3.2 電力量需要予測と供給曲線

A. COMPENSATED



P/P : PRIVATE PROPERTY

B. NOT COMPENSATED

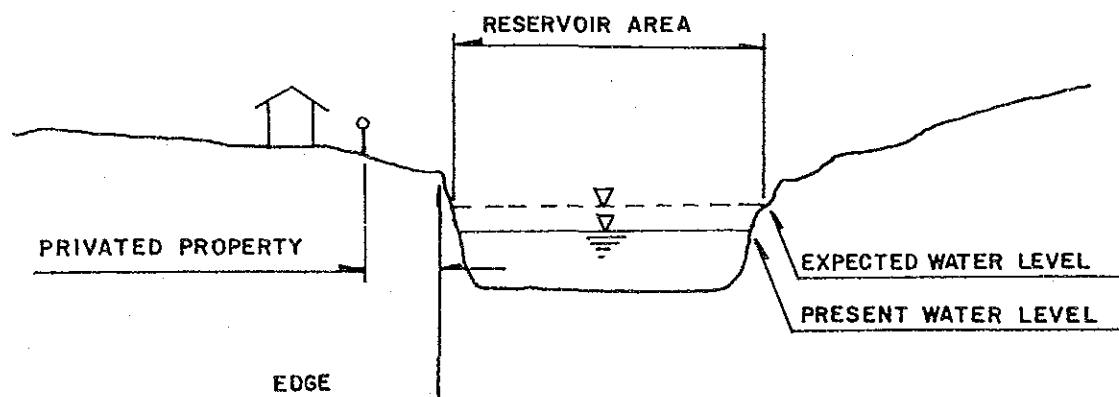
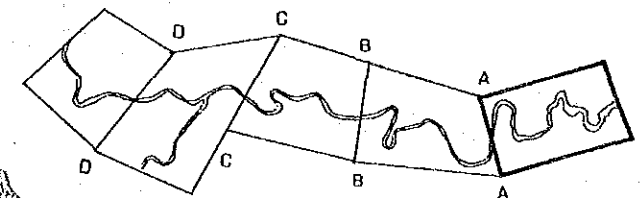
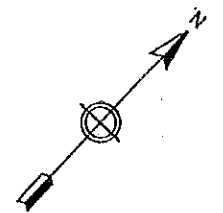


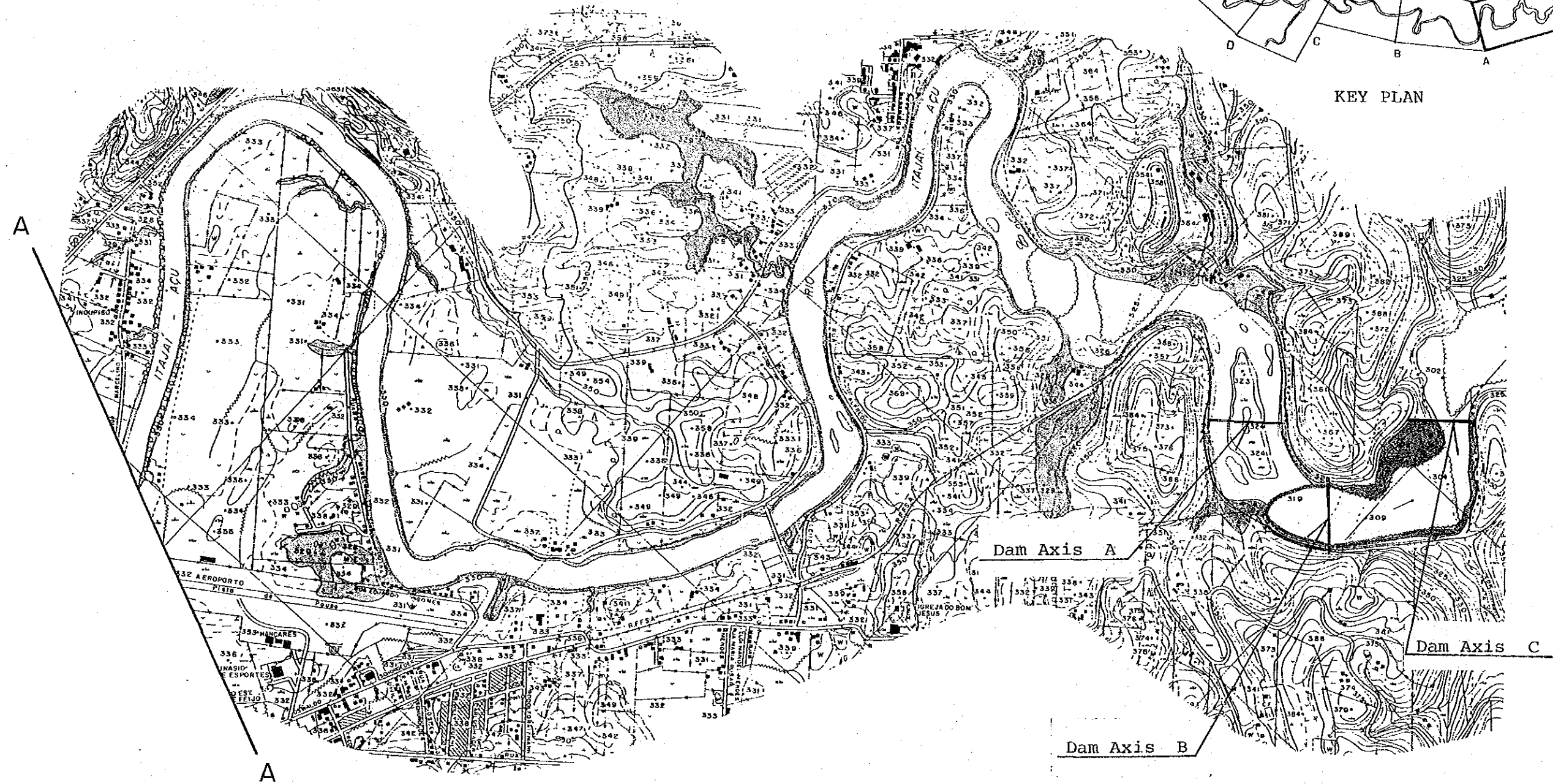
図 5.1 補償区域の定義

Legend

-  Submerged Area by
The Dam Axis A & B
-  Submerged Area by
The Dam Axis C

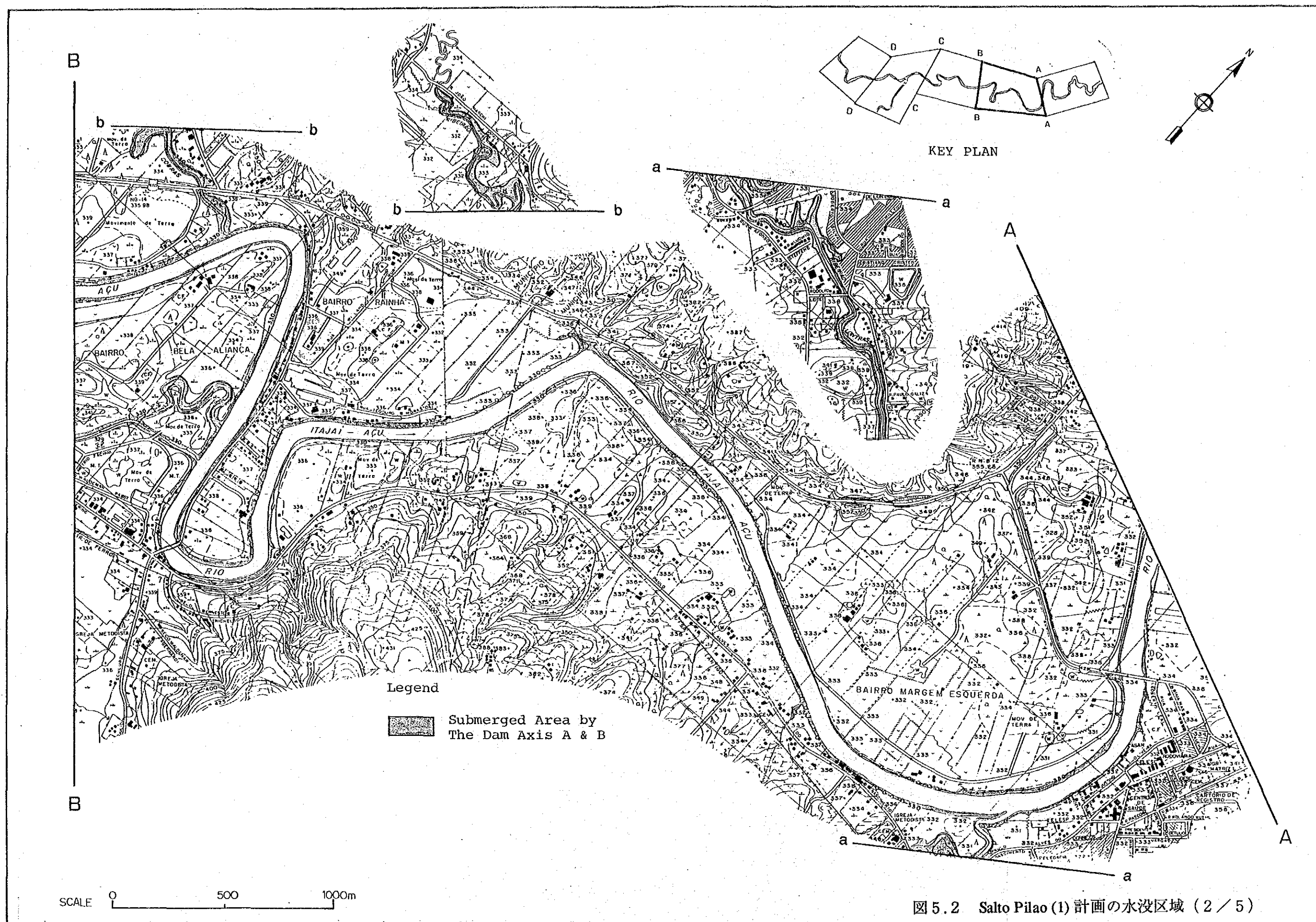


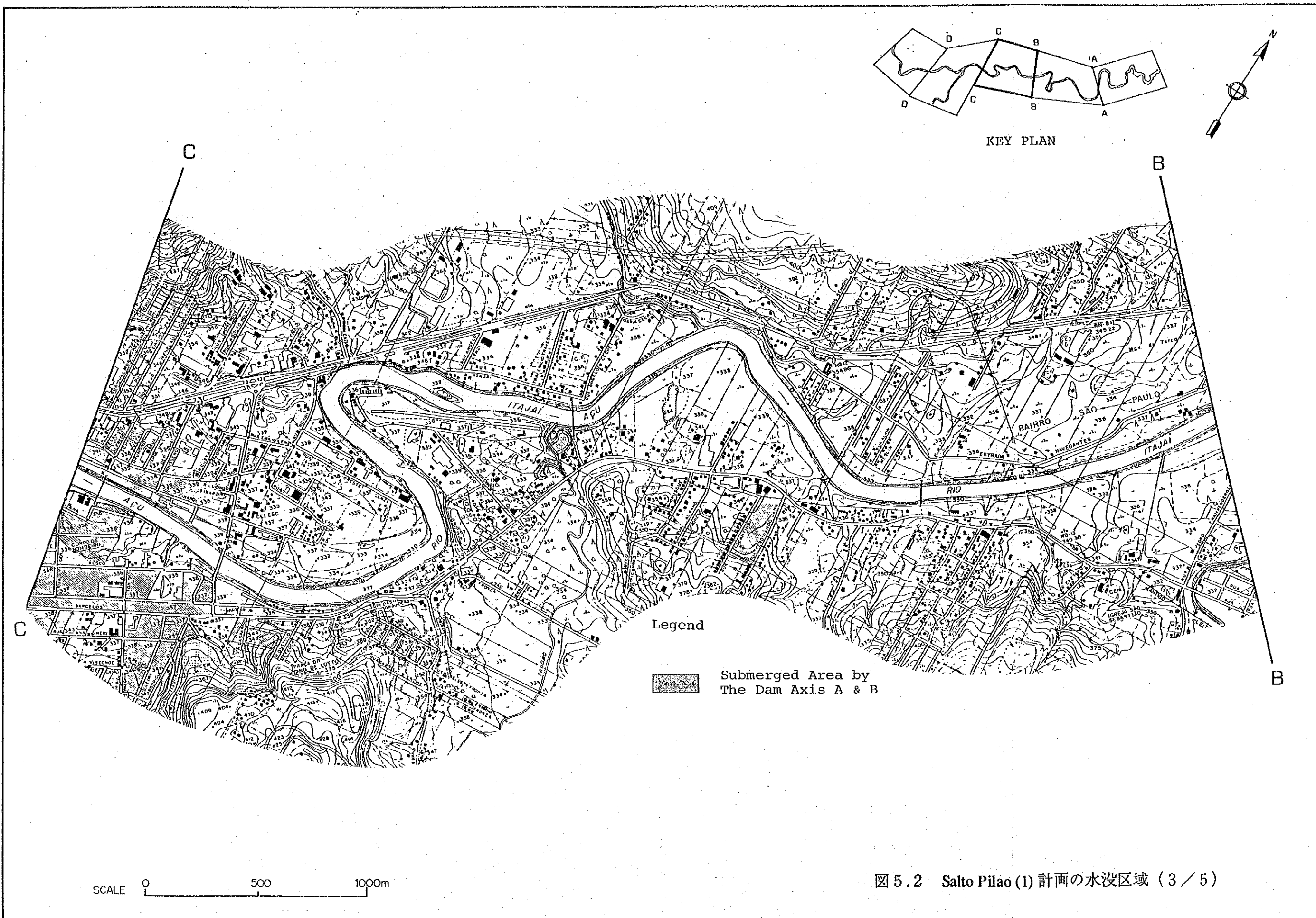
KEY PLAN



SCALE 0 500 1000m

図 5.2 Salto Pilao (1) 計画の水没区域 (1/5)





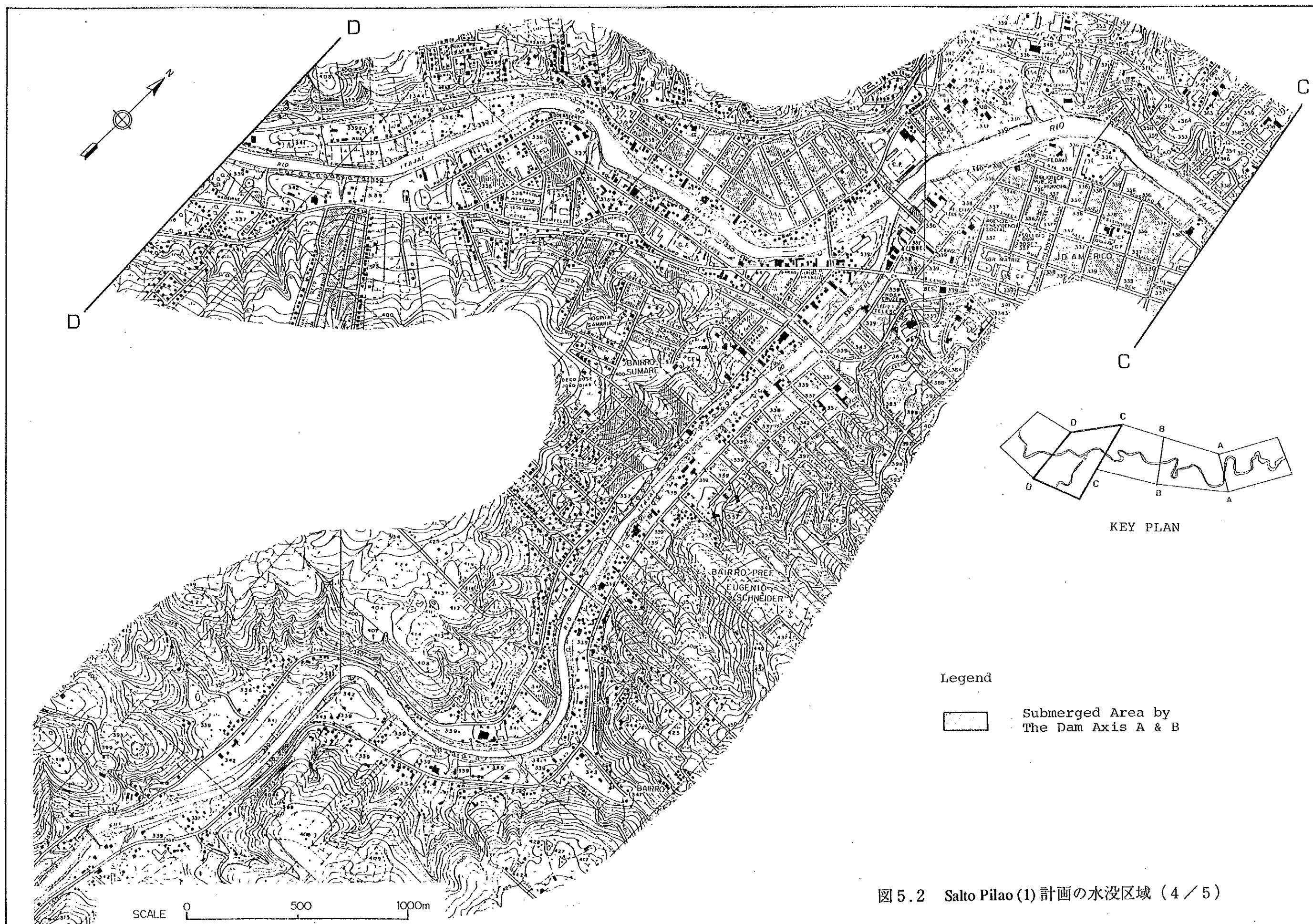
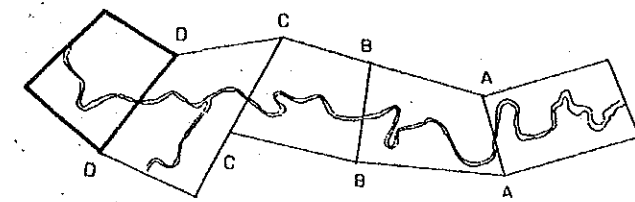
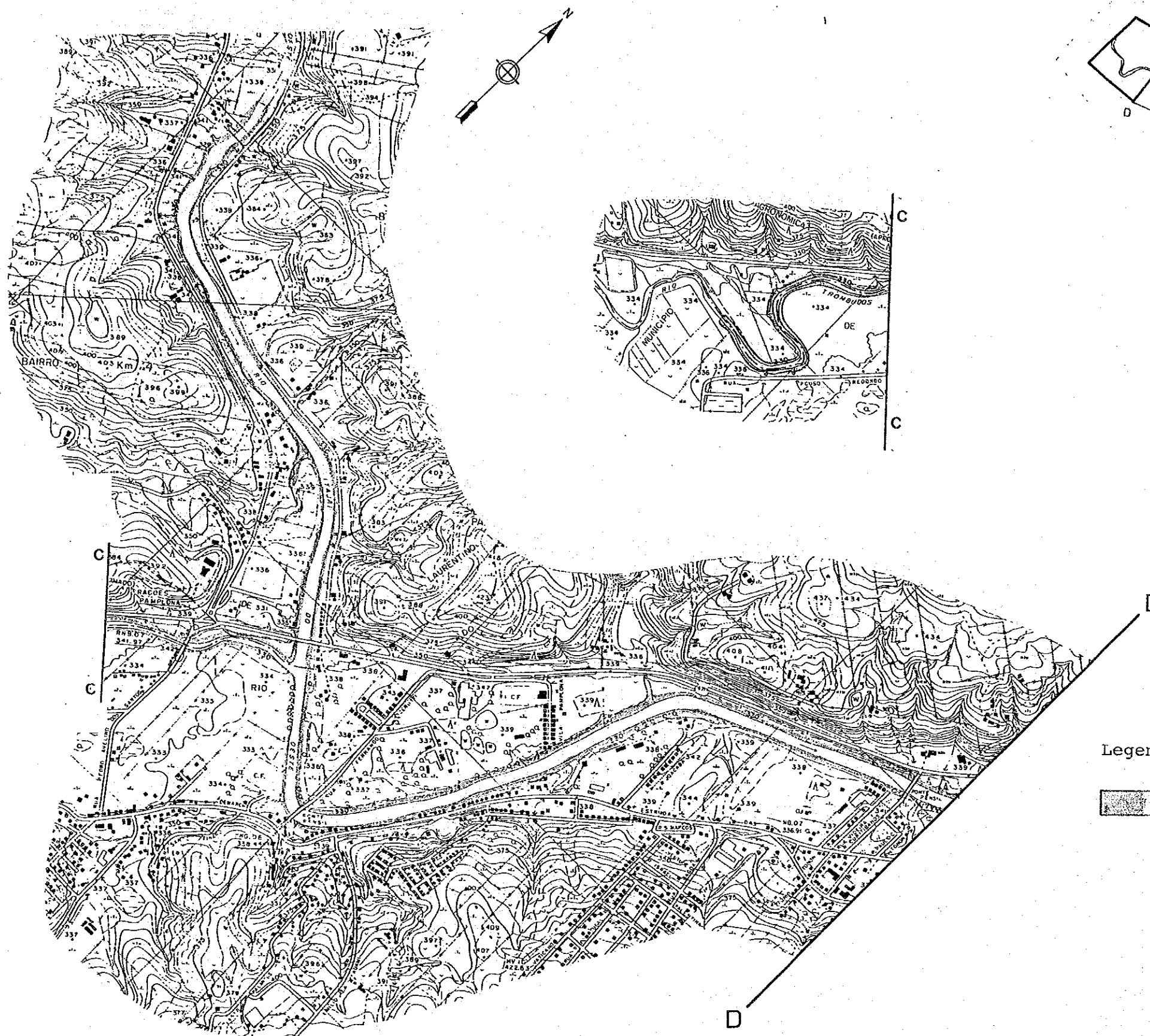


図 5.2 Salto Pilao (1) 計画の水没区域 (4 / 5)



KEY PLAN

Legend



Submerged Area by
The Dam Axis A & B

図 5.2 Salto Pilao (1) 計画の水没区域 (5 / 5)

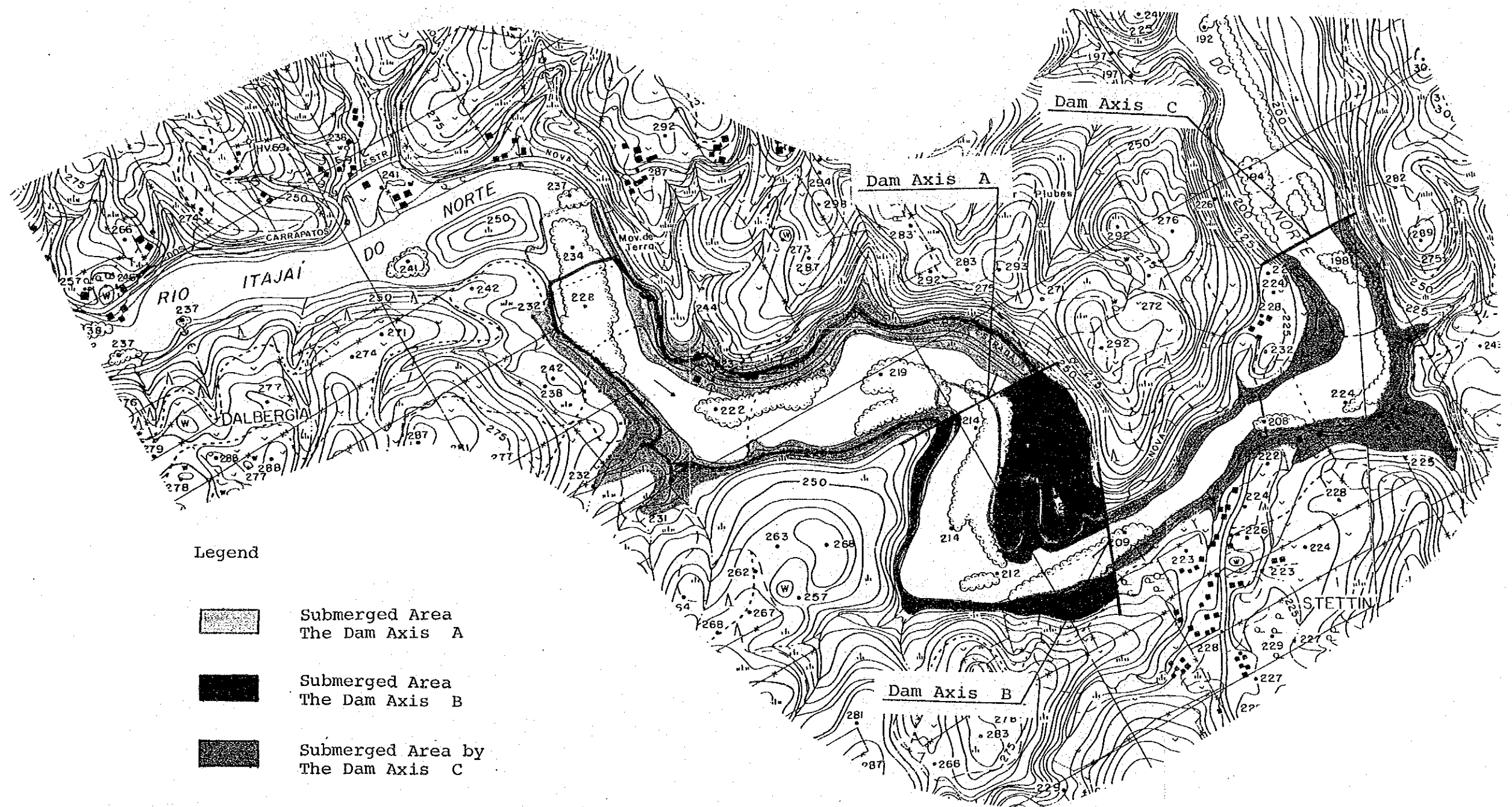
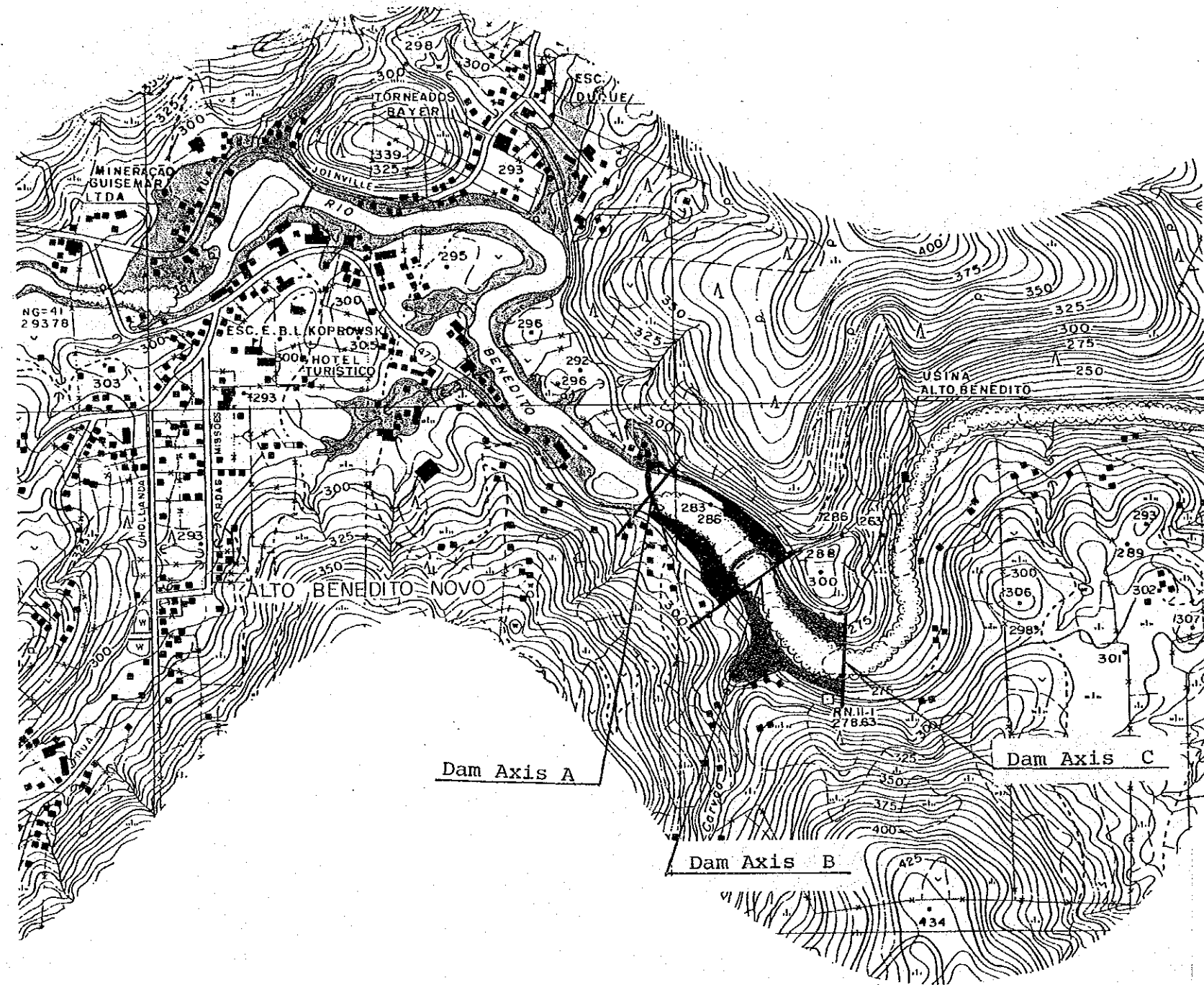


図 5.3 Dalbergia 計画の水没区域



Legend

-  Submerged Area by The Dam Axis A
-  Submerged Area The Dam Axis B
-  Submerged Area by The Dam Axis C

SCALE 0 500m

図 5.4 Benedito Novo計画の水没区域

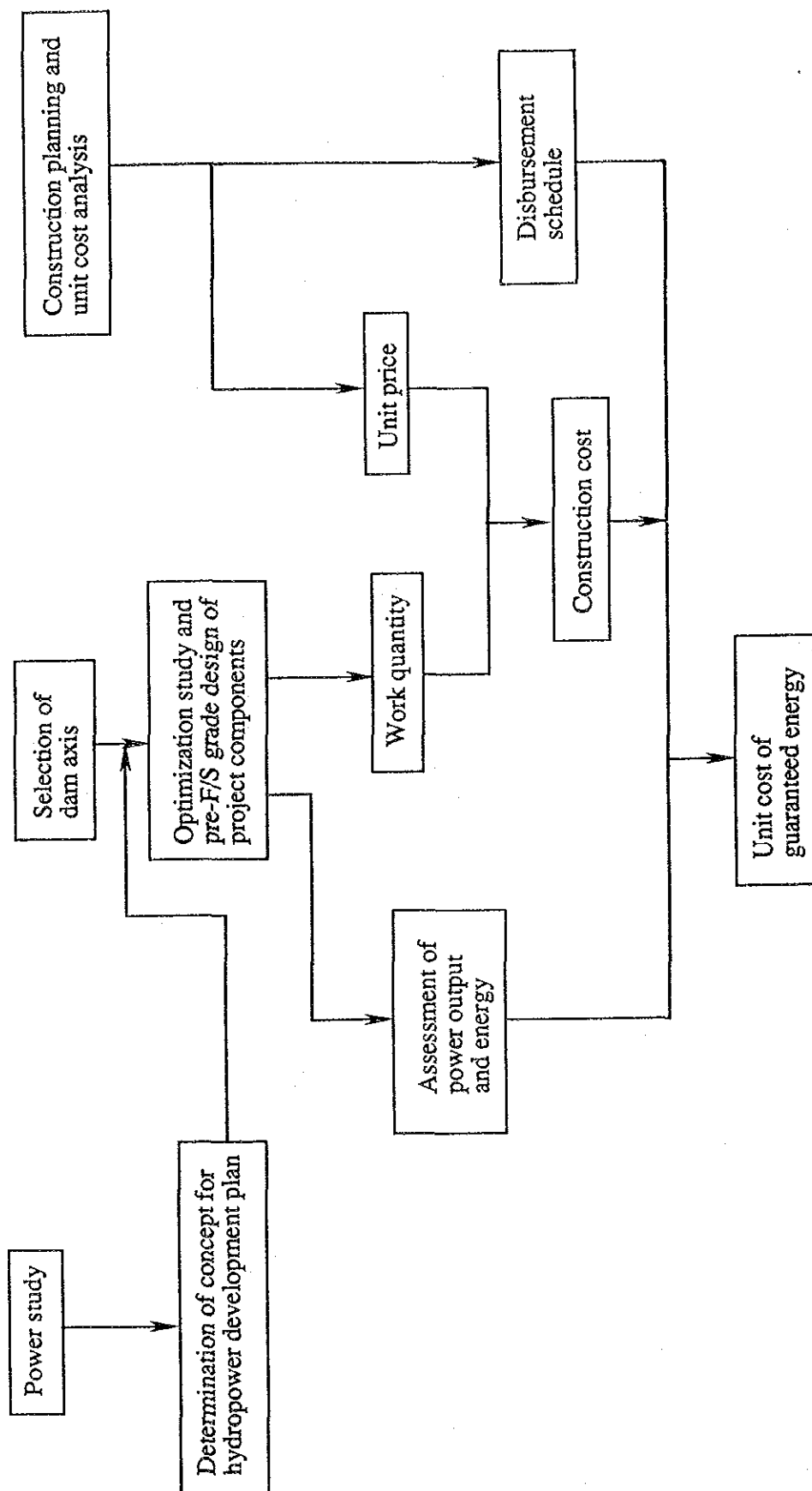
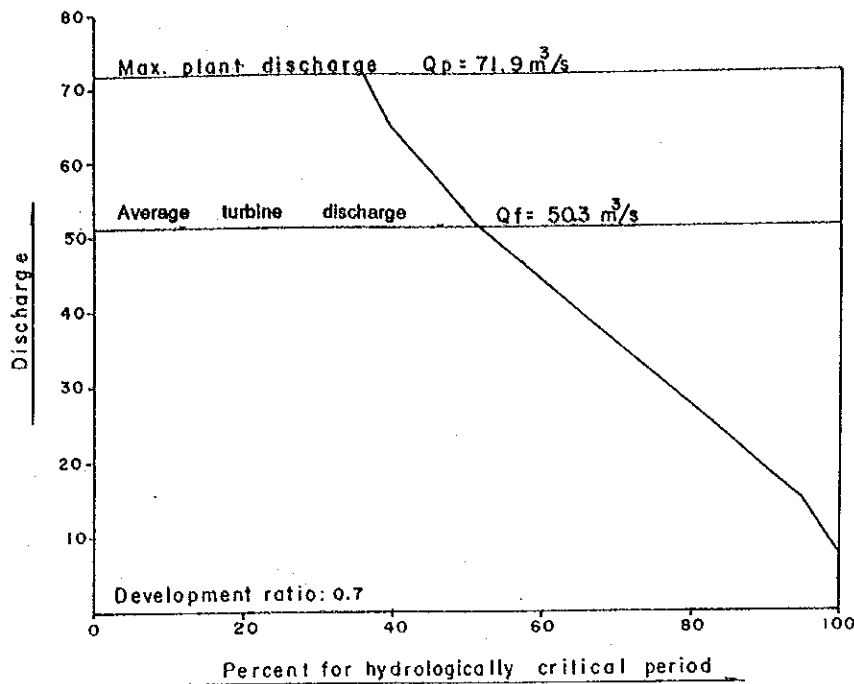
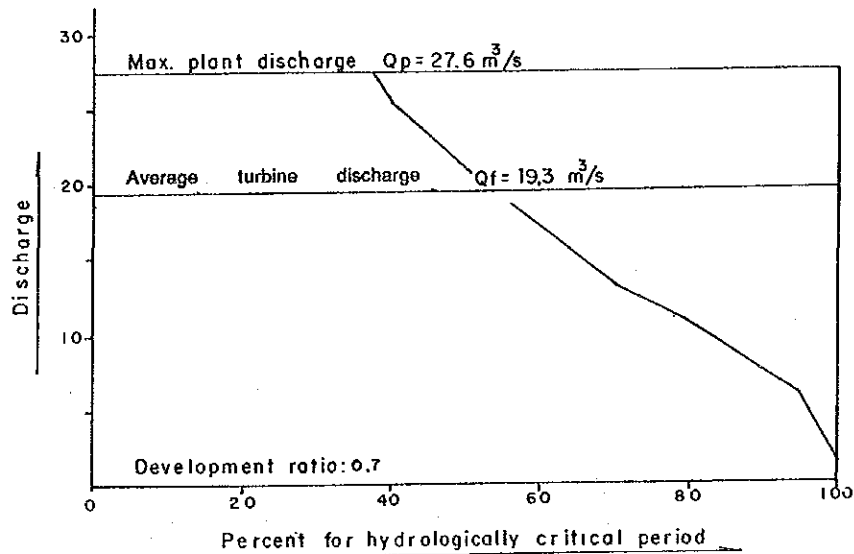


図 6.1 作業手順



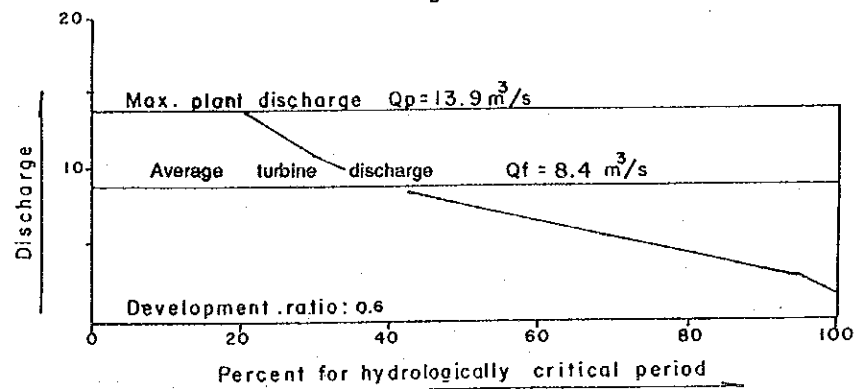
Excess Percent (%)	Flow Discharge (m^3/s)
1	562.0
5	318.0
10	204.0
15	155.0
20	121.0
30	83.9
40	64.6
50	53.1
60	44.4
70	35.7
80	27.4
90	18.9
95	15.0
100	7.3

Salto Pilão (I) Scheme



Excess Percent (%)	Flow Discharge (m^3/s)
1	280.3
5	145.0
10	82.8
15	60.6
20	48.2
30	33.2
40	25.4
50	20.8
60	17.0
70	13.1
80	10.6
90	7.5
95	5.7
100	1.2

Dalbergia Scheme



Excess Percent (%)	Flow Discharge (m^3/s)
1	75.5
5	31.7
10	20.6
15	16.5
20	14.0
30	10.8
40	9.1
50	7.6
60	6.6
70	5.6
80	4.6
90	3.4
95	2.8
100	1.9

Benedito Novo Scheme

図 6.2 最大使用水量と常時使用水量の相関図

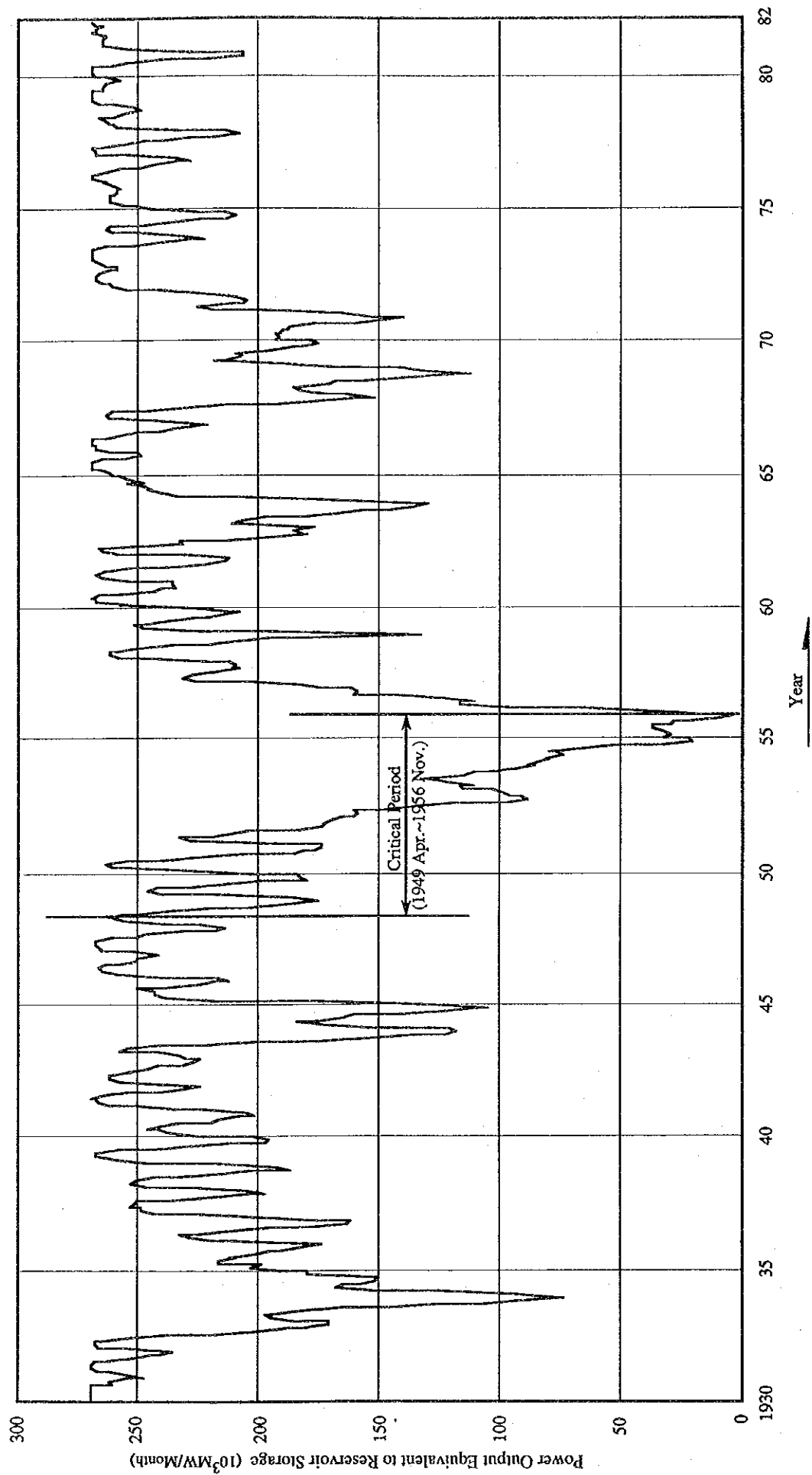


図 6.3 南部及び南東部電力系統における最渇水期間

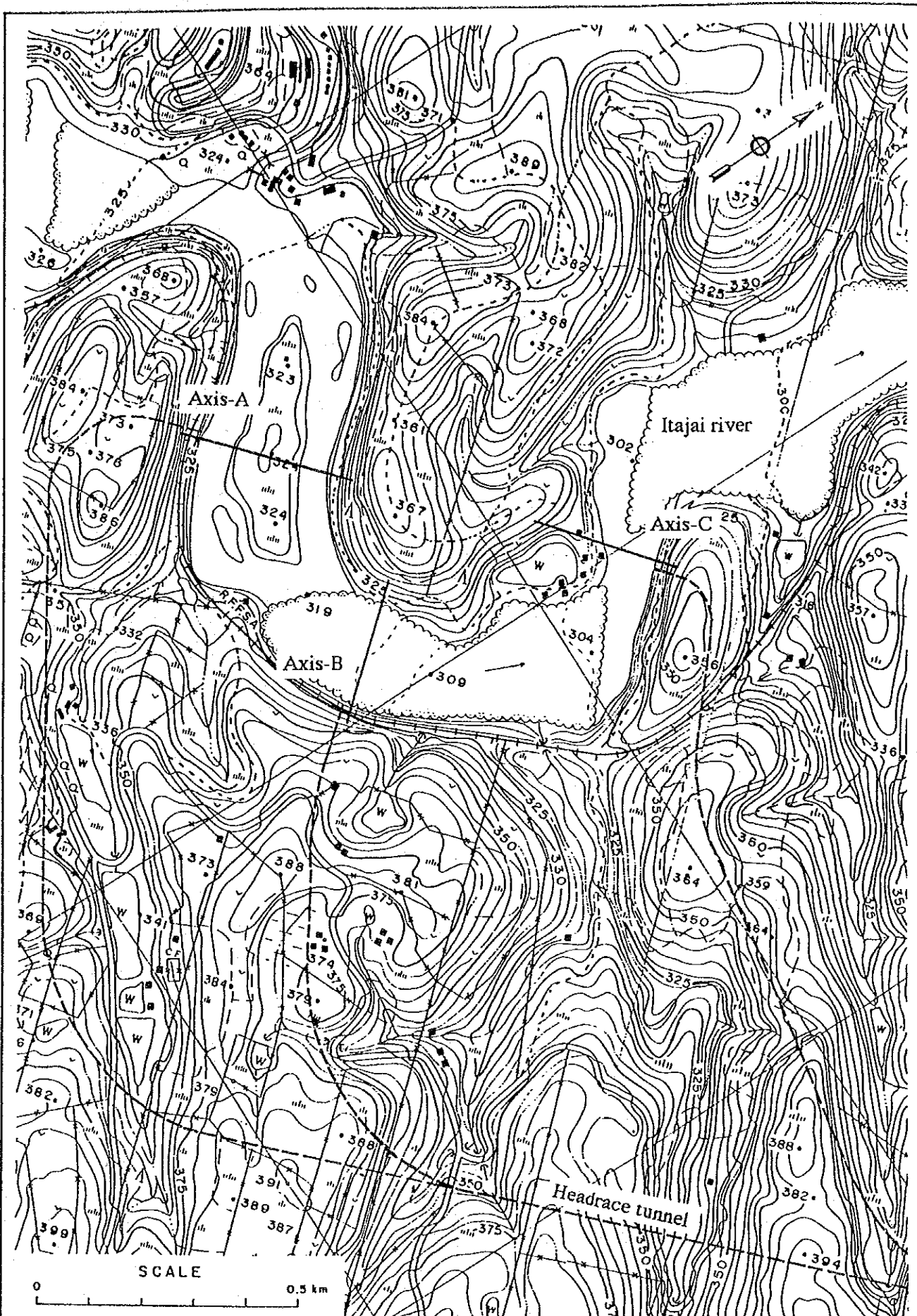


図 6.4 Salto Pilao (1) 計画の代替ダム軸の位置図



図 6.5 Salto Pilao (1) 計画の比較案の一般配置図

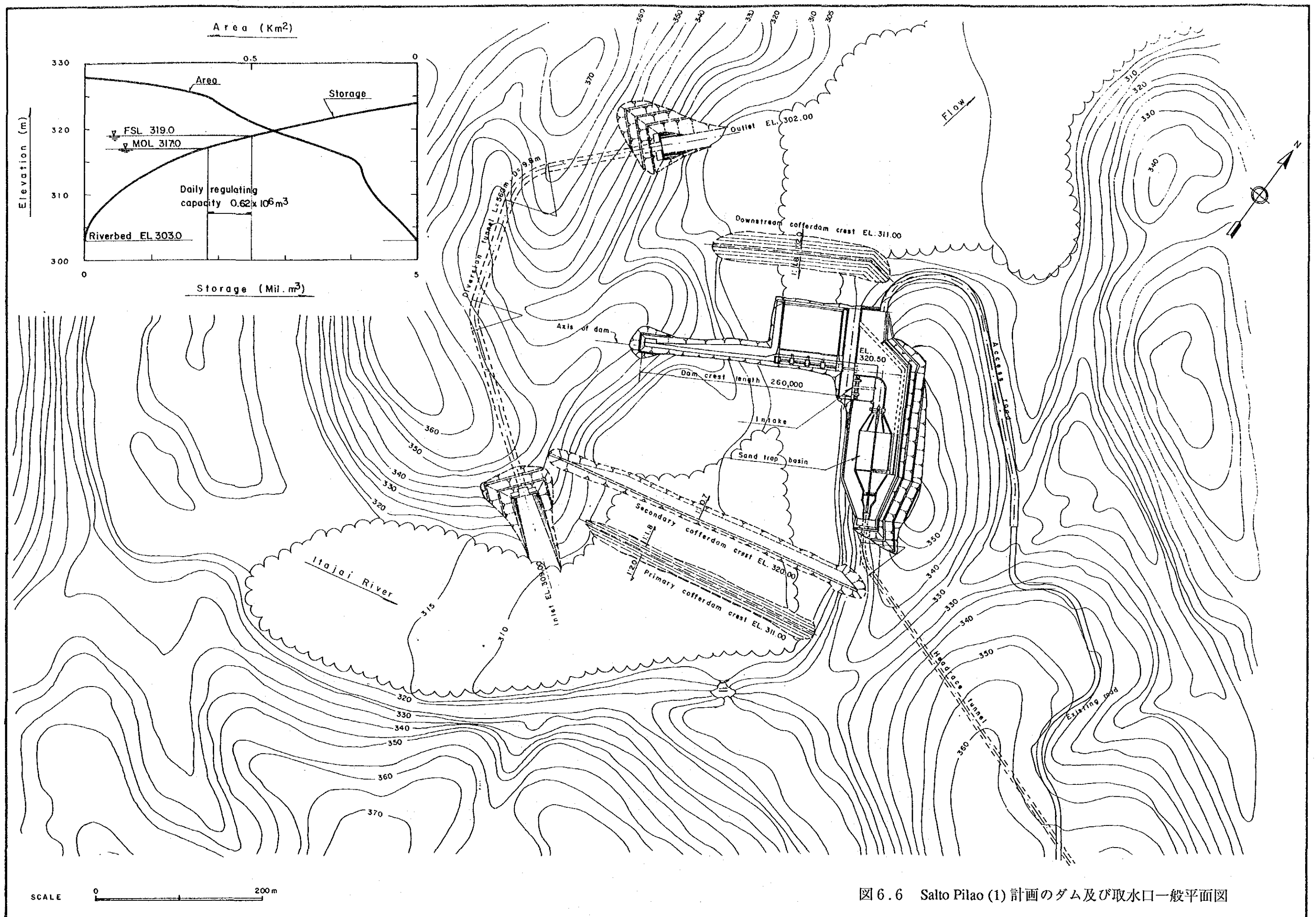
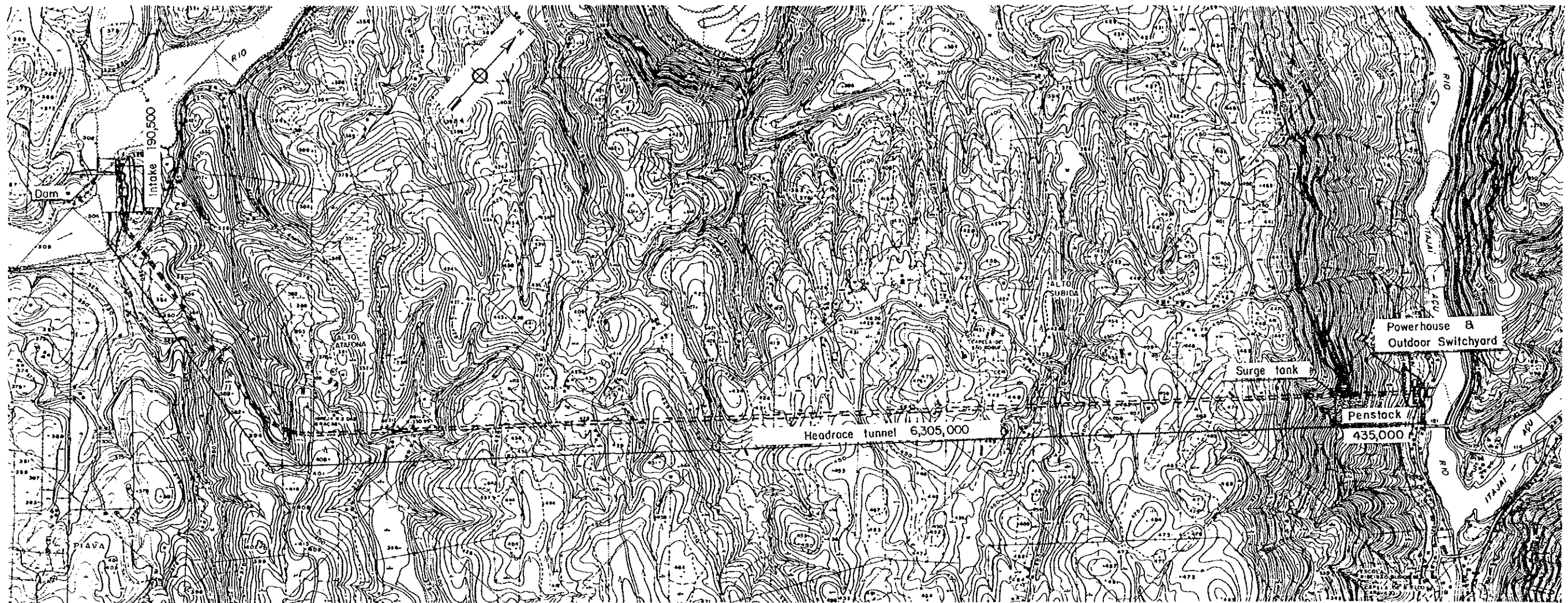
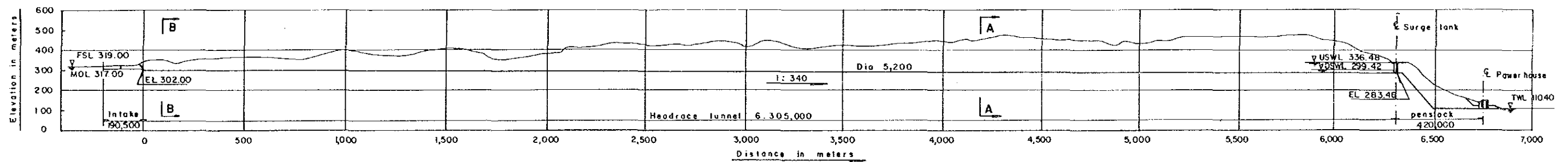


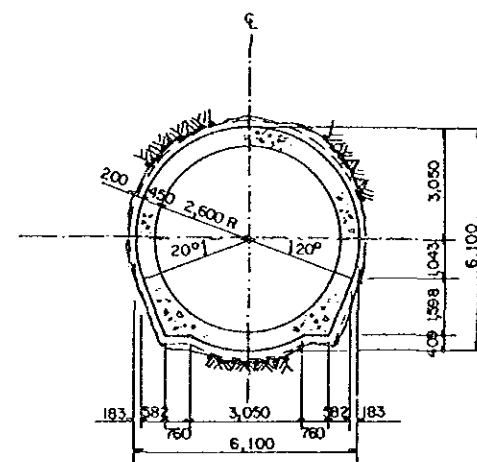
図 6.6 Salto Pilao (1) 計画のダム及び取水口一般平面図



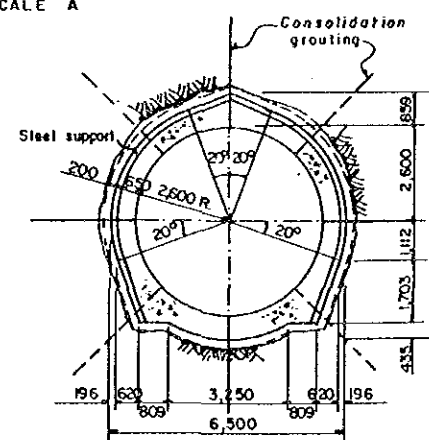
PLAN SCALE A



PROFILE SCALE A



SECTION A-A



SECTION B-B

TYPICAL SECTION OF HEADRACE TUNNEL SCALE B

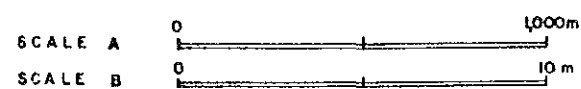


図 6.7 Salto Pilao (1) 計画の発電水路一般平面図及び縦断面図

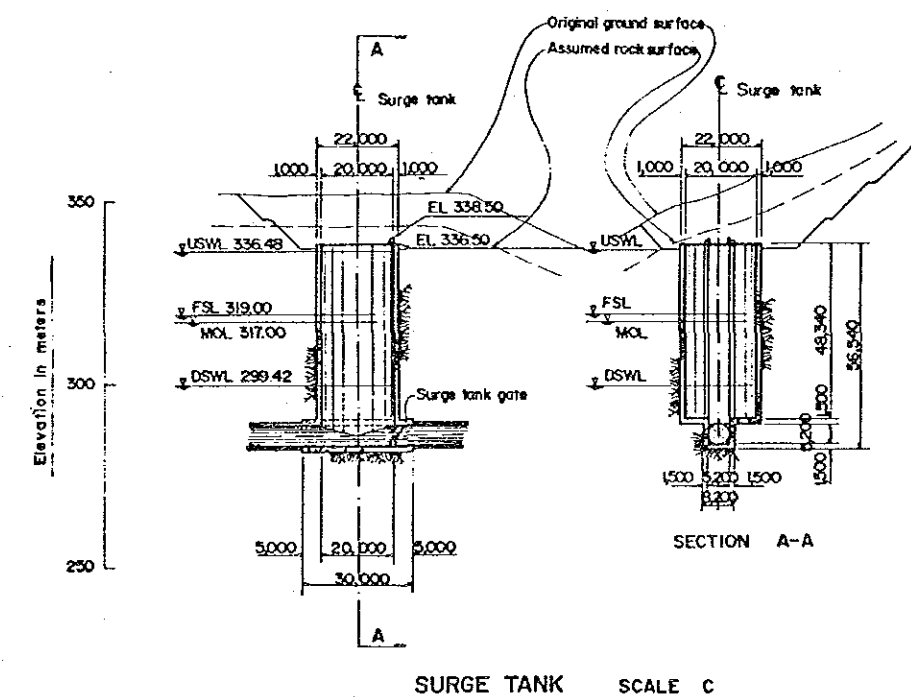
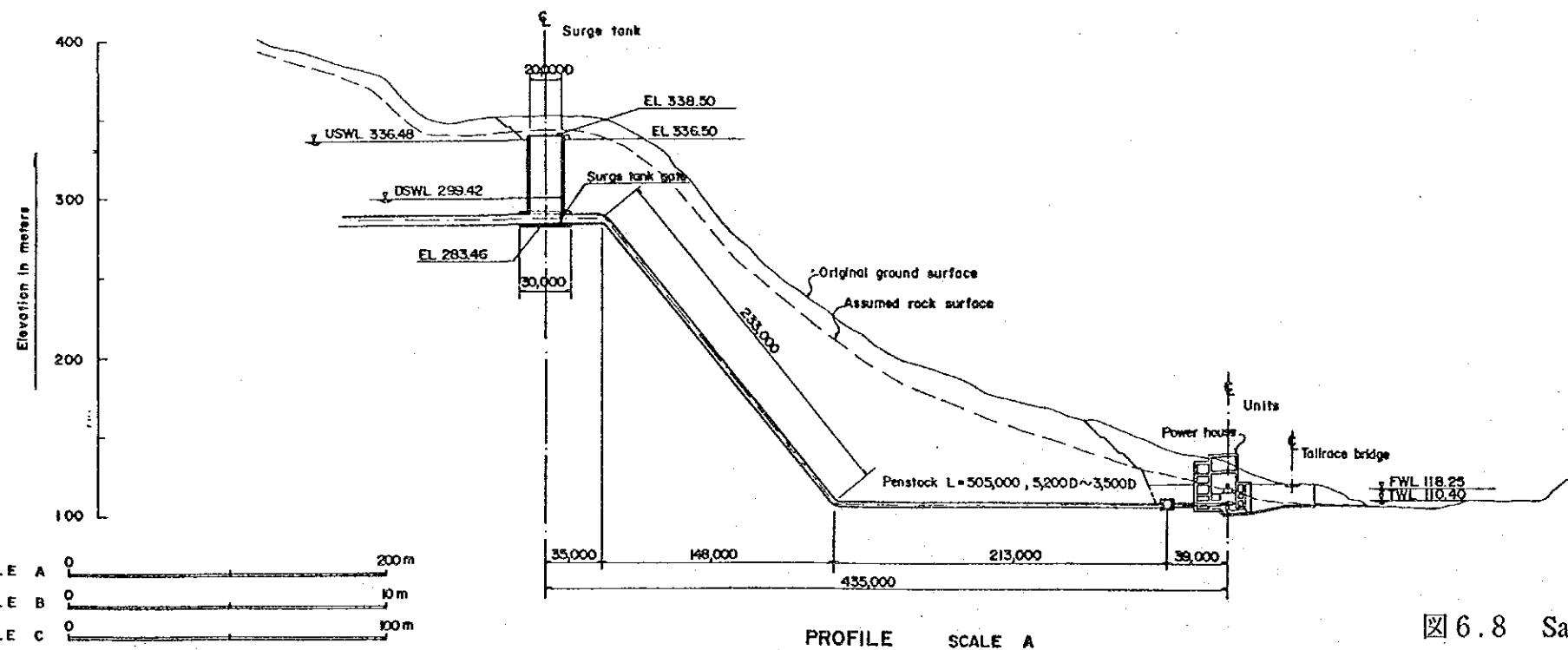
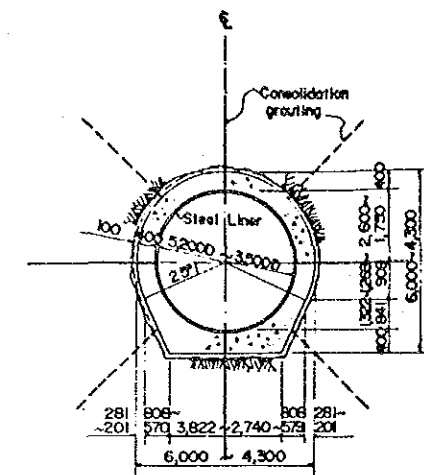
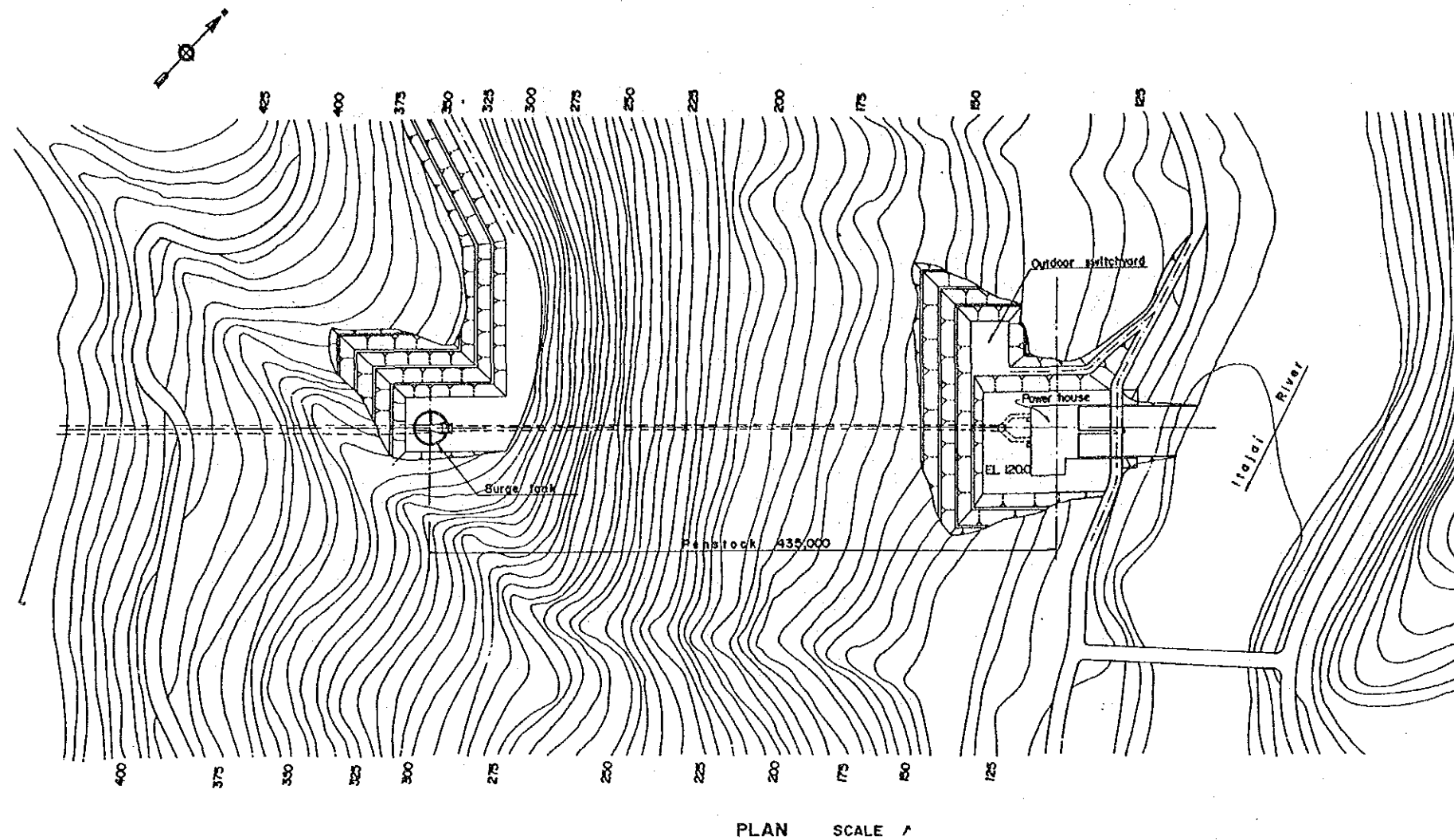
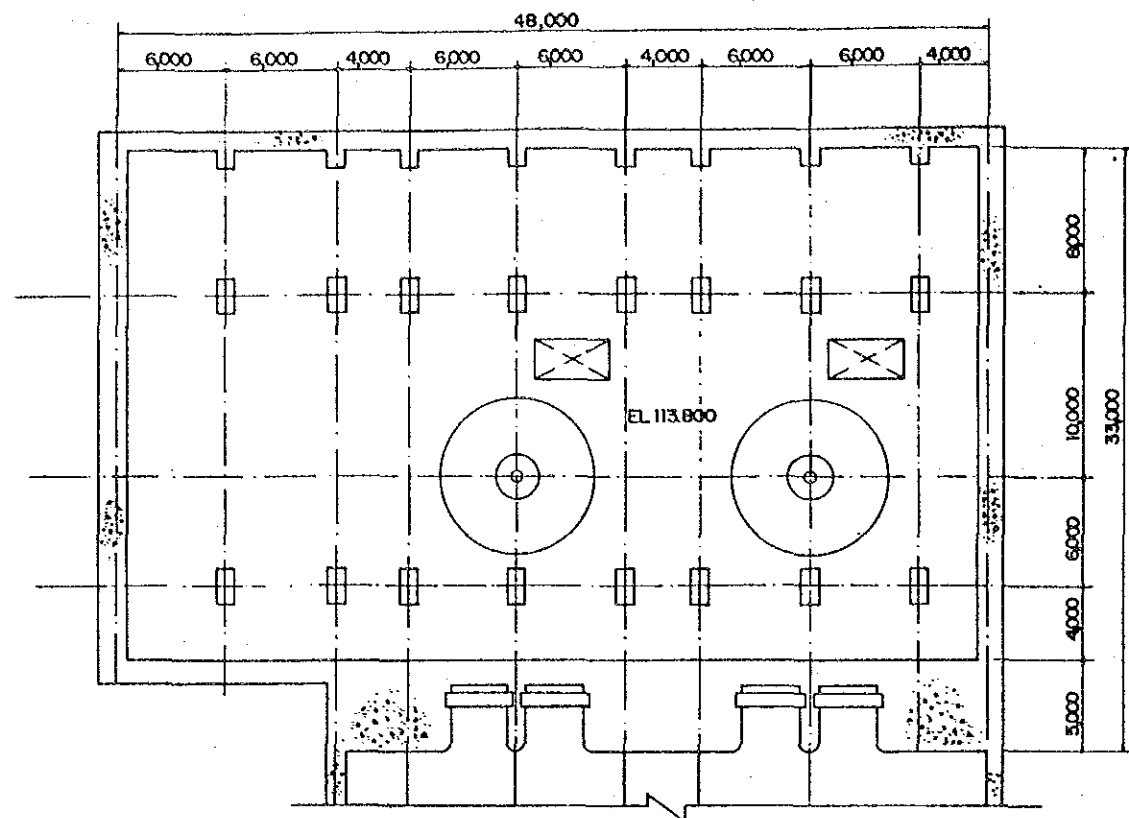
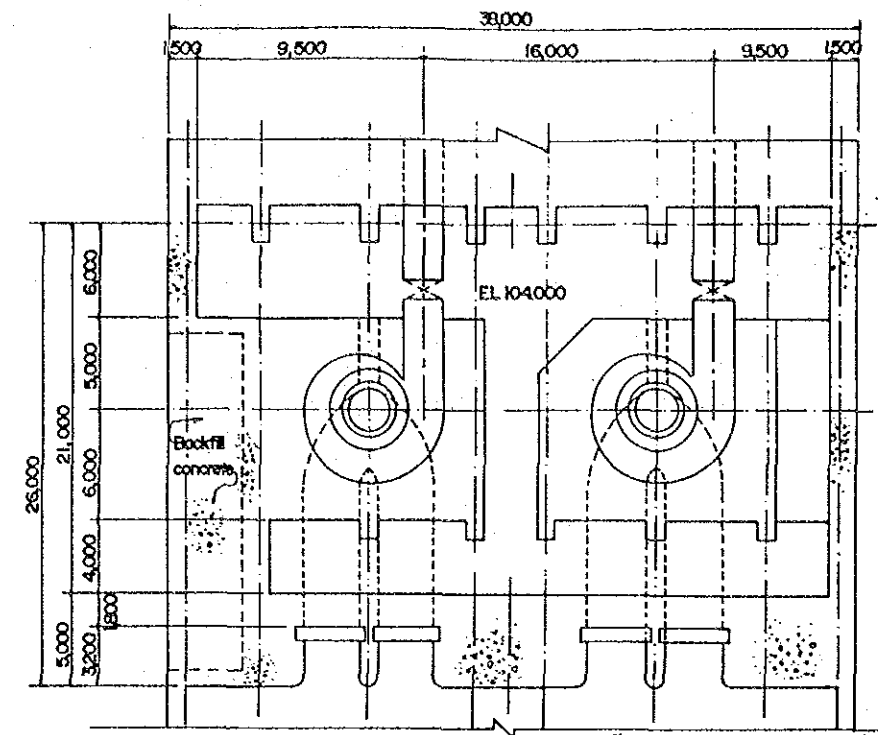


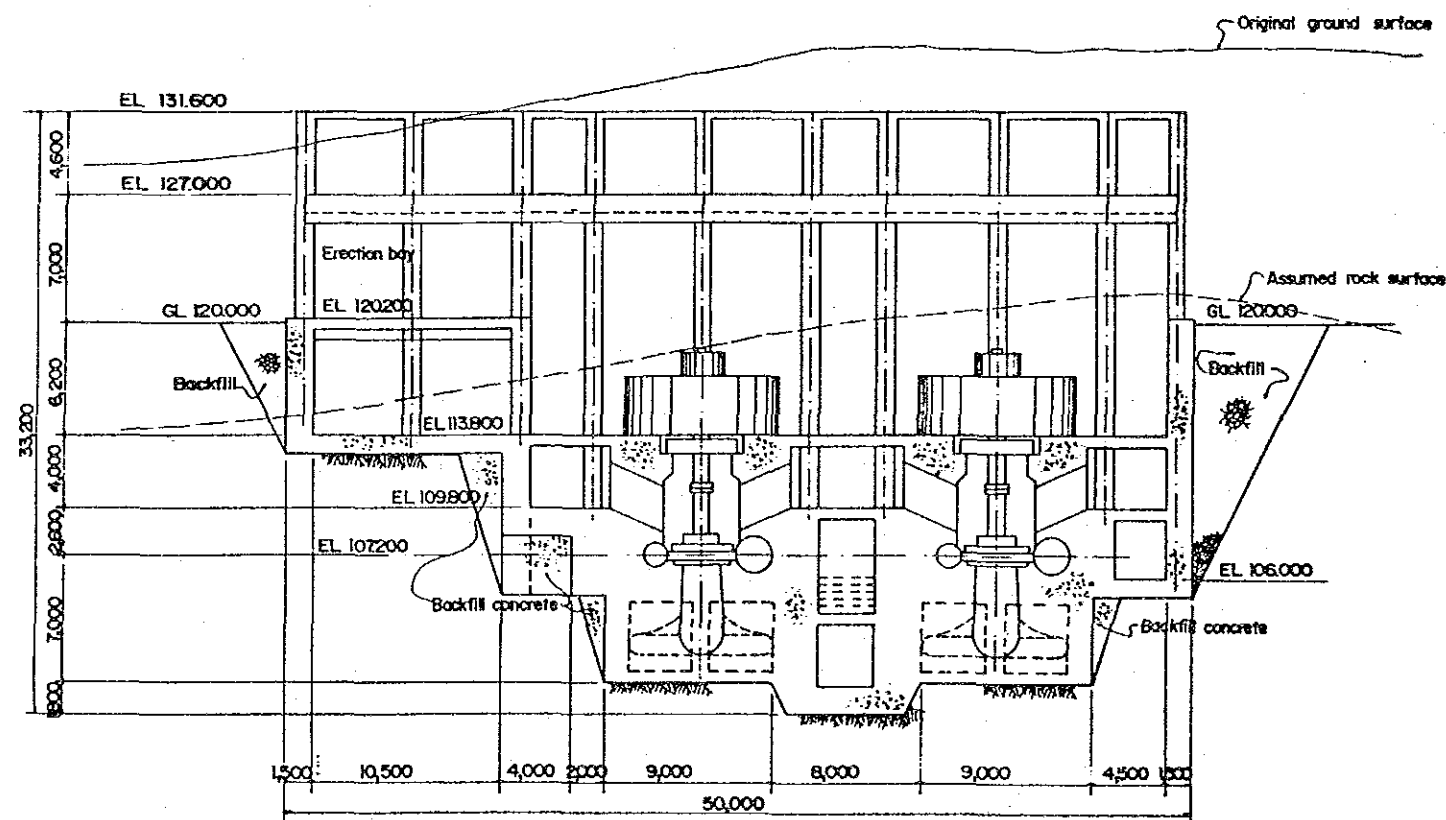
図 6.8 Salto Pilao (1) 計画の調圧水槽、水圧鉄管一般平面図及び縦断面図



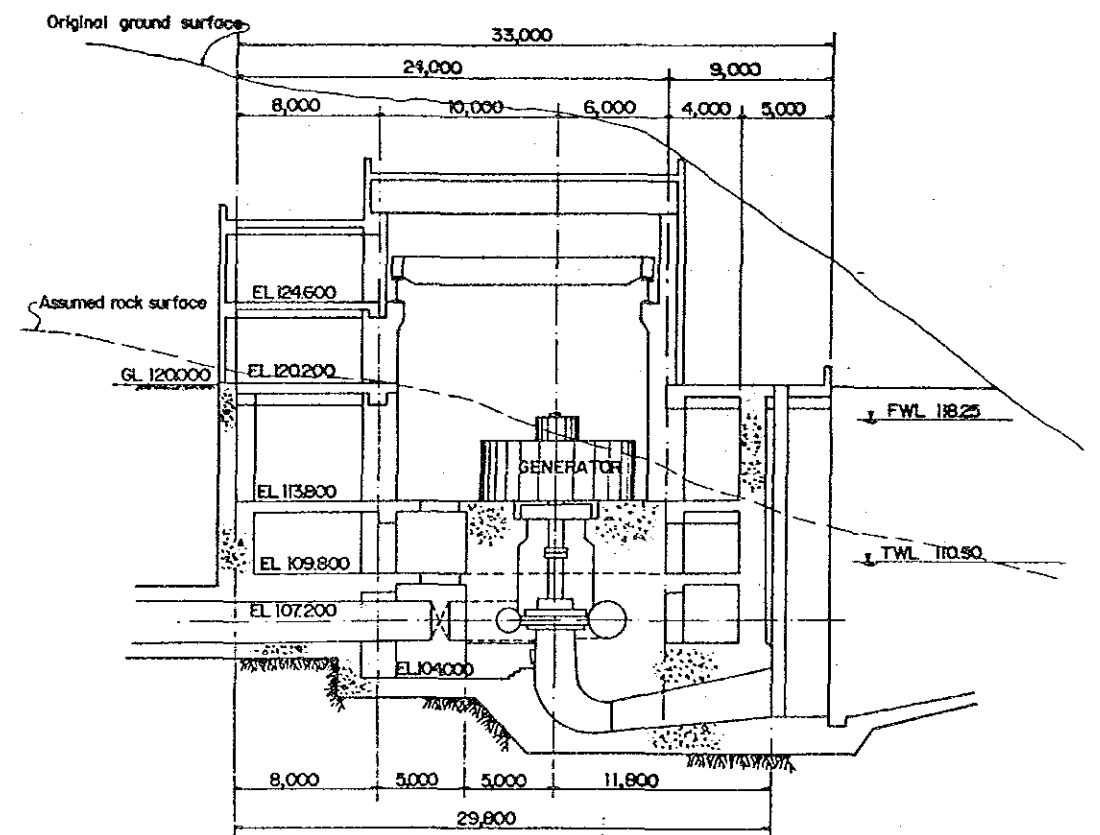
PLAN (EL 113.800)



PLAN (EL 107.200)



LONGITUDINAL SECTION



TRANSVERSE SECTION

図 6.9 Salto Pilao (1) 計画の発電所

SCALE 0 20m

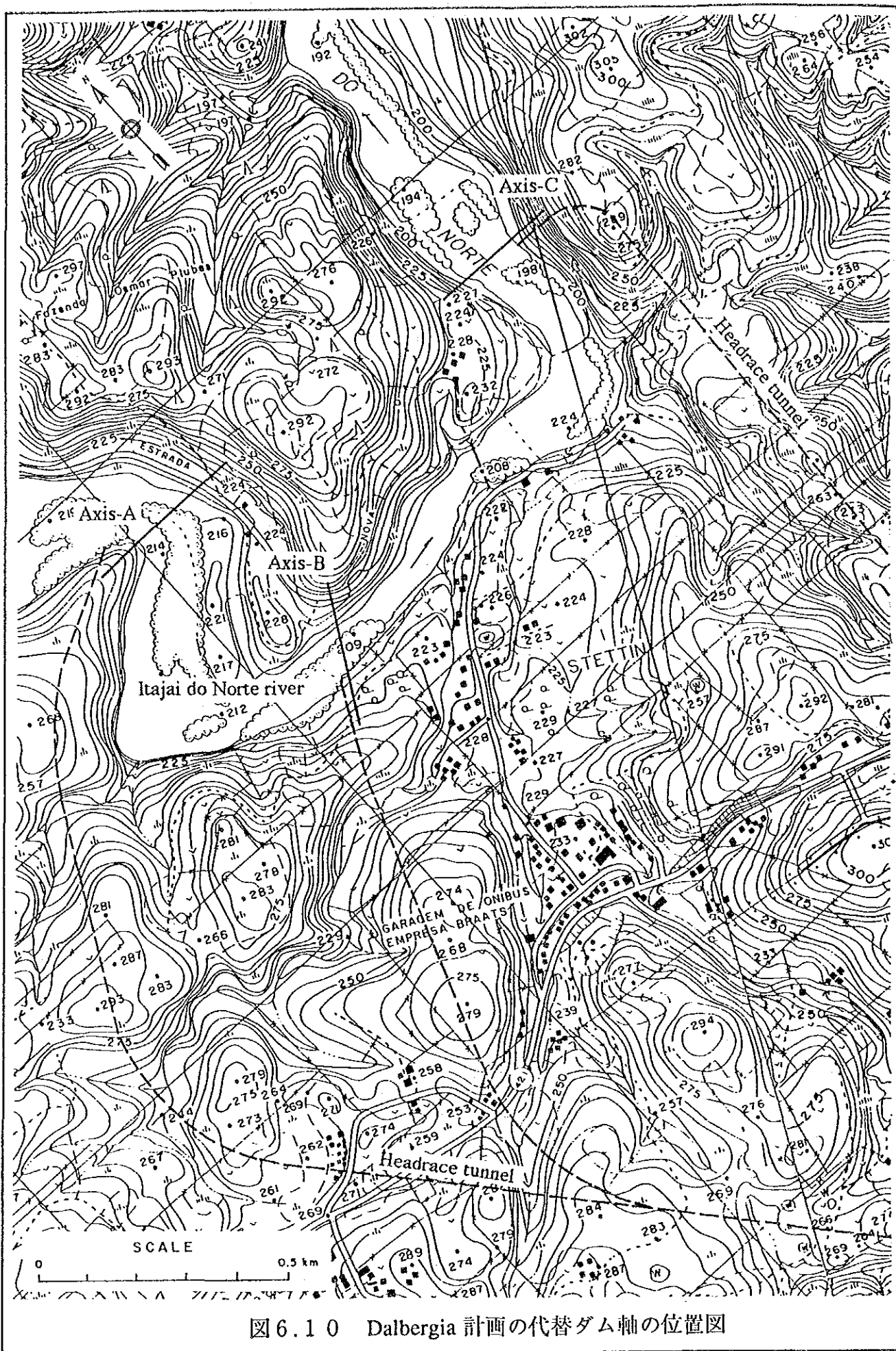


図6.10 Dalbergia 計画の代替ダム軸の位置図

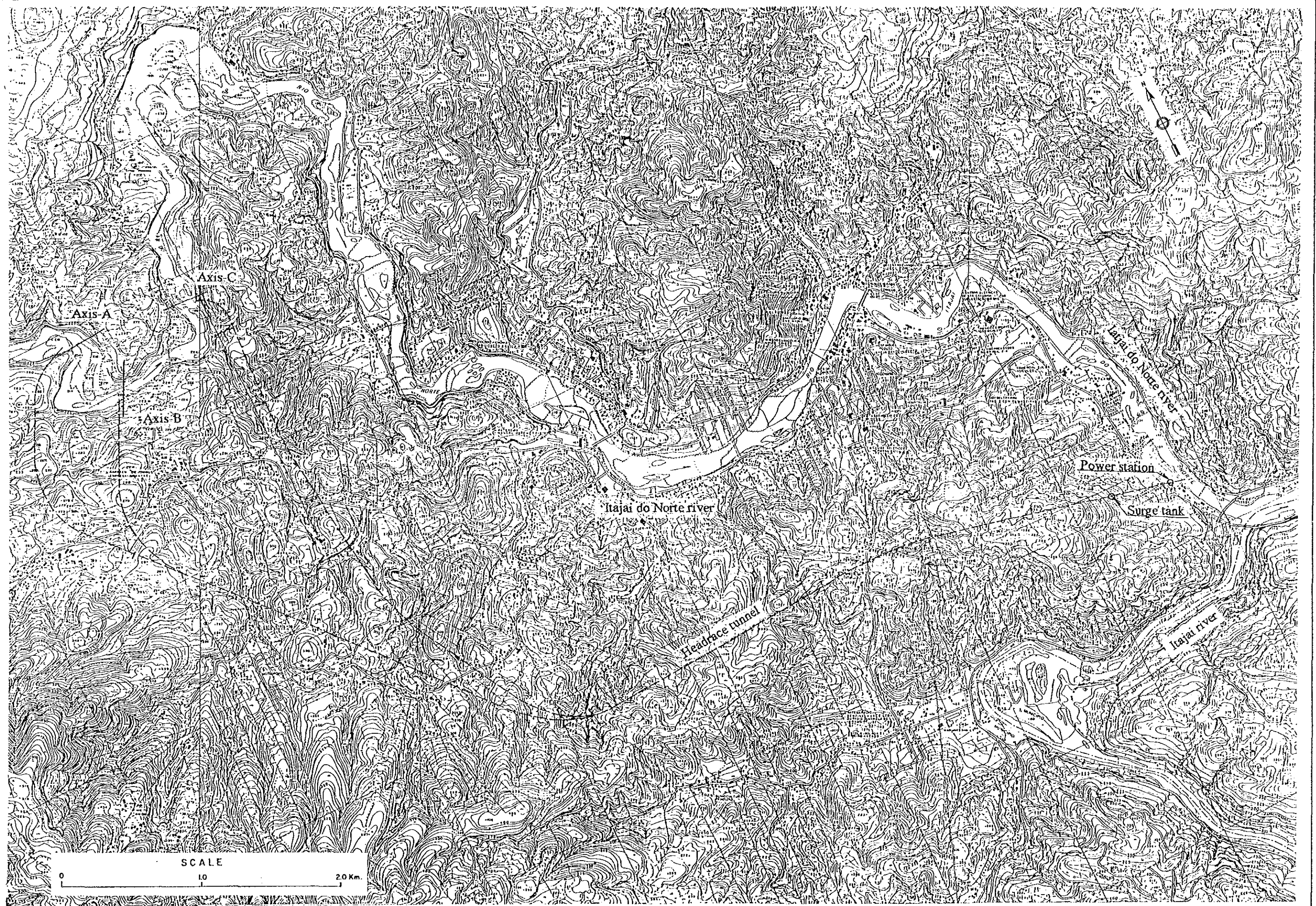


図 6.1 1 Dalbergia 計画の比較案の一般配置図