

**Table 6.5 Results of Reservoir Operation Study for Tri An Hydropower Station**

Description	Present Condition	Condition-1		Condition-2		Condition-3	
		Results of reservoir operation study	Increment to present Condition	Results of reservoir operation study	Increment to the Condition-1	Results of reservoir operation study	Increment to the Condition-2
• Firm Discharge (m <sup>3</sup> /sec)	241	266	25	259	-7	308	49
• Minimum Plant Factor (%)	27	30	3	29	-1	35	6
• Peak Duration Hour	6.57	7.25	0.68	7.06	-0.19	8.40	1.34
• Firm Peak Power (MW)	372	373	1	372	-1	374	2
• Firm Energy (GWh/year)	944	1,042	98	1,015	-27	1,207	192
• Secondary Energy (GWh/year)	799	739	-60	712	-27	602	-110
• Total Energy (GWh/year)	1,743	1,781	38	1,727	-54	1,809	82

\* Remarks

Condition-1 : with Ham Thuan - Da Mi HPP (under construction)

Condition-2 : with Ham Thuan - Da Mi HPP and Dai Ninh HPP (committed for its construction)

Condition-3 : with Ham Thuan - Da Mi HPP, Dai Ninh HPP and Dong Nai No. 3 and No.4 Combined HPP (Development Case-4)

Table 6.6 Economic Project Cost of Alternative Development Case

Cost Items	Case-1		Case-2		Case-3		Case-4		Case-5		Case-6		Case-7		Case-8			
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC		
(1) Dong Nai No.3																		
Construction Cost	153,889	94,957	161,239	98,333	163,533	104,249	174,959	104,789	174,959	104,789	174,959	104,789	174,959	104,789	174,959	104,789	174,959	104,789
1 Preparatory Works	0	5,295	0	5,405	0	5,794	0	5,821	0	5,821	0	5,821	0	5,821	0	5,821	0	5,821
1 Civil Work	86,796	80,497	92,027	83,444	94,490	85,837	101,826	91,003	101,826	91,003	101,826	91,003	101,826	91,003	101,826	91,003	101,826	91,003
1 Hydromechanical Works	49,008	2,400	17,473	16,505	2,629	19,134	17,900	2,860	17,900	2,860	17,900	2,860	17,900	2,860	17,900	2,860	17,900	2,860
1 Hydroelectric Works	3,073	1,819	4,945	5,953	49,683	54,640	52,100	5,235	52,100	5,235	52,100	5,235	52,100	5,235	52,100	5,235	52,100	5,235
2 Transmission Line	14,279	4,222	16,800	14,892	4,716	19,008	16,163	5,118	16,163	5,118	16,163	5,118	16,163	5,118	16,163	5,118	16,163	5,118
II Engineering Service	665	665	665	665	665	665	665	665	665	665	665	665	665	665	665	665	665	665
III Administration Expense	1,970	3,037	1,970	3,037	1,970	3,037	1,970	3,037	1,970	3,037	1,970	3,037	1,970	3,037	1,970	3,037	1,970	3,037
IV Land compensation and Resettlement	15,483	9,369	16,207	9,716	16,942	10,380	17,751	10,802	17,751	10,802	17,751	10,802	17,751	10,802	17,751	10,802	17,751	10,802
V Physical Contingency																		
Total Project Cost	185,621	112,569	194,308	116,490	196,799	123,253	212,813	129,511	212,813	129,511	212,813	129,511	212,813	129,511	212,813	129,511	212,813	129,511
(2) Dong Nai No.4																		
Construction Cost	156,552	90,120	157,493	91,515	159,008	91,744	158,467	91,355	158,467	91,355	158,467	91,355	158,467	91,355	158,467	91,355	158,467	91,355
1 Preparatory Works	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460	6,460
1 Civil Work	72,214	72,775	144,989	79,985	74,027	145,013	73,769	74,327	73,769	74,327	73,769	74,327	73,769	74,327	73,769	74,327	73,769	74,327
1 Hydromechanical Works	16,666	2,654	19,520	17,059	2,717	19,778	17,535	2,793	17,535	2,793	17,535	2,793	17,535	2,793	17,535	2,793	17,535	2,793
1 Hydroelectric Works	64,835	6,524	71,360	63,612	6,368	69,980	61,622	6,150	61,622	6,150	61,622	6,150	61,622	6,150	61,622	6,150	61,622	6,150
2 Transmission Line	2,837	1,707	4,544	2,837	1,707	4,544	2,837	1,707	2,837	1,707	2,837	1,707	2,837	1,707	2,837	1,707	2,837	1,707
II Engineering Service	14,142	4,478	16,620	14,278	4,521	16,799	14,134	4,495	14,134	4,495	14,134	4,495	14,134	4,495	14,134	4,495	14,134	4,495
III Administration Expense	0	631	0	641	0	641	0	642	0	642	0	642	0	642	0	642	0	642
IV Land compensation and Resettlement	14,168	7,904	14,272	8,024	14,381	8,041	14,342	8,012	14,342	8,012	14,342	8,012	14,342	8,012	14,342	8,012	14,342	8,012
V Physical Contingency																		
Total Project Cost	184,661	103,124	186,027	104,699	188,726	104,922	187,131	104,562	187,131	104,562	187,131	104,562	187,131	104,562	187,131	104,562	187,131	104,562
Grand Total	325,371	222,504	351,664	223,663	354,327	224,800	354,894	224,703	354,894	224,703	354,894	224,703	354,894	224,703	354,894	224,703	354,894	224,703

Table 6.7 Summary of Optimization Study

Alternative Case No.	FSL of Reservoir	Economic Cost at a Discount Rate of 10%		Annual Benefit at Discount Rate of 10%		Annual Net Benefit (B-C)		
		FC	LC	Total	Alt.	LRMC	Therm.	Alt.
1	575	370.5	227.1	597.5	103.4	116.2	12.4	25.2
2	580	380.3	232.8	613.2	109.1	118.9	15.8	25.6
3	585	387.2	240.2	627.4	95.4	115.2	19.7	26.4
4	590	399.9	246.4	646.3	121.0	124.4	23.7	27.2
5	595	415.5	257.8	673.3	102.4	126.0	23.6	24.8
6	600	435.1	270.1	705.2	107.0	130.5	25.5	22.5
7	605	449.3	286.7	736.0	112.0	134.1	22.2	19.5
8	610	463.9	302.5	766.4	116.6	136.8	20.2	16.5

**Table 6.8 Input Data of EGEAS**

Source : Institute of Energy (IOE)

**Existing Project (as of end of December 1998)**

No.	Project Name	Type	Installed Capacity (MW)	Heat Rate (BTU/kWh)	Annual Energy (GWh)	Fuel Type	Loading Strategy	Installation Year	Remarks
1	Da Nhim	HYDR	160	-	1,050	-	Intermediate	1963	4 x 40 MW
2	Tri An	HYDR	400	-	1,712	-	Intermediate	1988	4 x 100 MW
3	Thac Mo	HYDR	150	-	604	-	Intermediate	1994	2 x 75 MW
4	Thac Ba	HYDR	108	-	425	-	Intermediate	1973	3 x 36 MW
5	Hoa Binh	HYDR	1,920	-	8,349	-	Intermediate	1994	8 x 240 MW
6	Vinh Son	HYDR	66	-	215	-	Intermediate	1994	2 x 33 MW
7	Small Hydro	HYDR	50	-	150	-	Intermediate	1994	
8	Thu Duc OIL	THERMAL	165	8,981	-	OIL	Peak	1975	1 x 33, 2 x 66 MW
9	Tra Noc (Can Tho) OIL	THERMAL	33	8,981	-	OIL	Peak	1975	1 x 33 MW
10	Ba Ria GAS	THERMAL	220	10,342	-	GAS	Peak	1993	
11	Thu Duc GAS	THERMAL	128	10,342	-	GAS	Peak	1991	
12	DIESEL	THERMAL	397	13,652	-	DIESEL	Peak	1978	
13	Phu My GAS	THERMAL	288	10,342	-	GAS	Peak	1998	2 x 144 MW
14	Tra Noc (Can Tho) GAS	THERMAL	75	10,342	-	GAS	Peak	1996	2 x 37.5 MW
15	Ninh Binh	THERMAL	100	8,981	-	COAL	Base	1974	4 x 25 MW
16	Uong Bi	THERMAL	105	8,981	-	COAL	Base	1975	1 x 50, 1 x 55 MW
17	Pha Lai	THERMAL	440	8,981	-	COAL	Base	1987	4 x 110 MW
18	Heip Phuoc (IPP)	THERMAL	250	10,342	-	GAS	Peak	1998	2 x 125 MW

**Committed Project**

No.	Project Name	Type	Installed Capacity (MW)	Heat Rate (BTU/kWh)	Annual Energy (GWh)	Fuel Type	Loading Strategy	Installation Year	Remarks
1	Ba Ria 306-1	THERMAL	56	10,342	-	GAS	Peak	1999	
2	Tra Noc (Can Tho)	THERMAL	75	10,342	-	GAS	Peak	1999	2 x 37.5 MW
3	Wantsila 1, 2 (IPP)	THERMAL	120	13,652	-	DIESEL	Peak	2000	4 x 15, 4 x 15 MW
4	Yali 1-2	HYDR	360	-	1,821	-	Intermediate	2000	2 x 180 MW
5	Phu My 1-1 (CC)	THERMAL	240	7,584	-	GAS	Peak	2000	1 x 240 MW
6	Ham Thuan - Da Mi	HYDR	475	-	1,555	-	Intermediate	2000	2 x 150, 2 x 88.5 MW
7	Song Hinh 1, 2	HYDR	70	-	357	-	Intermediate	2000	
8	Pha Lai 1	THERMAL	300	8,981	-	COAL	Base	2001	1 x 300 MW
9	Ba Ria 306-2	THERMAL	56	10,342	-	GAS	Peak	2001	
10	Can Don	HYDR	72	-	295	-	Intermediate	2002	2 x 36 MW
11	Soc Trang	THERMAL	475	10,342	-	GAS	Peak	2002	
12	Na Duong	THERMAL	100	8,981	-	COAL	Base	2003	2 x 50 MW
13	Cao Ngan	THERMAL	100	8,981	-	COAL	Base	2003	2 x 50 MW
14	Phu My 1-2 (CC)	THERMAL	240	7,584	-	GAS	Peak	2003	1 x 240 MW
15	O Mon 1	THERMAL	300	8,981	-	OIL	Base	2004	1 x 300 MW
16	Dai Ninh	HYDR	300	-	1,218	-	Intermediate	2004	2 x 150 MW
17	Yali 3-4	HYDR	360	-	1,821	-	Intermediate	2005	2 x 180 MW
18	Se San 3	HYDR	260	-	1,177	-	Intermediate	2005	2 x 130 MW
19	Phu My 1-3 (CC)	THERMAL	240	10,342	-	GAS	Peak	2005	1 x 240 MW
20	Pha Lai 2	THERMAL	300	8,981	-	COAL	Base	2006	1 x 300 MW
21	O Mon 2	THERMAL	300	8,981	-	OIL	Base	2006	1 x 300 MW

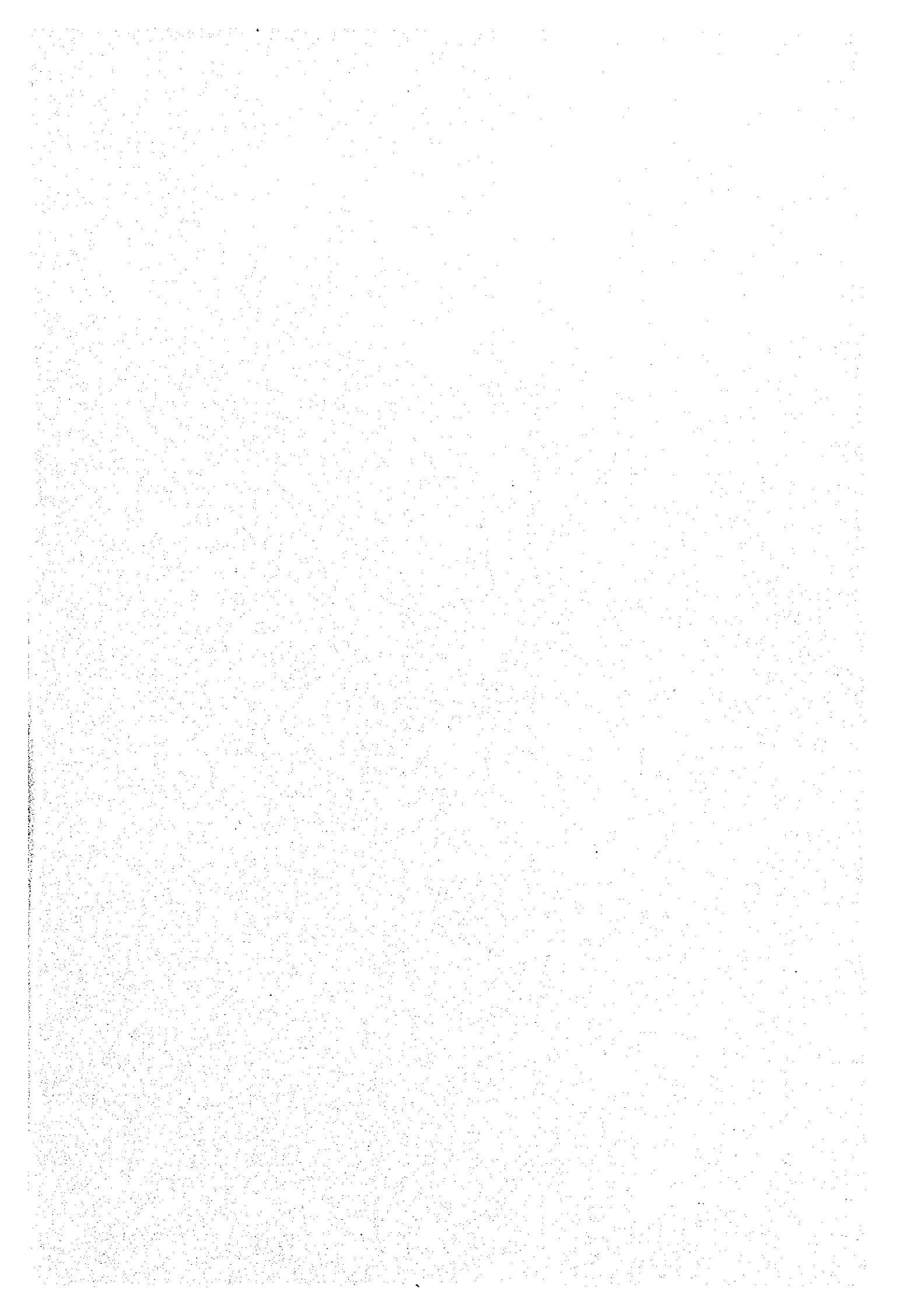
**Planning Project**

No.	Project Name	Type	Installed Capacity (MW)	Heat Rate (BTU/kWh)	Annual Energy (GWh)	Fuel Type	Loading Strategy	Installation Cost (\$/kW)	Remarks
1	Soi La	HYDR	2,400	-	10,400	-	Intermediate	875	8 x 300 MW
2	Dai Thi	HYDR	300	-	950	-	Intermediate	1,136	
3	Plei Krong	HYDR	120	-	533	-	Intermediate	1,835	
4	Se San 4	HYDR	330	-	1,348	-	Intermediate	877	
5	Dong Nai No.3 (DN3)	HYDR	240	-	736	-	Intermediate	1,564	
6	Dong Nai No.4 (DN4)	HYDR	270	-	841	-	Intermediate	1,201	
7	CC-1 (300MW)	THERMAL	300	7,584	-	GAS	Intermediate	562	
8	CC-2 (430MW)	THERMAL	430	7,584	-	GAS	Intermediate	619	
9	Coal-1 (300MW)	THERMAL	300	8,981	-	COAL	Base	1,330	
10	Coal-2 (500MW)	THERMAL	500	8,981	-	COAL	Base	1,330	

Note: Thermal efficiency applied for each thermal type plant is as follows:

Coal Thermal	38%	Gas Turbine	33%	Oil Thermal	38%
Diesel	25%	Combined Cycle	45%		





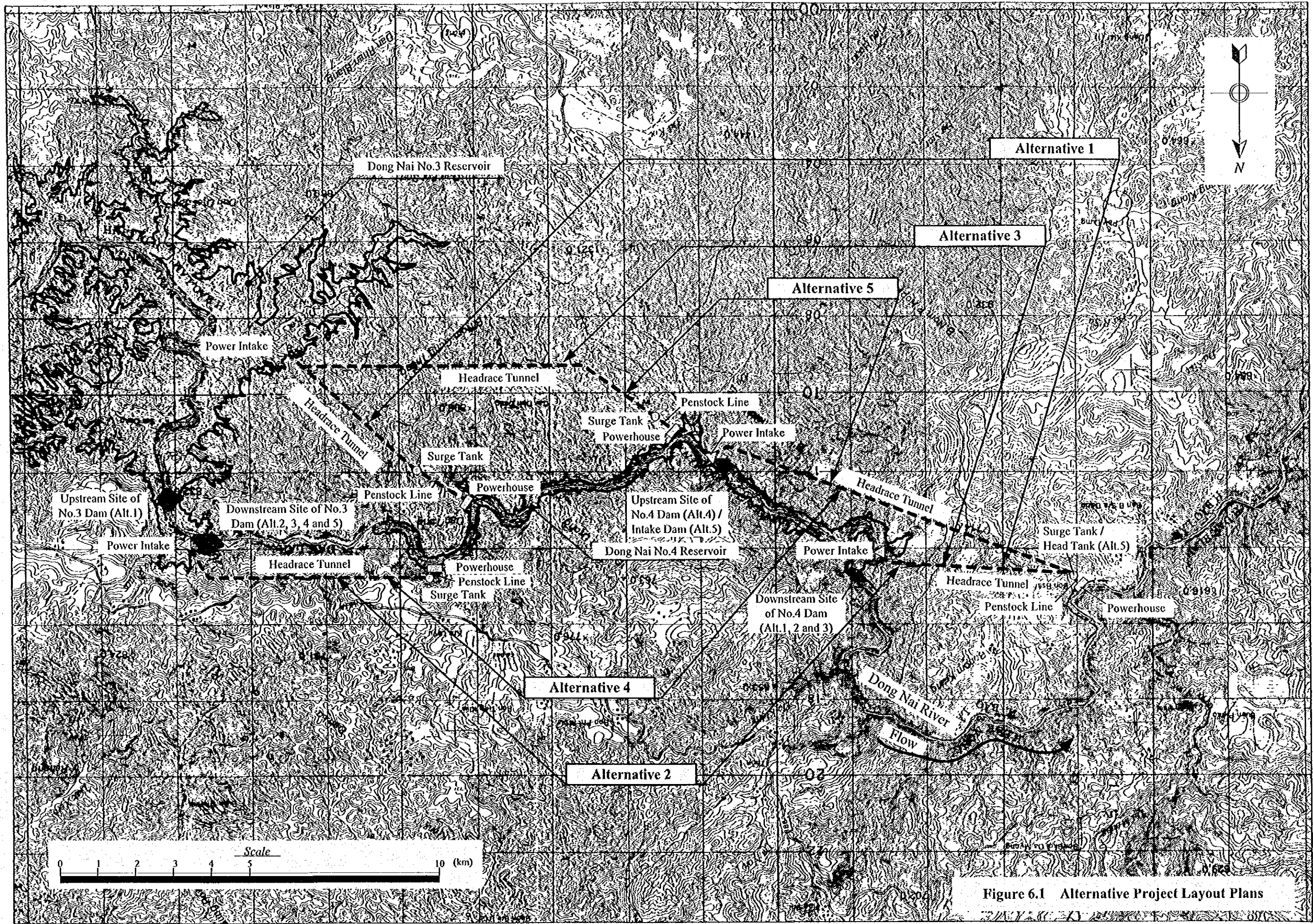


Figure 6.1 Alternative Project Layout Plans

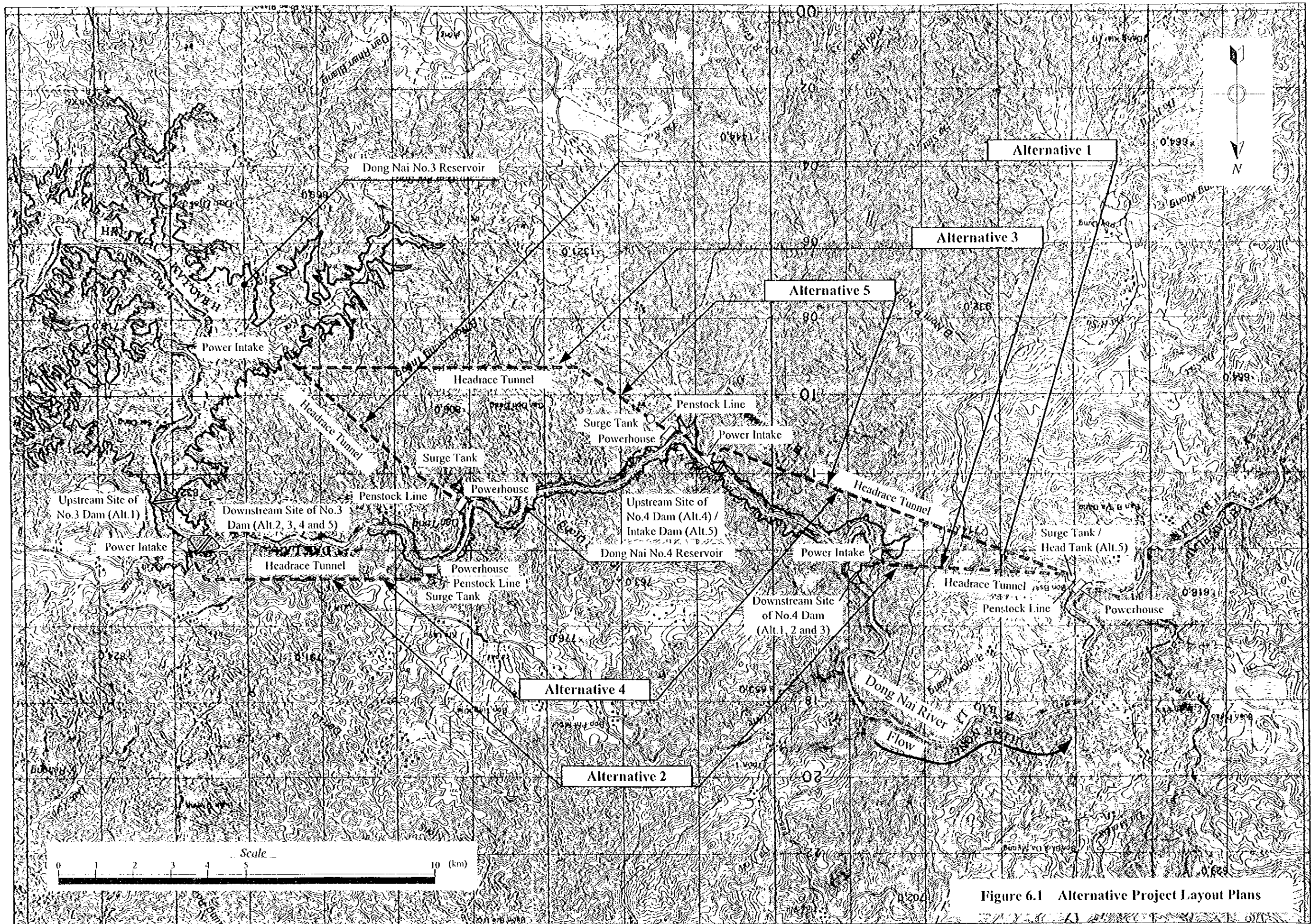


Figure 6.1 Alternative Project Layout Plans

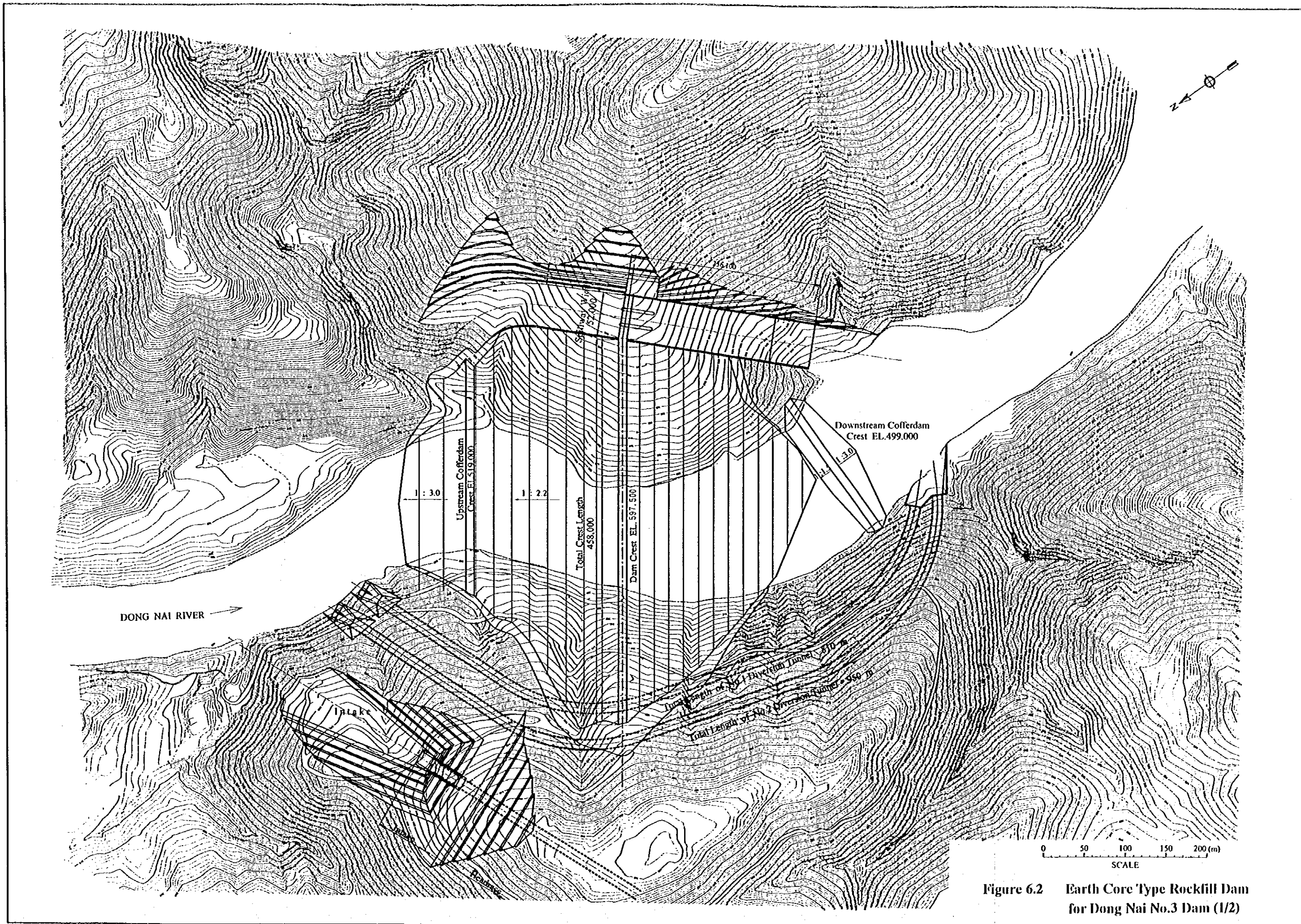


Figure 6.2 Earth Core Type Rockfill Dam for Dong Nai No.3 Dam (1/2)



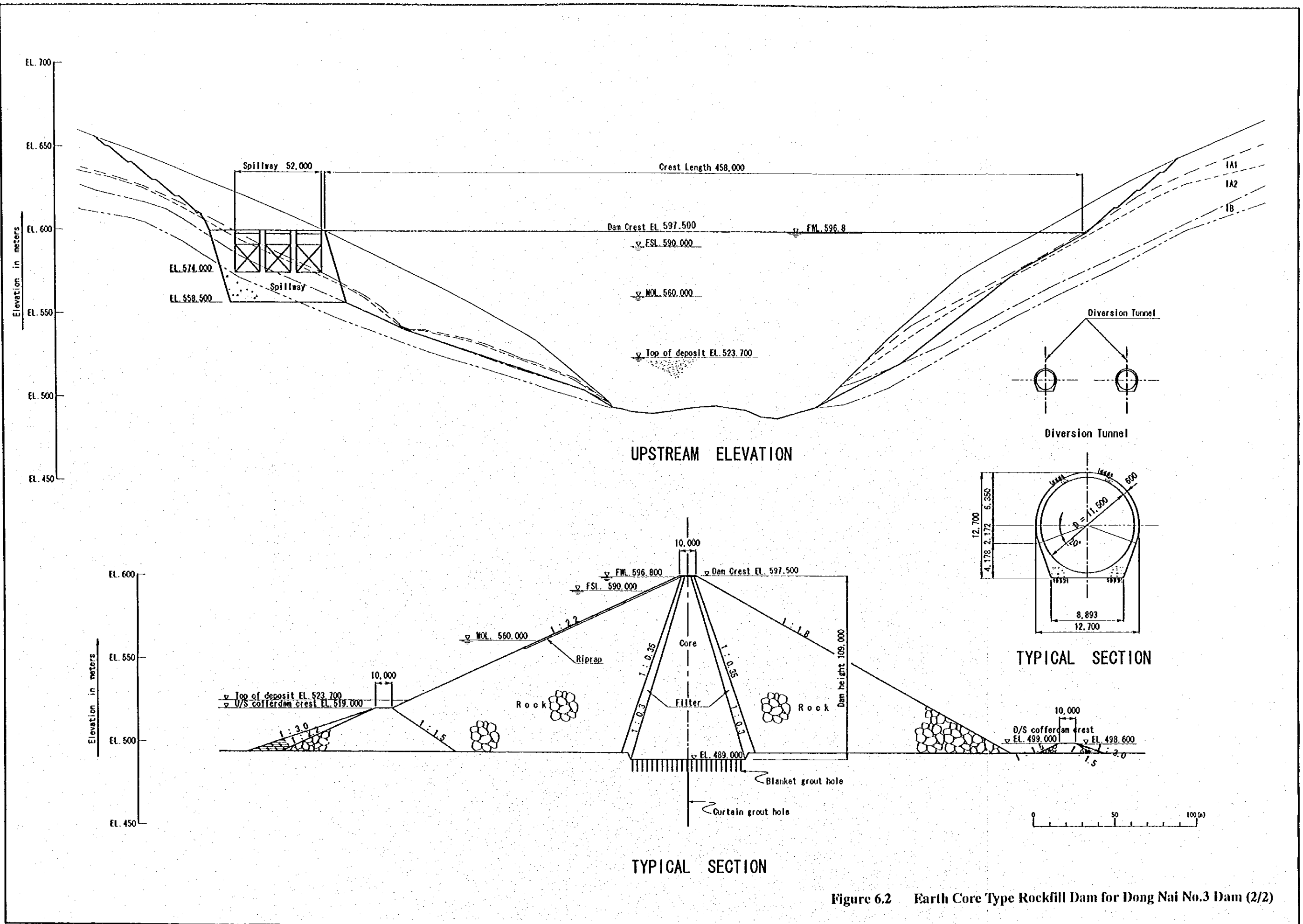
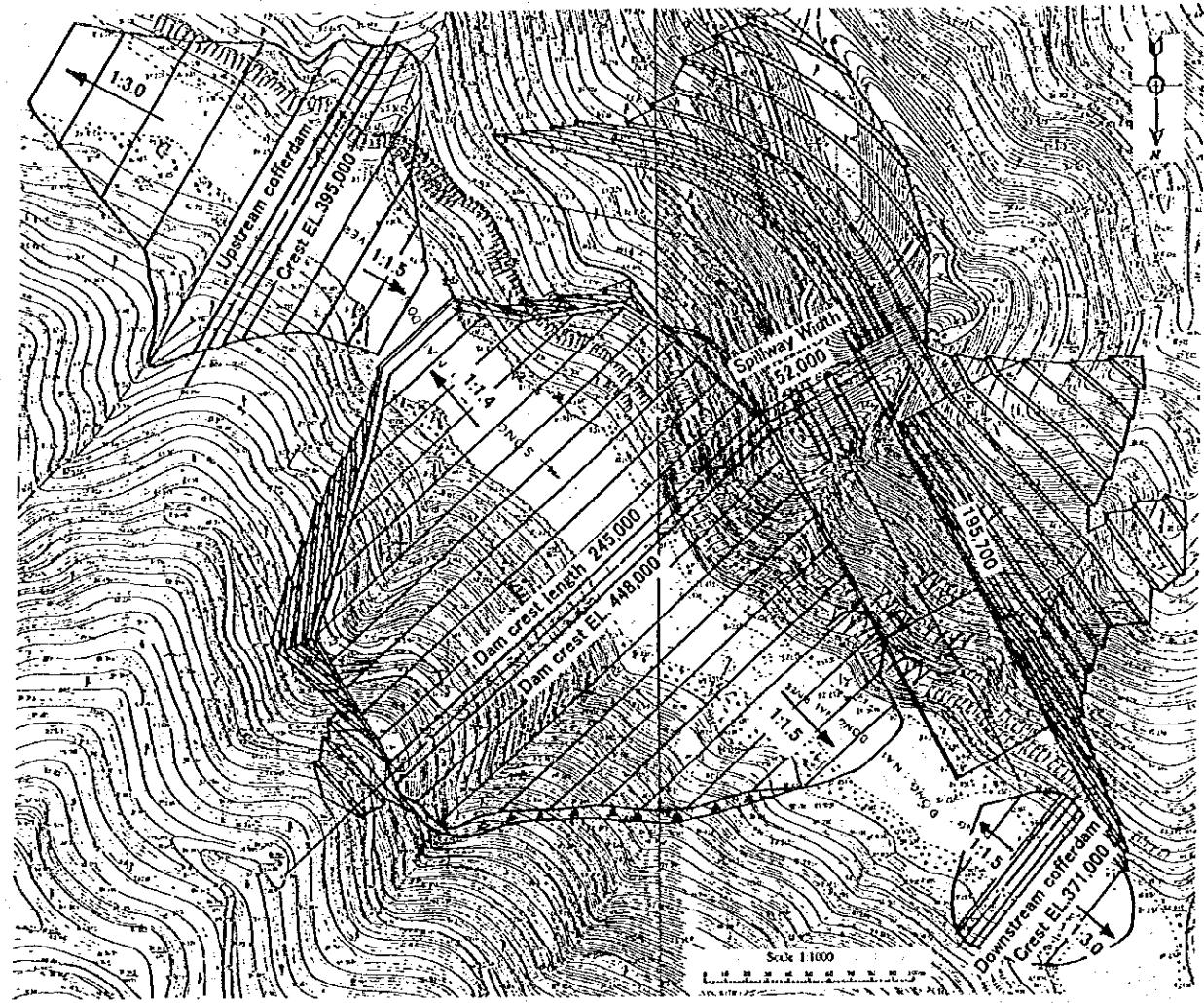
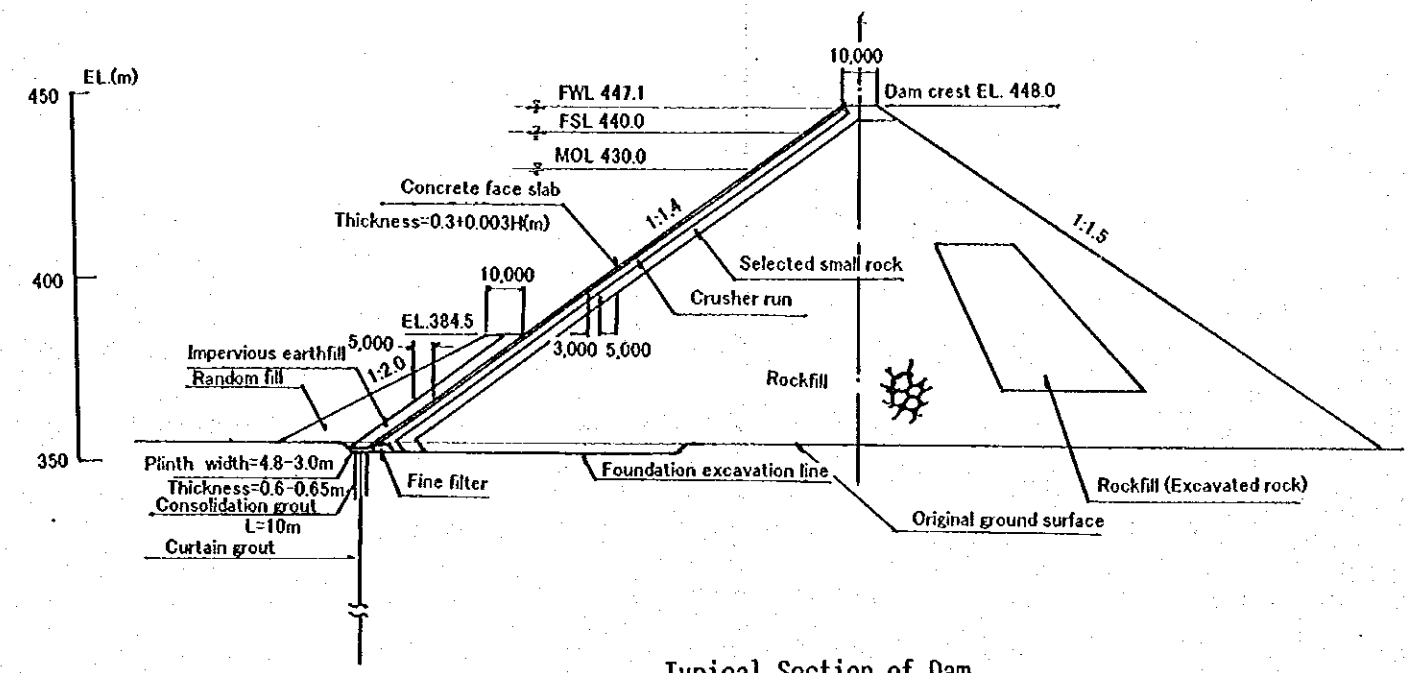


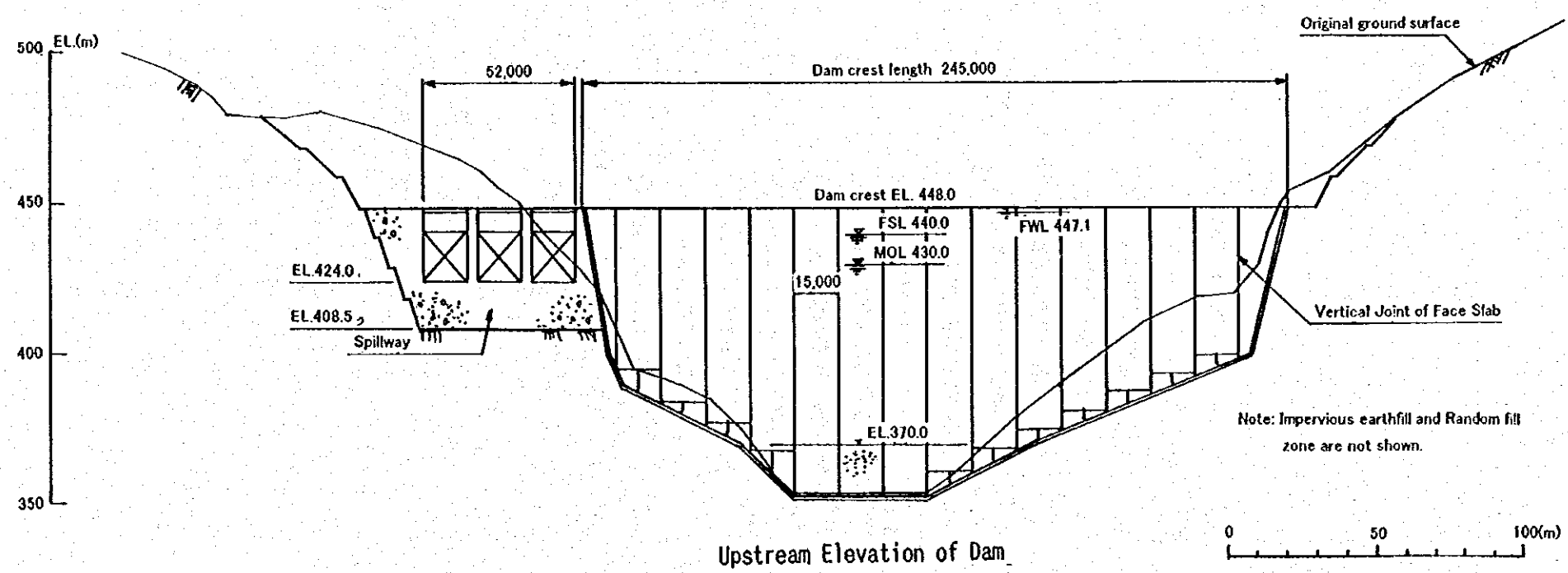
Figure 6.2 Earth Core Type Rockfill Dam for Dong Nai No.3 Dam (2/2)



Plan of Dam



Typical Section of Dam



Upstream Elevation of Dam

Figure 6.3 Concrete Facing Rockfill Type Dam for Dong Nai No.4 Dam

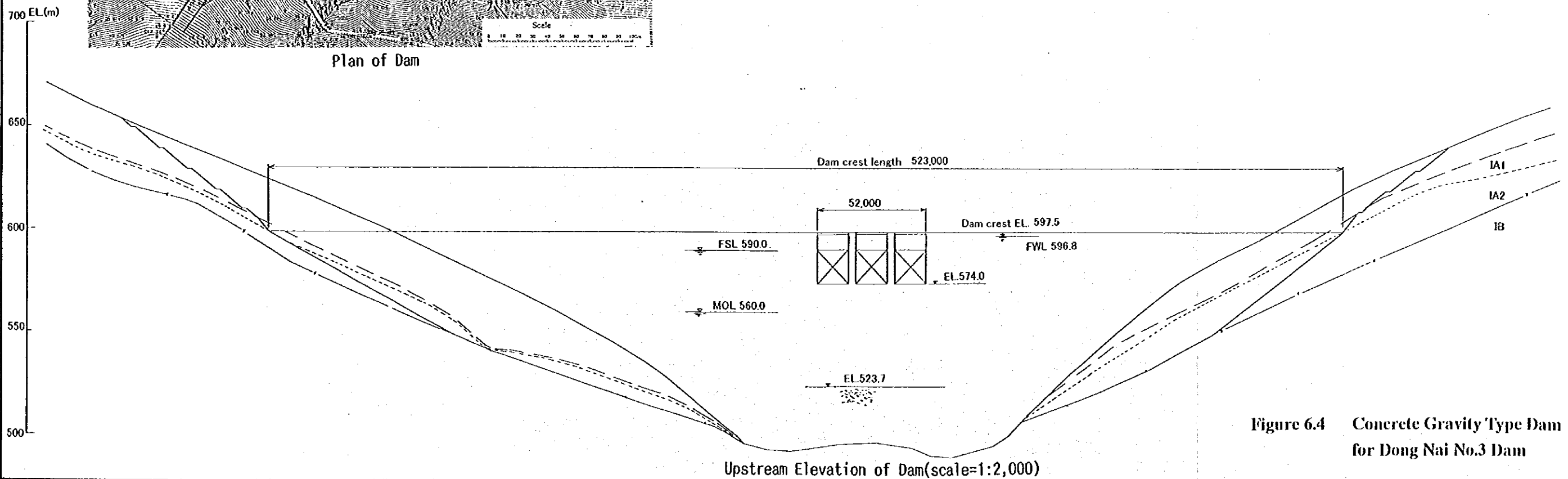
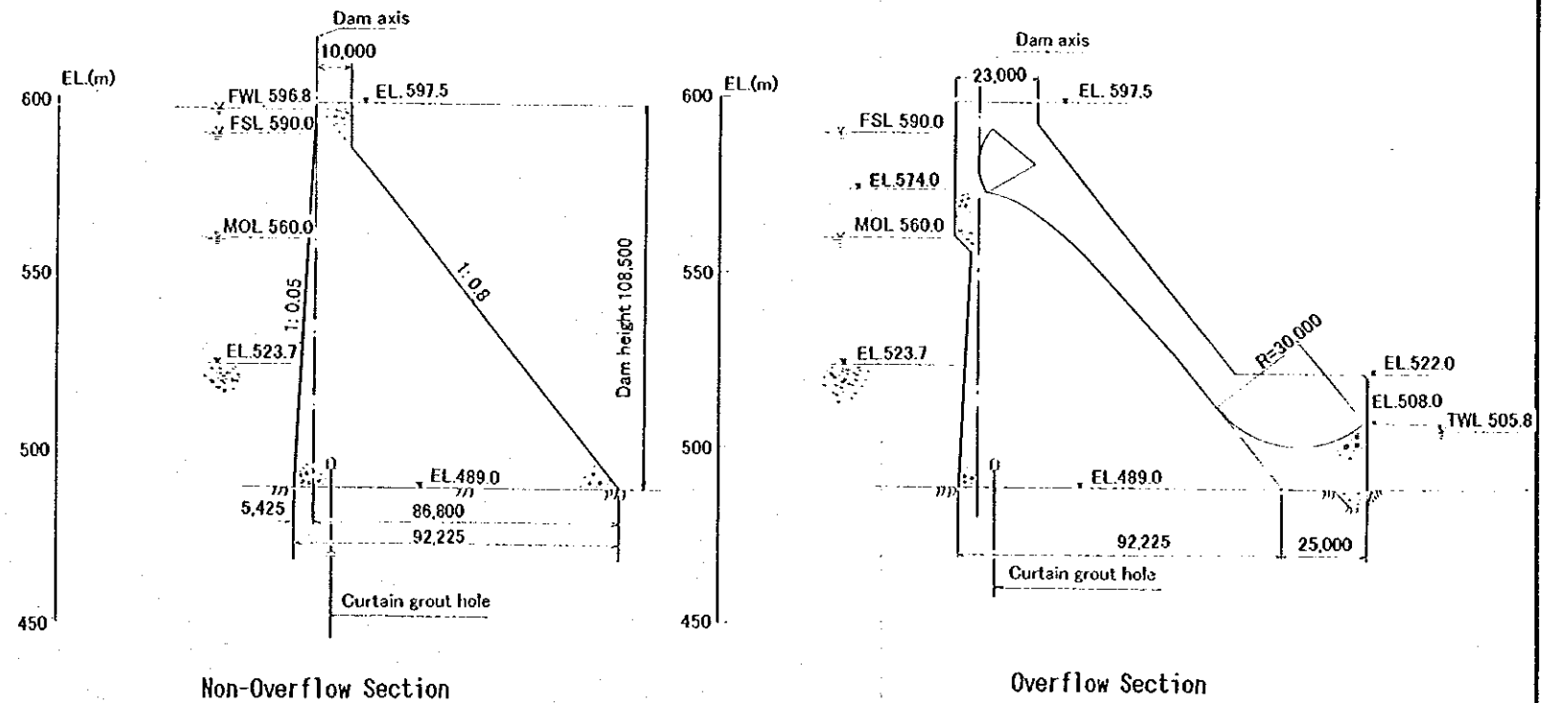
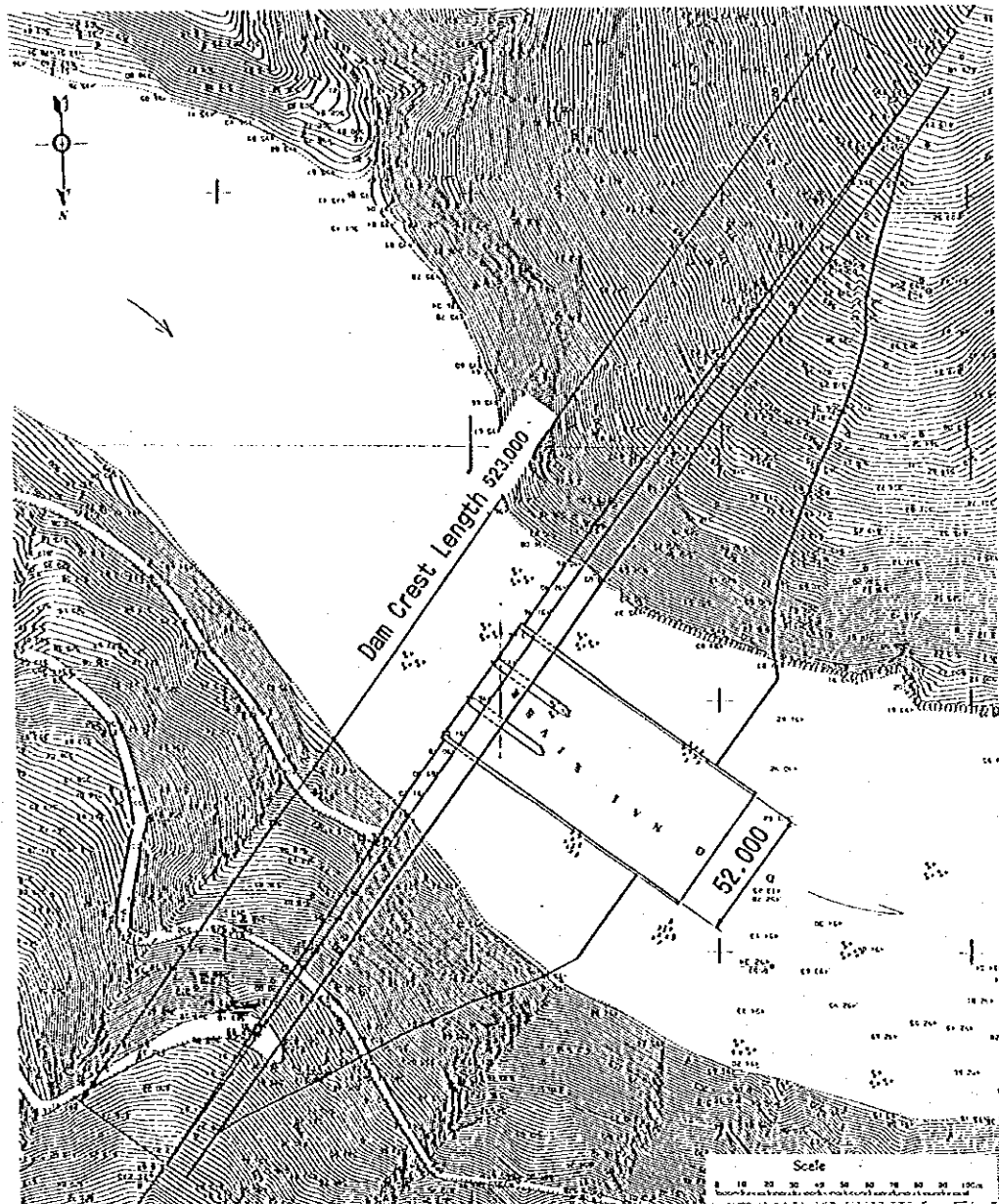
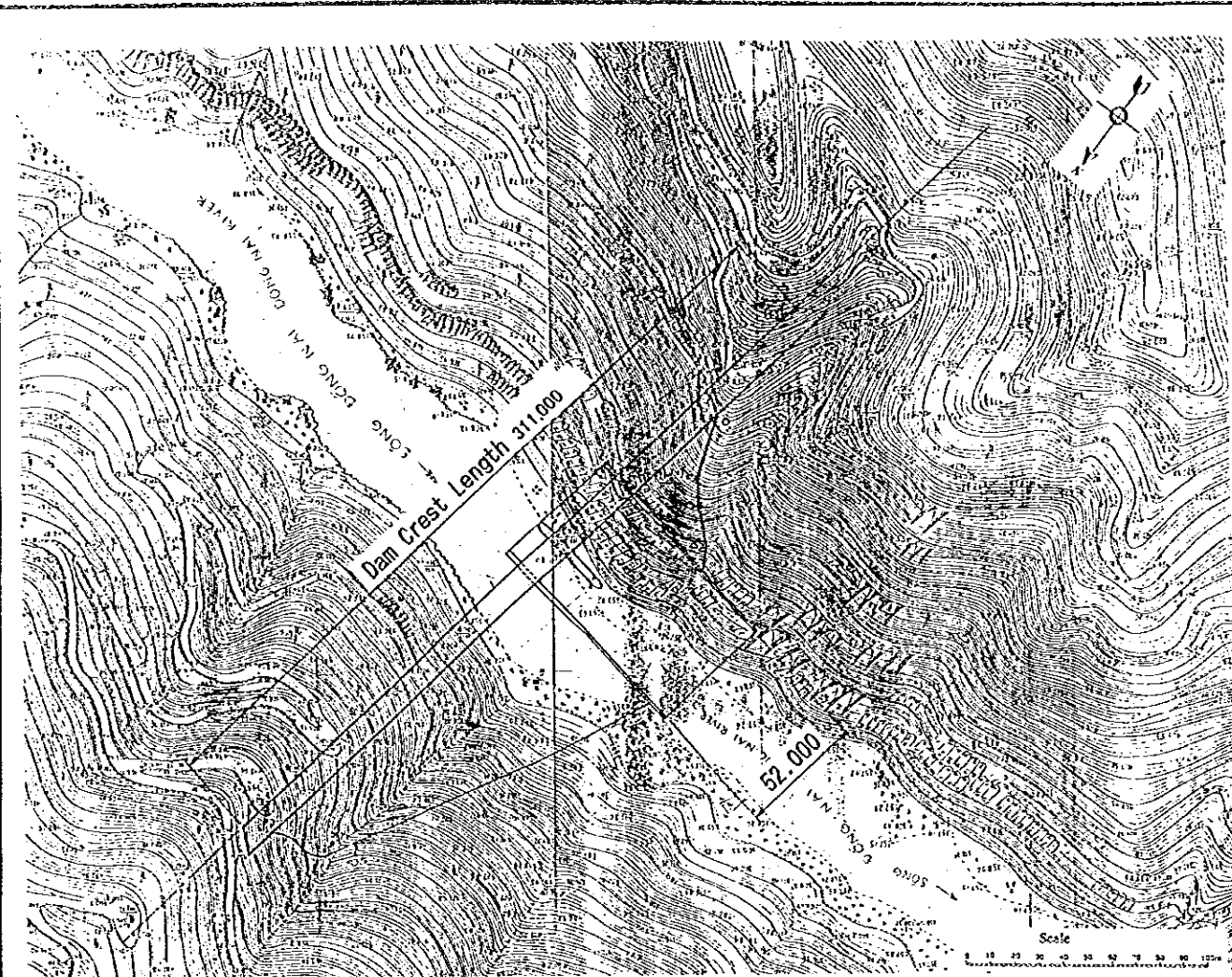
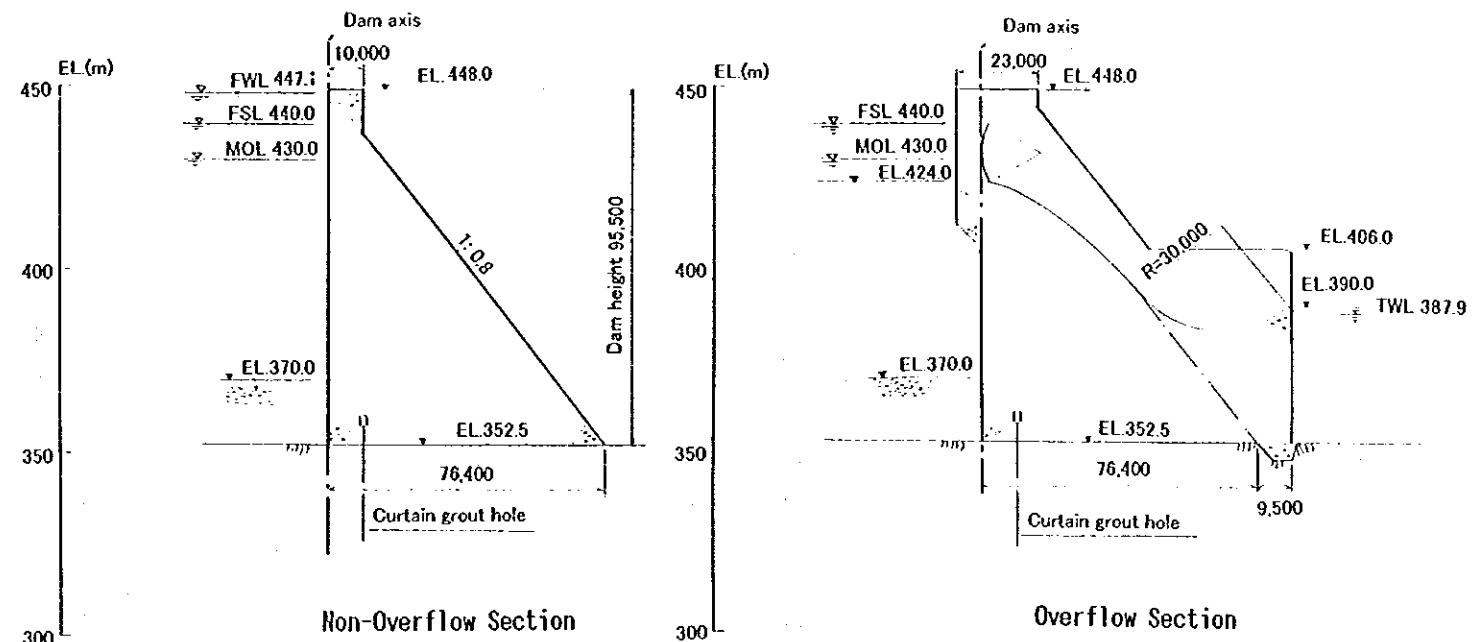


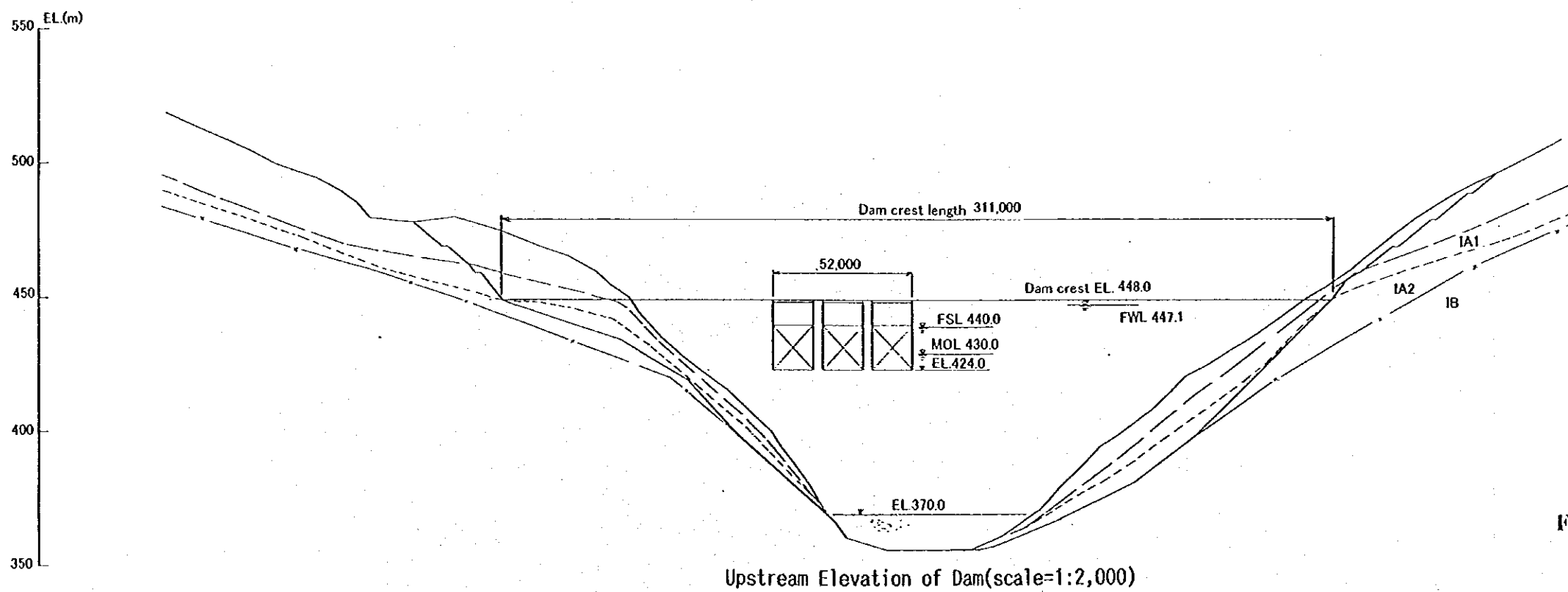
Figure 6.4 Concrete Gravity Type Dam for Dong Nai No.3 Dam



Plan of Dam

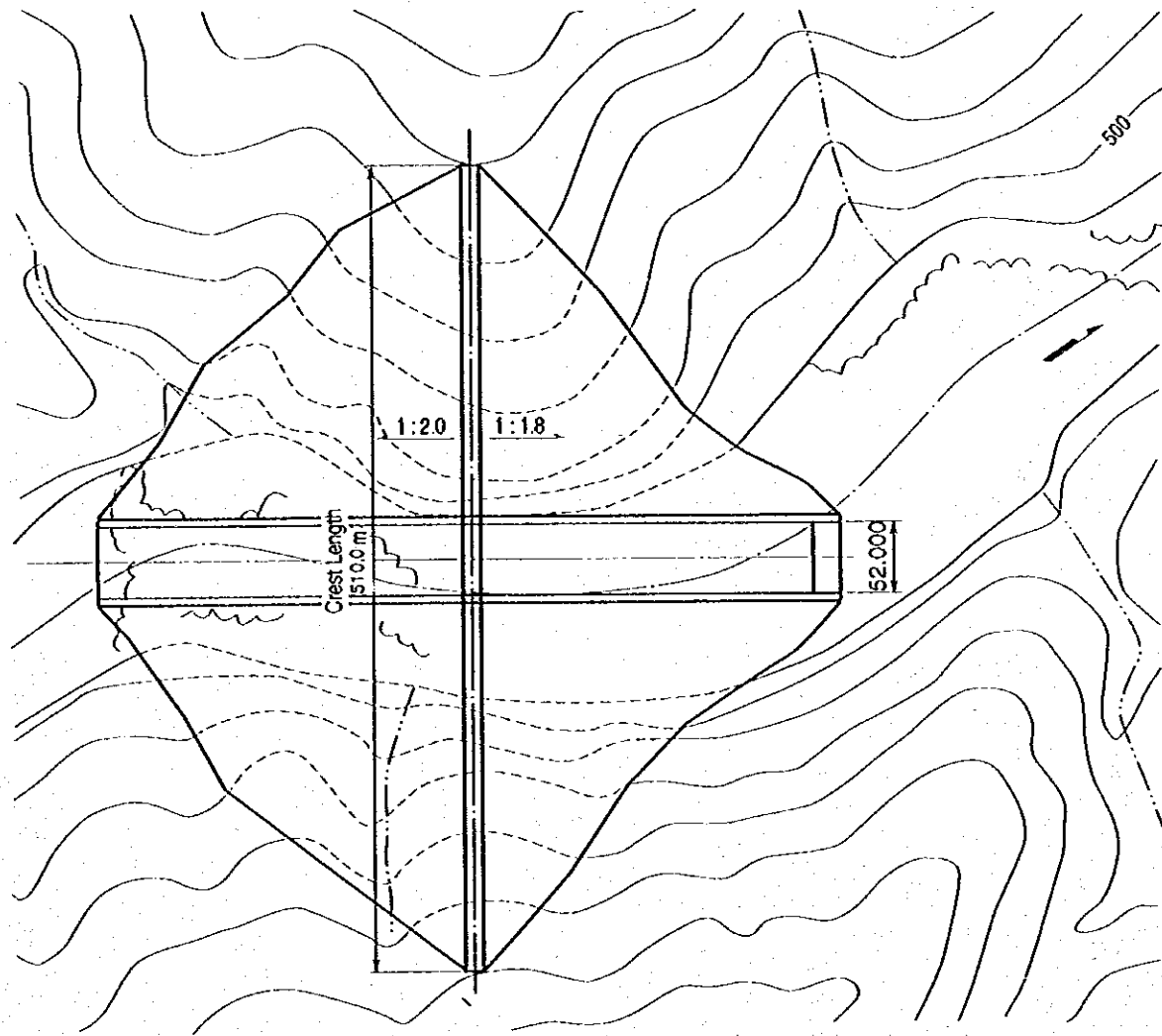


Typical Section of Dam (scale=1:2,000)

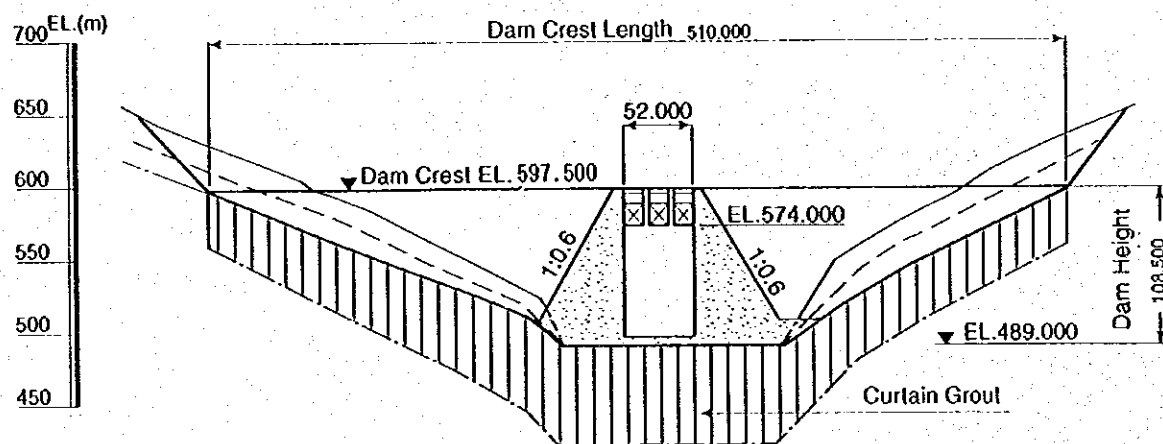


Upstream Elevation of Dam (scale=1:2,000)

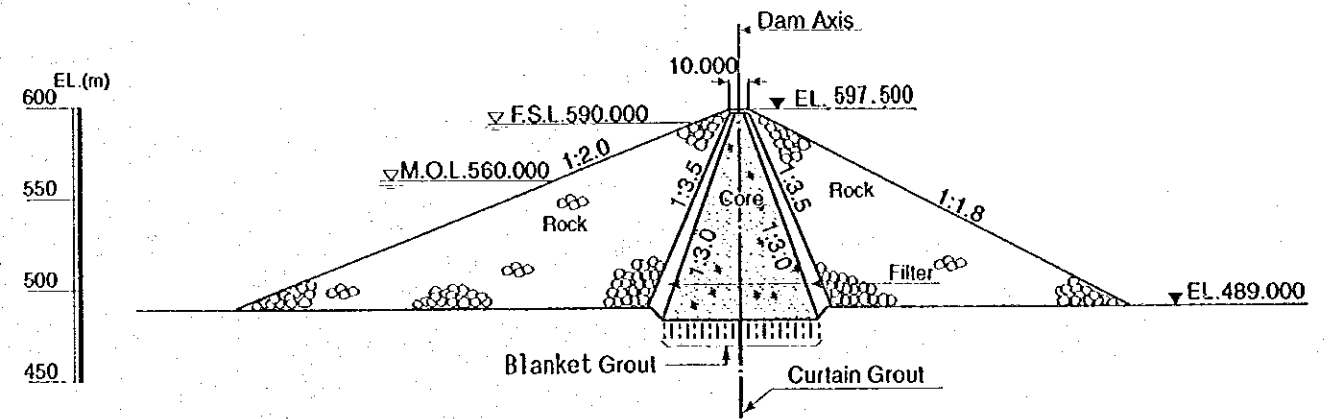
Figure 6.5 Concrete Gravity Type Dam for Dong Nai No.4 Dam



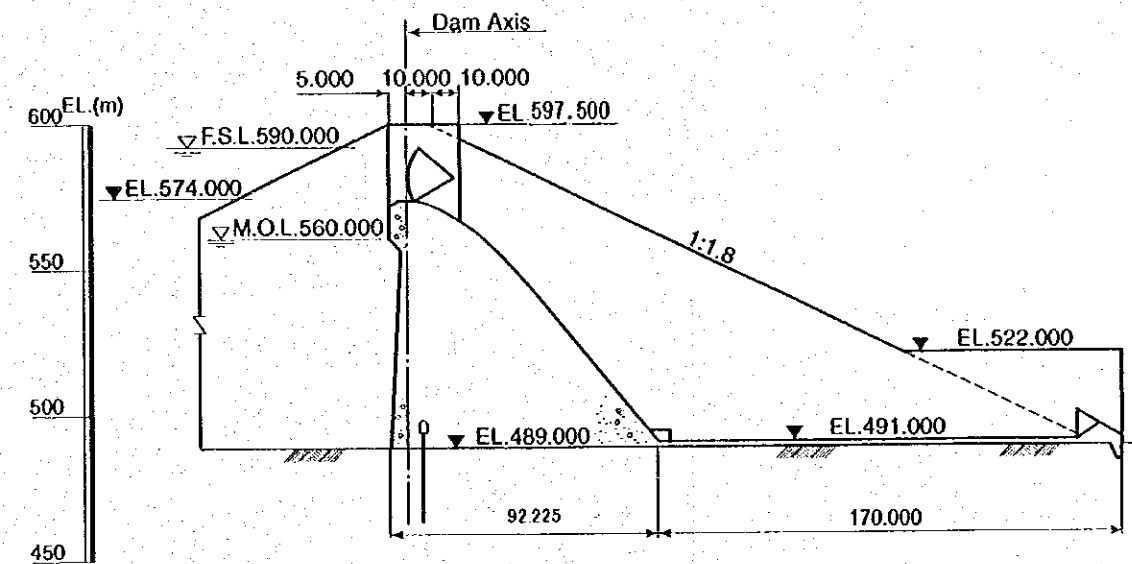
PLAN OF DAM (Scale=1:5,000)



UPSTREAM ELEVATION OF DAM (Scale=1:5,000)



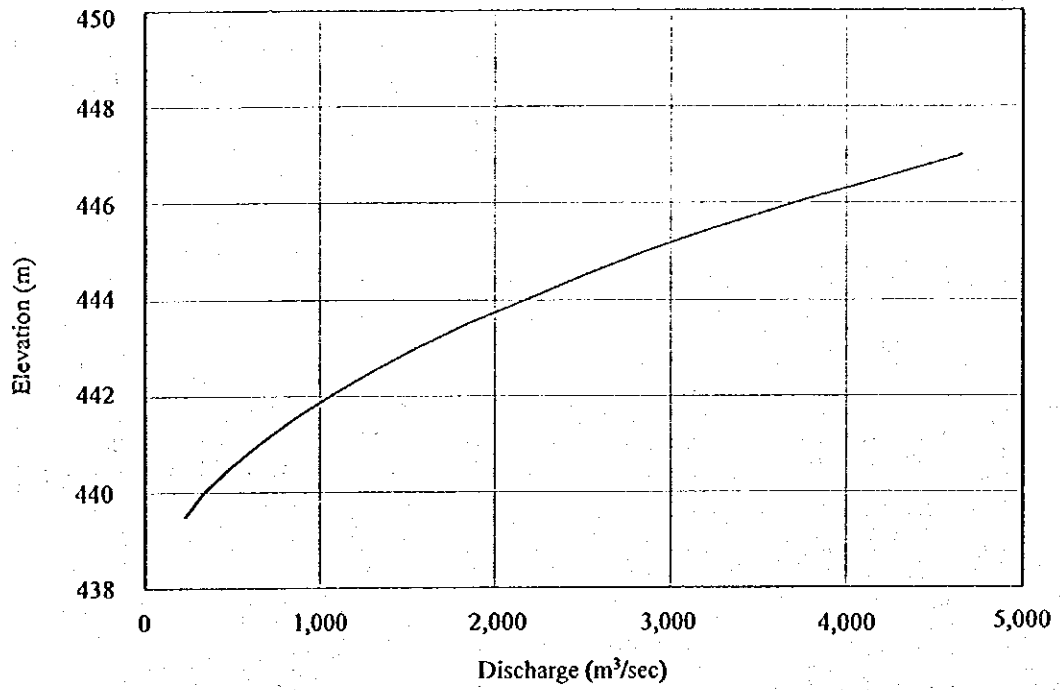
TYPICAL SECTION OF ROCKFILL DAM (Scale=1:4,000)



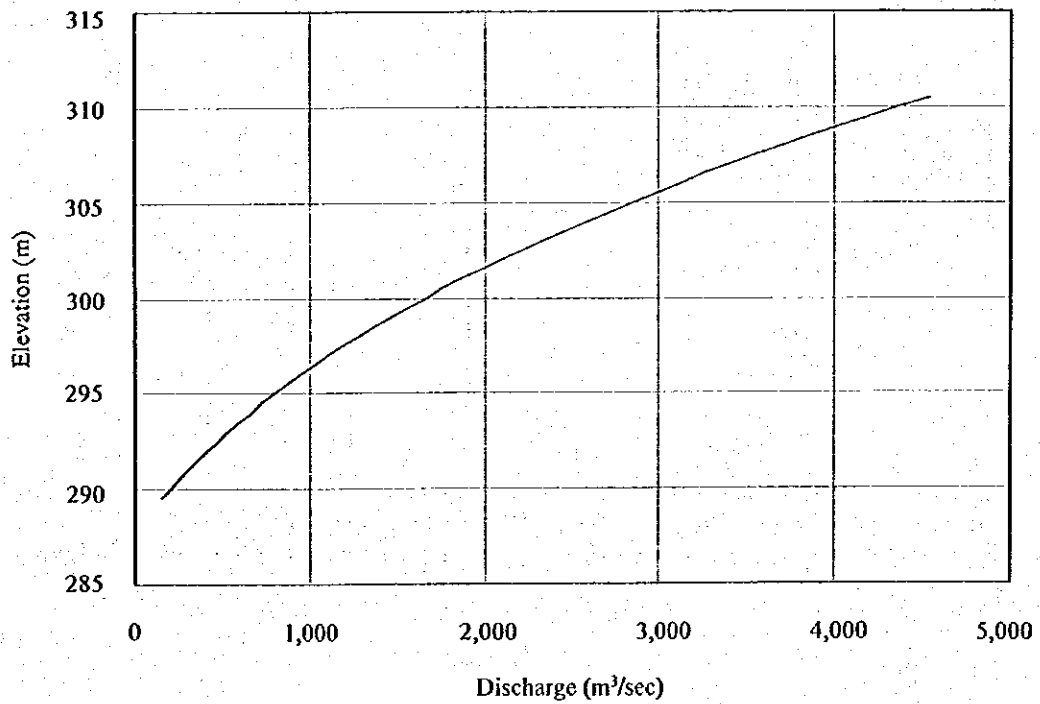
TYPICAL SECTION OF CONCRETE GRAVITY DAM (Scale=1:2,500)

Figure 6.6 Combined Type of Concrete Gravity Dam and Rockfill Dam for Dorg Nai No.3 Dam



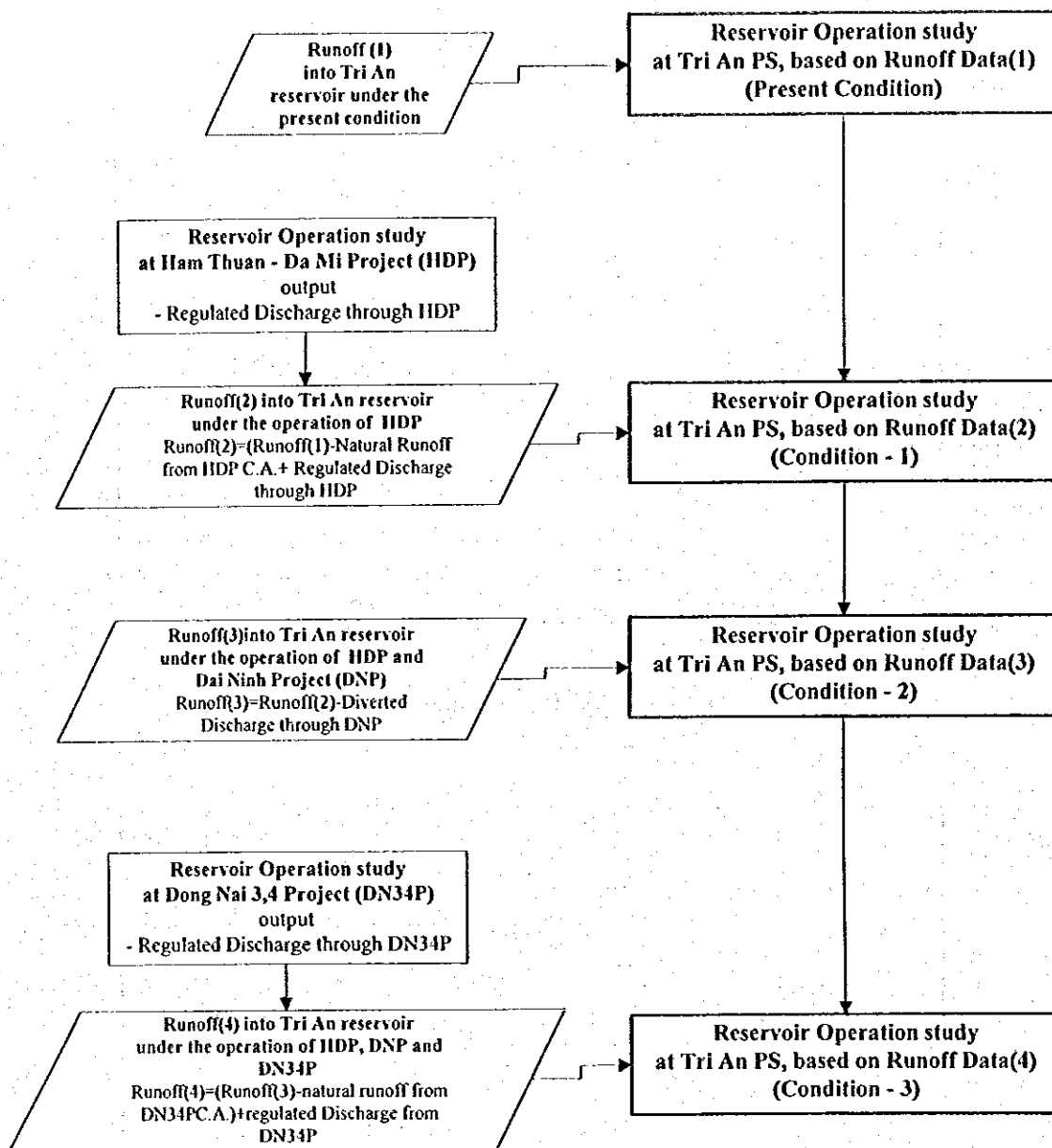


Dong Nai No.3 Power Station Site



Dong Nai No.4 Power Station Site

Figure 6.7 Rating Curve of Dong Nai River at Dong Nai No.3 and No.4 Power Station Sites



**\*Remarks**

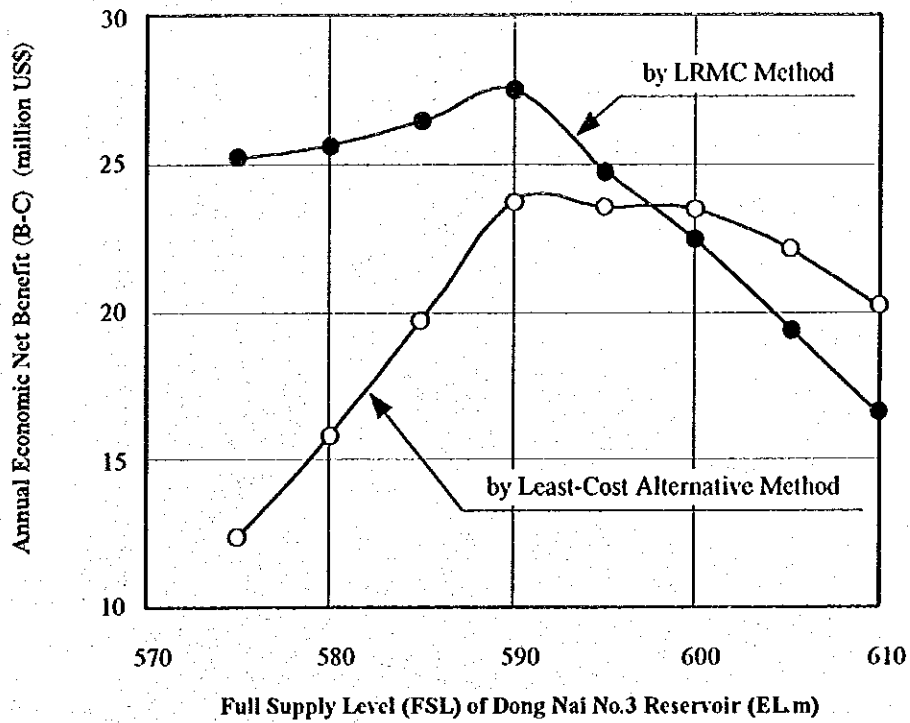
Condition - 1 : Under the operation of Ham Thuan - Da Mi project

Condition - 2 : Under the operation of Ham Thuan - Da Mi and Dai Ninh project

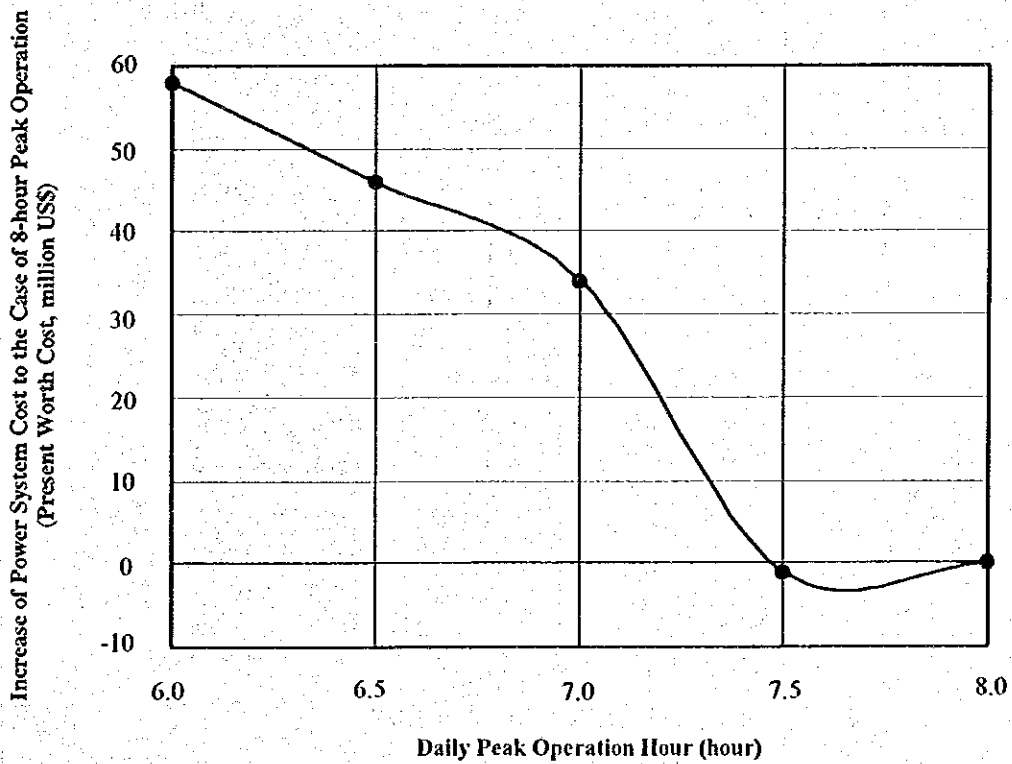
Condition - 3 : Under the operation of Ham Thuan - Da Mi, Dai Ninh and Dong Nai No.3 & No.4 project

**Figure 6.8 Flow of Reservoir Operation Study to Estimate of Existing Tri An Hydropower Station**





**Optimization of Full Supply Level (FSL) of Dong Nai No.3 Reservoir**



**Optimization of Daily Minimum Operation Hour**

**Figure 6.9 Results of Optimization Study of Project Development Scale**