

Table 23 DISBURSEMENT SCHEDULE OF CONSTRUCTION COST

Unit: M\$10³

	Total Amount	1st year (1985)	2nd year (1986)	3rd year (1987)	4th year (1988)	5th year (1989)
1. River Diversion Works	F.C. 790			290	330	170
	L.C. 1,360			490	570	300
	Sub-total 2,150			780	900	470
2. Main Dam	F.C. 1,800				950	850
	L.C. 8,200				4,300	3,900
	Sub-total 10,000				5,250	4,750
3. Stilling Basin	F.C. 90				90	
	L.C. 620				620	
	Sub-total 710				710	
4. River Outlet	F.C. 1,200			120	960	120
	L.C. 200					200
	Sub-total 1,400			120	960	320
5. Saddle Dam	F.C. 1,100				340	760
	L.C. 3,270				1,030	2,240
	Sub-total 4,370				1,370	3,000
6. Relocation Road	F.C. 1,520				450	1,070
	L.C. 5,710				1,690	4,020
	Sub-total 7,230				2,140	5,090
7. Preparatory Works	F.C. 1,000			820	90	90
	L.C. 3,040			2,480	280	280
	Sub-total 4,040			3,300	370	370
8. Advance Payment	F.C. -			5,000	-2,000	-3,000
	L.C. -					
	Sub-total -			5,000	-2,000	-3,000
9. Compensation	F.C. -					
	L.C. 25,700			25,700		
	Sub-total 25,700			25,700		
10. Engineering Services and Government Administration (Design and Supervision)	F.C. 5,900	700	1,200	700	1,400	1,900
	L.C. 2,500	300	500	300	600	800
	Sub-total 8,400	1,000	1,700	1,000	2,000	2,700
11. Contingencies						
	Physical Contingencies					
	Price Escalation					
Physical Contingencies	F.C. 2,680	140	240	390	920	990
	L.C. 10,120	60	100	5,790	1,820	2,350
	Sub-total 12,800	200	340	6,180	2,740	3,340
Price Escalation	F.C. 4,370	90	230	500	1,530	2,020
	L.C. 15,420	30	90	7,490	3,020	4,790
	Sub-total 19,790	120	320	7,990	4,550	6,810
Total	F.C. 20,450	930	1,670	7,820	5,060	4,970
	L.C. 76,140	390	690	42,250	13,930	18,880
Grand Total	96,590	1,320	2,360	50,070	18,990	23,850

Remarks: (1) At 1983 price level
(2) F.C. : Foreign currency portion
(3) L.C. : Local currency portion

Table 24 ANNUAL OPERATION AND MAINTENANCE COST

Unit: M\$10³

Item	Amount
<u>1. Operating Personnel</u>	
Super scale technician in-charge-of management (1 person)	25
General Clerk (1 person)	10
Mechanical technician (1 person)	15
Electrical technician (1 person)	15
Caretaker (3 persons)	20
Sub-total	85
<u>2. Administration and Maintenance</u>	
Civil works	
- Total construction cost* of main dam, stilling basin, civil works of river outlet, saddle dam and preparatory works x 0.2% = 23,070 x 0.002	46
Mechanical works	
- Total construction cost* of hydro-mechanical works of river outlet x 1% = 1,554 x 0.01	16
Sub-total	62
<u>3. Miscellaneous</u>	13
Grand Total	160

Remarks; (1) *: Including physical contingency (20%)
 (2) At 1983 price level

Table 25 SUMMARY OF ALTERNATIVE CONSTRUCTION COSTS (1983 PRICE)

(Unit: M\$10³)

Item	Beris Dam, Case No.						Tawar-Muda Dam
	1	2	3	4	5	6	
1. River Diversion Works	2,150	2,150	2,150	2,150	6,200	2,150	6,820
2. Main Dam	6,610	9,000	10,000	11,480	7,930	10,000	9,970
3. Stilling Basin	710	710	710	710	4,560	710	10,700
4. River Outlet/Power Station	1,400	1,400	1,400	1,400	3,120	1,630	3,490
5. Saddle Dam	2,380	3,810	4,370	5,830	4,370	4,370	30,600
6. Relocation Road	5,370	6,430	7,230	9,920	7,230	7,230	1,120
7. Generating Equipment and Transmission Line	-	-	-	-	-	5,400	-
8. Preparatory Works	3,980	4,000	4,040	4,110	4,090	4,110	5,600
9. Compensation	12,600	22,330	25,700	30,090	25,700	25,700	14,400
10. Engineering Services and Government Administration (Design and Supervision)	8,400	8,400	8,400	8,400	8,100	8,700	8,700
11. Contingencies							
Physical contingencies	8,720	11,670	12,800	14,810	14,300	14,000	18,300
Price escalation	13,480	18,000	19,790	22,900	22,100	21,700	28,300
Sub-total	22,200	29,670	32,590	37,710	36,400	35,700	46,600
Grand Total	65,800	87,900	96,590	111,800	107,700	105,700	138,000

Remark: Case 3 is corresponding to the proposed plan of the Beris dam and the cost is derived from Tables 21 and 22.

Table 26 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 1 (1/3)

{Main dam : Concrete gravity }
{Saddle dam: Rockfill }
{HWL : El. 77.0 m }
{In case of valve house constructed }

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
1. River Diversion Works				
Excavation, common	m ³	200	5	1
Excavation, weatherd rock	m ³	200	9	2
Excavation, rock	m ³	600	20	12
Excavation, tunnel	m ³	7,300	90	657
Concrete, in open	m ³	320	240	77
Concrete, in tunnel	m ³	2,100	270	567
Backfill grouting	m	220	170	37
Curtain and consolidation grouting	m	470	250	118
Diversion gate	ton	35	13,000	455
Care of river	L.S.		-	30
Miscellaneous	L.S.		-	194
Sub-total				2,150
2. Main Dam*				
Excavation, common	m ³	5,500	5	28
Excavation, weathered rock	m ³	9,700	9	87
Excavation, rock	m ³	7,200	20	144
Concrete in dam	m ³	35,800	130	4,654
Curtain and consolidation grouting	m	4,380	250	1,095
Measuring apparatus	L.S.		-	100
Miscellaneous	L.S.		-	502
Sub-total				6,610

Remark; *: Including secondary cofferdam of 1.2×10^3 m³.

Table 27 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 1 (2/3)

{Main dam : Concrete gravity
{Saddle dam: Rockfill
{HWL : El. 77.0 m
{In case of valve house constructed}

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
3. Stilling Basin				
Excavation, common	m ³	300	5	2
Excavation, weathered rock	m ³	1,400	9	13
Excavation, rock	m ³	5,500	20	110
Concrete in open	m ³	2,700	190	513
Miscellaneous	L.S.		-	72
Sub-total				710
4. River Outlet				
Concrete in open	m ³	400	240	96
Trash rack	ton	7	9,000	63
Emergency gate	ton	15	15,000	225
Steel pipe shell	ton	36	8,000	288
Release valve*	set	2	300,000	600
Miscellaneous	L.S.		-	128
Sub-total				1,400
5. Saddle Dam				
Excavation, common	m ³	14,800	5	74
Excavation, weathered rock	m ³	8,900	9	80
Excavation, rock	m ³	400	20	8
Embankment, core	m ³	10,800	10	108
Embankment, filter	m ³	9,300	37	344
Embankment, rock	m ³	28,000	17	476
Curtain grouting	m	3,310	250	828
Blanket grouting	m	890	140	125
Slush grouting	m	870	140	121
Measuring apparatus	L.S.		-	80
Miscellaneous	L.S.		-	136
Sub-total				2,380

Remark; *: Consisting of one hollow jet valve (ø1,500), one high pressure slide gate valve (ø600) and guard valve (ø1,500) for one set.

Table 28 DETAILED CONSTRUCTION COST ESTIMATES
 - CASE 1 (3/3)

{Main dam : Concrete gravity }
 {Saddle dam: Rockfill }
 {HWL : El. 77.0 m }
 {In case of valve house constructed }

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
6. Relocation Road				
Road	km	9.6	390,000	3,744
Bridges (1 no.)	m	170	5,800	986
Low voltage power line (1 = 9.77 km)	km	9.77	15,000	147
Miscellaneous	L.S.		-	493
Sub-total				5,370
7. Preparatory Works	L.S.		-	3,980
8. Compensation	L.S.		-	12,600
9. Engineering Services and Government Administration (Design and Supervision)	L.S.		-	8,400
10. Contingencies				
Physical contingencies	L.S.		-	8,720
Price Escalation	L.S.		-	13,480
Sub-total				22,200
Grand Total				65,800
Foreign Currency Portion				13,900
Local Currency Portion				51,900

Table 29 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 2 (1/3)

{Main dam : Concrete gravity
Saddle dam: Rockfill
HWL : El. 83.0 m
{In case of valve house constructed}

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
1. River Diversion Works				
Excavation, common	m ³	200	5	1
Excavation, weathered rock	m ³	200	9	2
Excavation, rock	m ³	600	20	12
Excavation, tunnel	m ³	7,300	90	657
Concrete, in open	m ³	320	240	77
Concrete, in tunnel	m ³	2,100	270	567
Backfill grouting	m	220	170	37
Curtain and consolidation grouting	m	470	250	118
Diversion gate	ton	35	13,000	455
Care of river	L.S.		-	30
Miscellaneous	L.S.		-	194
Sub-total				2,150
2. Main Dam*				
Excavation, common	m ³	6,600	5	33
Excavation, weathered rock	m ³	12,200	9	110
Excavation, rock	m ³	9,200	20	184
Concrete in dam	m ³	50,200	130	6,526
Curtain and consolidation grouting	m	5,210	250	1,303
Measuring apparatus	L.S.		-	100
Miscellaneous	L.S.		-	744
Sub-total				9,000

Remark; *: Including secondary cofferdam of 1.2×10^3 m³.

Table 30 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 2 (2/3)

(Main dam : Concrete gravity
Saddle dam: Rockfill
HWL : El. 83.0 m
(In case of valve house constructed)

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
3. Stilling Basin				
Excavation, common	m ³	300	5	2
Excavation, weathered rock	m ³	1,400	9	13
Excavation, rock	m ³	5,500	20	110
Concrete in open	m ³	2,700	190	513
Miscellaneous	L.S.		-	72
Sub-total				710
4. River Outlet				
Concrete in open	m ³	400	240	96
Trash rack	ton	7	9,000	63
Emergency gate	ton	15	15,000	225
Steel pipe shell	ton	36	8,000	288
Release valve*	set	2	300,000	600
Miscellaneous	L.S.		-	128
Sub-total				1,400
5. Saddle Dam				
Excavation, common	m ³	24,200	5	121
Excavation, weathered rock	m ³	11,600	9	104
Excavation, rock	m ³	500	20	10
Embankment, core	m ³	19,500	10	195
Embankment, filter	m ³	16,400	37	607
Embankment, rock	m ³	64,400	17	1,095
Curtain grouting	m	4,050	250	1,013
Blanket grouting	m	1,300	140	182
Slush grouting	m	970	140	136
Measuring apparatus	L.S.		-	80
Miscellaneous	L.S.		-	267
Sub-total				3,810

Remark; *: Consisting of one hollow jet valve (ø1,500), one high pressure slide gate valve (ø600) and guard valve (ø1,500) for one set.

Table 31 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 2 (3/3)

{Main dam : Concrete gravity
Saddle dam: Rockfill
HWL : EL. 83.0 m
In case of valve house constructed}

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
6. Relocation Road				
Road	km	10.4	390,000	4,056
Bridges (1 no.)	m	280	5,800	1,624
Low voltage power line	km	10.68	15,000	160
Miscellaneous	L.S.		-	590
Sub-total				6,430
7. Preparatory Works	L.S.		-	4,000
8. Compensation	L.S.		-	22,330
9. Engineering Services and Government Administration (Design and Supervision)	L.S.		-	8,400
10. Contingencies				
Physical contingencies	L.S.		-	11,670
Price escalation	L.S.		-	18,000
Sub-total				29,670
Grand Total				87,900
Foreign Currency Portion				18,500
Local Currency Portion				69,400

Table 32 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 4 (1/3)

{Main dam : Concrete gravity }
{Saddle dam: Rockfill }
{HWL : El. 88.0 m }
{In case of valve house constructed }

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
1. River Diversion Works				
Excavation, common	m ³	200	5	1
Excavation, weathered rock	m ³	200	9	2
Excavation, rock	m ³	600	20	12
Excavation, tunnel	m ³	7,300	90	657
Concrete, in open	m ³	320	240	77
Concrete, in tunnel	m ³	2,100	270	567
Backfill grouting	m	220	170	37
Curtain and consolidation grouting	m	470	250	118
Diversion gate	ton	35	13,000	455
Care of river	L.S.		-	30
Miscellaneous	L.S.		-	194
Sub-total				2,150
2. Main Dam*				
Excavation, common	m ³	7,800	5	39
Excavation, weathered rock	m ³	14,900	9	134
Excavation, rock	m ³	12,400	20	248
Concrete in dam	m ³	64,700	130	8,411
Curtain and consolidation grouting	m	6,420	250	1,605
Measuring apparatus	L.S.		-	100
Miscellaneous	L.S.		-	943
Sub-total				11,480

Remark; *: Including secondary cofferdam of 1.2×10^3 m³.

Table 33 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 4 (2/3)

(Main dam : Concrete gravity
Saddle dam: Rockfill
HWL : EL. 88.0 m
(In case of valve house constructed)

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
3. Stilling Basin				
Excavation, common	m ³	300	5	2
Excavation, weathered rock	m ³	1,400	9	13
Excavation, rock	m ³	5,500	20	110
Concrete in open	m ³	2,700	190	513
Miscellaneous	L.S.		-	72
Sub-total				710
4. River Outlet				
Concrete in open	m ³	400	240	96
Trash rack	ton	7	9,000	63
Emergency gate	ton	15	15,000	225
Steel pipe shell	ton	36	8,000	288
Release valve*	set	2	300,000	600
Miscellaneous	L.S.		-	128
Sub-total				1,400
5. Saddle Dam				
Excavation, common	m ³	46,700	5	234
Excavation, weathered rock	m ³	14,300	9	129
Excavation, rock	m ³	600	20	12
Embankment, core	m ³	26,600	10	266
Embankment, filter	m ³	24,200	37	895
Embankment, rock	m ³	127,400	17	2,166
Curtain grouting	m	4,710	250	1,178
Blanket grouting	m	1,760	140	246
Slush grouting	m	1,180	140	166
Measuring apparatus	L.S.		-	80
Miscellaneous	L.S.		-	458
Sub-total				5,830

Remark; *: Consisting of one hollow jet valve (ø1,500), one high pressure slide gate valve (ø600) and guard valve (ø1,500) for one set.

Table 34 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 4 (3/3)

{Main dam : Concrete gravity
Saddle dam: Rockfill
HWL : El. 88.0 m
{In case of valve house constructed}

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
6. Relocation Road				
Road	km	15.8	390,000	6,162
Bridges (1 no.)	m	450	5,800	2,610
Low voltage power line	km	16.25	15,000	244
Miscellaneous	L.S.		-	904
Sub-total				9,920
7. Preparatory Works	L.S.		-	4,110
8. Compensation	L.S.		-	30,090
9. Engineering Services and Government Administration (Design and Supervision)	L.S.		-	8,400
10. Contingencies				
Physical contingencies	L.S.		-	14,810
Price escalation	L.S.		-	22,900
Sub-total				37,710
Grand Total				111,800
Foreign Currency Portion				23,700
Local Currency Portion				88,100

Table 35 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 5 (1/3)

{Main dam : Rockfill
{Saddle dam: Rockfill
{HWL : El. 85.0 m
{In case of valve house constructed}

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
1. River Diversion Works				
Excavation, common	m ³	3,700	5	19
Excavation, weathered rock	m ³	4,300	9	39
Excavation, rock	m ³	10,600	20	212
Excavation, tunnel	m ³	16,500	90	1,485
Concrete in open	m ³	800	240	192
Concrete in tunnel	m ³	5,400	270	1,458
Backfill grouting	m	630	170	107
Curtain and consolidation grouting	m	4,660	250	1,165
Diversion gates	ton	70	13,000	910
Care of river	L.S.		-	50
Miscellaneous	L.S.		-	563
Sub-total				6,200
2. Main Dam				
Excavation, common	m ³	50,000	5	250
Excavation, weathered rock	m ³	9,800	9	88
Excavation, rock	m ³	4,000	20	80
Concrete in gallery	m ³	2,900	190	551
Embankment, core	m ³	39,300	10	393
Embankment, filter	m ³	34,000	37	1,258
Embankment, rock	m ³	212,000	17	3,604
Curtain grouting	m	3,100	250	775
Blanket grouting	m	1,500	140	210
Measuring apparatus	L.S.		-	100
Miscellaneous	L.S.		-	621
Sub-total				7,930

Table 36 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 5 (2/3)

(Main dam : Rockfill
Saddle dam: Rockfill
HWL : El. 85.0 m
(In case of valve house constructed)

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
3. Spillway/Stilling Basin				
Excavation, common	m ³	14,700	5	74
Excavation, weathered rock	m ³	37,500	9	338
Excavation, rock	m ³	94,400	20	1,888
Concrete in open	m ³	9,300	190	1,767
Curtain grouting	m	300	250	75
Miscellaneous	L.S.		-	418
Sub-total				4,560
4. River Outlet				
Excavation shaft	m ³	900	90	81
Concrete in open	m ³	400	240	96
Concrete in shaft	m ³	250	270	68
Backfill grouting	m	40	170	7
Trash rack	ton	7	9,000	63
Emergency gate	ton	40	15,000	600
Steel pipe shell	ton	160	8,000	1,280
Release valve*	set	2	300,000	600
Miscellaneous	L.S.		-	325
Sub-total				3,120
5. Saddle Dam				
Excavation, common	m ³	27,800	5	139
Excavation, weathered rock	m ³	12,600	9	114
Excavation, rock	m ³	500	20	10
Embankment, core	m ³	22,300	10	223
Embankment, filter	m ³	18,600	37	688
Embankment, rock	m ³	80,700	17	1,372
Curtain grouting	m	4,250	250	1,063
Blanket grouting	m	1,500	140	210
Slush grouting	m	1,070	140	150
Measuring apparatus	L.S.		-	80
Miscellaneous	L.S.		-	322
Sub-total				4,370

Remark; *: Consisting of one hollow jet valve (ø1,500), one high pressure slide gate valve (ø600) and guard valve (ø1,500) for one set.

Table 37 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 5 (3/3)

(Main dam : Rockfill
Saddle dam: Rockfill
HWL : El. 85.0 m
(In case of valve house constructed)

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
6. Relocation Road				
Road	km	11.9	390,000	4,641
Bridge (1 no.)	m	300	5,800	1,740
Low voltage power line	km	12.2	15,000	183
Miscellaneous	L.S.		-	666
Sub-total				7,230
7. Preparatory Work	L.S.		-	4,090
8. Compensation	L.S.		-	25,700
9. Engineering Services and Government Administration (Design and Supervision)	L.S.		-	8,100
10. Contingencies				
Physical contingencies	L.S.		-	14,300
Price escalation	L.S.		-	22,100
Sub-total				36,400
Grand Total				107,700
Foreign Currency Portion				22,800
Local Currency Portion				84,900

Table 38 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 6 (1/3)

{Main dam : Concrete gravity
Saddle dam: Rockfill
HWL : El. 85.0 m
In case of power station/valve house
constructed

(1983 price)

Item	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
1. River Diversion works				
Excavation, common	m ³	200	5	1
Excavation, weathered rock	m ³	200	9	2
Excavation, rock	m ³	600	20	12
Excavation, tunnel	m ³	7,300	90	657
Concrete in open	m ³	320	240	77
Concrete in tunnel	m ³	2,100	270	567
Backfill grouting	m	220	170	37
Curtain and consolidation grouting	m	470	250	118
Diversion gate	ton	35	13,000	455
Care of river	L.S.		-	30
Miscellaneous	L.S.		-	194
Sub-total				2,150
2. Main Dam*				
Excavation, common	m ³	7,100	5	36
Excavation, weathered rock	m ³	13,300	9	120
Excavation, rock	m ³	10,100	20	202
Concrete in dam	m ³	56,400	130	7,332
Curtain and consolidation grouting	m	5,520	250	1,380
Measuring apparatus	L.S.		-	100
Miscellaneous	L.S.		-	830
Sub-total				10,000
3. Stilling Basin				
Excavation, common	m ³	300	5	2
Excavation, weathered rock	m ³	1,400	9	13
Excavation, rock	m ³	5,500	20	110
Concrete in open	m ³	2,700	190	513
Miscellaneous	L.S.		-	72
Sub-total				710

Remark; *: Including secondary cofferdam of 1.2×10^3 m³.

Table 39. DETAILED CONSTRUCTION COST ESTIMATES
- CASE 6 (2/3)

Main dam : Concrete gravity
Saddle dam: Rockfill
HWL : El. 85.0 m
{In case of power station/valve house
constructed}

Item	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
4. Power Station/Valve House				
Excavation, common	m ³	3,500	5	18
Excavation, weathered rock	m ³	1,400	9	13
Excavation, rock	m ³	900	20	18
Concrete in open	m ³	1,030	240	247
Trash rack	ton	7	9,000	63
Emergency gate	ton	15	15,000	225
Steel pipe shell	ton	36	8,000	288
Tailrace gate	ton	14	13,000	182
Release valve*	set	1	300,000	300
Miscellaneous	L.S.		-	276
Sub-total				1,630
5. Saddle Dam				
Excavation, common	m ³	27,800	5	139
Excavation, weathered rock	m ³	12,600	9	113
Excavation, rock	m ³	500	20	10
Embankment, core	m ³	22,300	10	223
Embankment, filter	m ³	18,600	37	688
Embankment, rock	m ³	80,700	17	1,372
Curtain grouting	m	4,250	250	1,063
Blanket grouting	m	1,500	140	210
Slush grouting	m	1,070	140	150
Measuring apparatus	L.S.		-	80
Miscellaneous	L.S.		-	322
Sub-total				4,370
6. Relocation Road				
Road	km	11.9	390,000	4,641
Bridge (1 no.)	m	300	5,800	1,740
Low voltage power line	km	12.2	15,000	184
Miscellaneous	L.S.		-	665
Sub-total				7,230

Remark; *: Consisting of one hollow jet valve (ø1,500), one high pressure slide gate valve (ø600) and one guard valve (ø1,500).

Table 40 DETAILED CONSTRUCTION COST ESTIMATES
- CASE 6 (3/3)

{Main dam : Concrete gravity }
{Saddle dam: Rockfill }
{HWL : El. 85.0 m }
{In case of power station/valve house }
{constructed }

(1983 price)

Item	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
7. Generating Equipment (3,000 kW) ^{/1}	L.S.		-	4,400
8. Transmission Line ^{/2} and Interconnection switchgear ^{/3}	L.S.		-	1,000
9. Preparatory Works	L.S.		-	4,110
10. Compensation	L.S.		-	25,700
11. Engineering services and government administration (Design and Supervision)	L.S.		-	8,700
12. Contingencies				
Physical contingencies	L.S.		-	14,000
Price escalation	L.S.		-	21,700
Sub-total				35,700
Grand Total				105,700
Foreign Currency Portion				22,400
Local Currency Portion				83,300

Remarks; /1: Francis turbine is considered.

/2: 33 kV, l = 17.4 km (from power station to Sik).

/3: 33 kV/11 kV, 4,000 kVA.

Table 41 DETAILED CONSTRUCTION COST ESTIMATES
OF TAWAR-MUDA DAM (1/3)

{Main dam : Rockfill }
{Saddle dams: Rockfill }
{HWL : El. 77.0 m }

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
1. River Diversion Works				
Excavation, common	m ³	63,000	5	315
Excavation, weathered rock	m ³	22,700	9	204
Excavation, rock	m ³	20,100	20	402
Excavation, tunnel	m ³	18,300	90	1,647
Concrete in open	m ³	1,410	230	324
Concrete in tunnel	m ³	7,400	260	1,924
Backfill grouting	m	520	160	83
Curtain and consolidation grouting	m	4,680	250	1,170
Diversion gate	ton	70	1,300	91
Care of river	L.S.		-	40
Miscellaneous	L.S.		-	620
Sub-total				6,820
2. Main Dam				
Excavation, common	m ³	98,400	5	492
Excavation, weathered rock	m ³	48,000	9	432
Excavation, rock	m ³	14,300	20	286
Concrete in gallery	m ³	3,520	230	810
Embankment, core	m ³	53,500	10	535
Embankment, filter	m ³	25,100	25	628
Embankment, rock	m ³	202,000	17	3,434
Curtain grouting	m	7,110	250	1,778
Blanket grouting	m	4,740	140	664
Miscellaneous	L.S.		-	911
Sub-total				9,970

Table 42 DETAILED CONSTRUCTION COST ESTIMATES
OF TAWAR-MUDA DAM (2/3)

{Main dam : Rockfill }
{Saddle dams: Rockfill }
{HWL : El. 77.0 m }

(1983 price)

Description	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
3. Spillway				
Excavation, common	m ³	133,000	5	665
Excavation, weathered rock	m ³	46,600	9	419
Excavation, rock	m ³	23,900	20	478
Concrete in open	m ³	44,100	180	7,938
Curtain grouting	m	900	250	225
Miscellaneous	L.S.		-	975
Sub-total				10,700
4. River Outlet				
Excavation, shaft	m ³	2,000	90	180
Concrete in open	m ³	900	230	207
Concrete in shaft	m ³	450	260	117
Backfill grouting	m	30	160	5
Trash rack	ton	7	9,000	63
Emergency gate	ton	40	15,000	600
Steel pipe shell	ton	160	8,000	1,280
Release valve*	set	2	300,000	600
Miscellaneous	L.S.		-	438
Sub-total				3,490
5. Saddle Dams				
i) Dams				
Excavation, common	m ³	263,000	5	1,315
Excavation, weathered rock	m ³	117,500	9	1,058
Excavation, rock	m ³	13,000	20	260
Embankment, core	m ³	188,600	10	1,886
Embankment, filter	m ³	113,400	25	2,835
Embankment, rock	m ³	611,300	17	10,392
Curtain grouting	m	30,800	250	7,700
Blanket grouting	m	7,110	140	995

Remark; *: Consisting of one hollow jet valve (ø1,500), one high pressure slide gate valve (ø600) and guard valve (ø1,500) for one set.

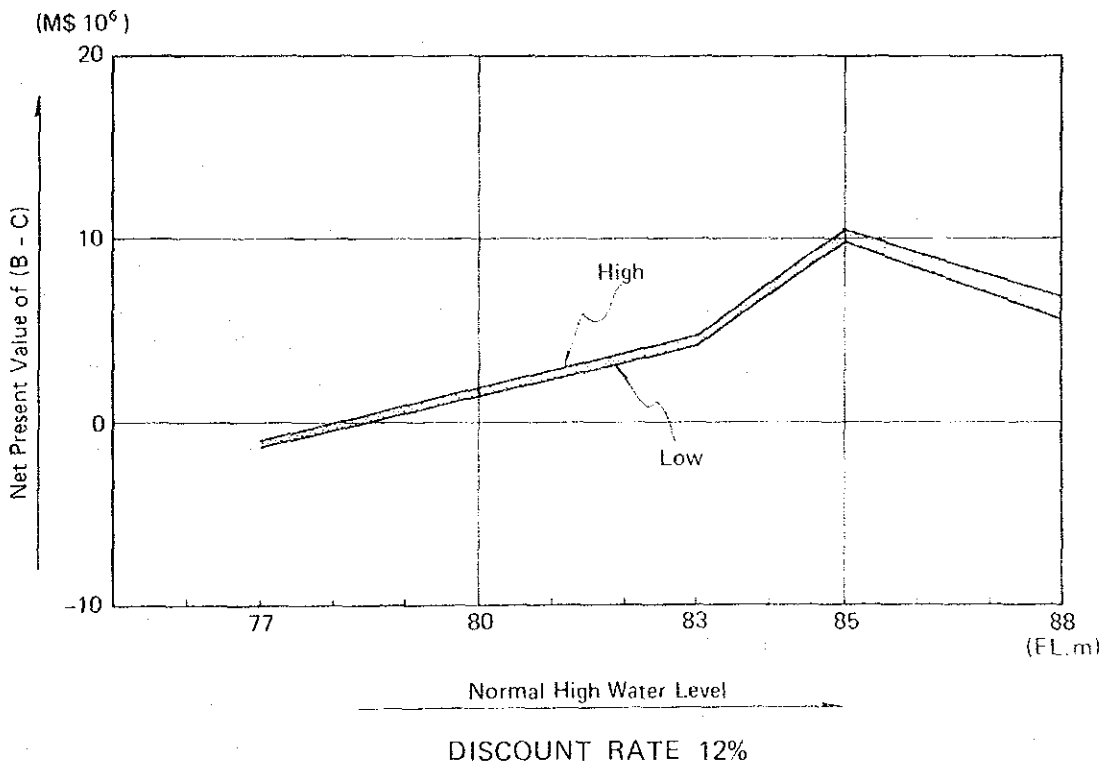
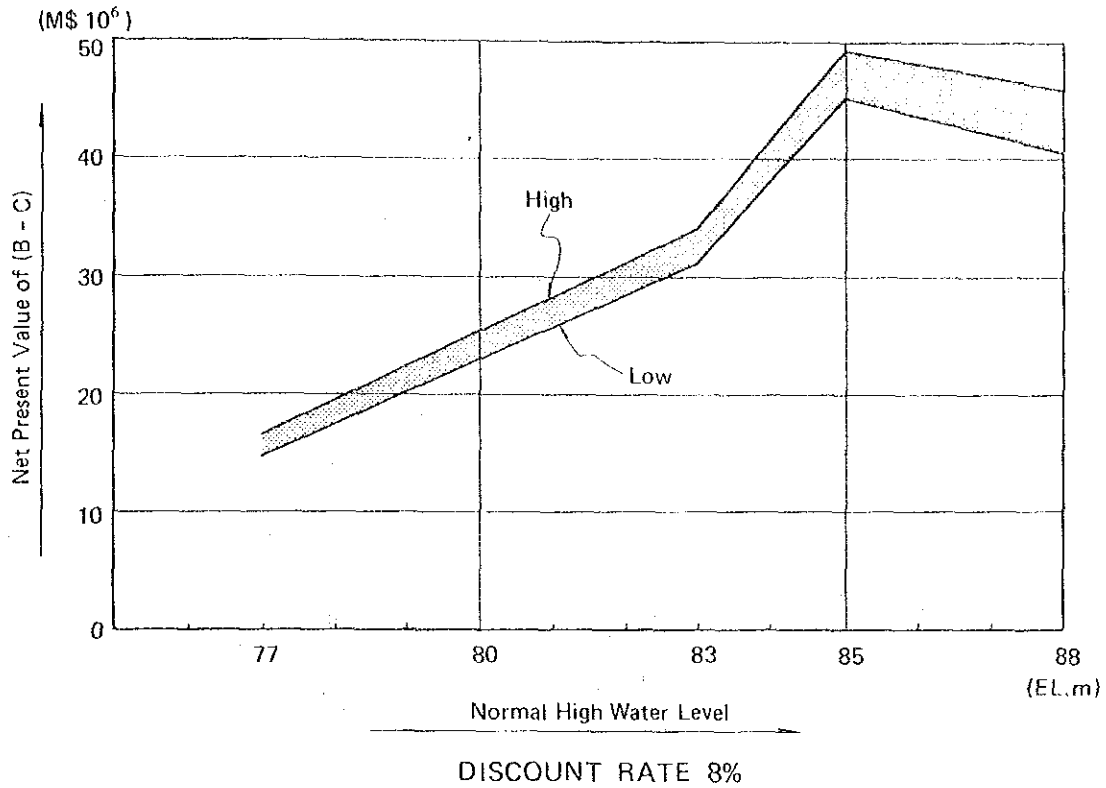
Table 43 DETAILED CONSTRUCTION COST ESTIMATES
OF TAWAR-MUDA DAM (3/3)

{ Main dam : Rockfill }
{ Saddle dams: Rockfill }
{ HWL : El. 77.0 m }

(1983 price)

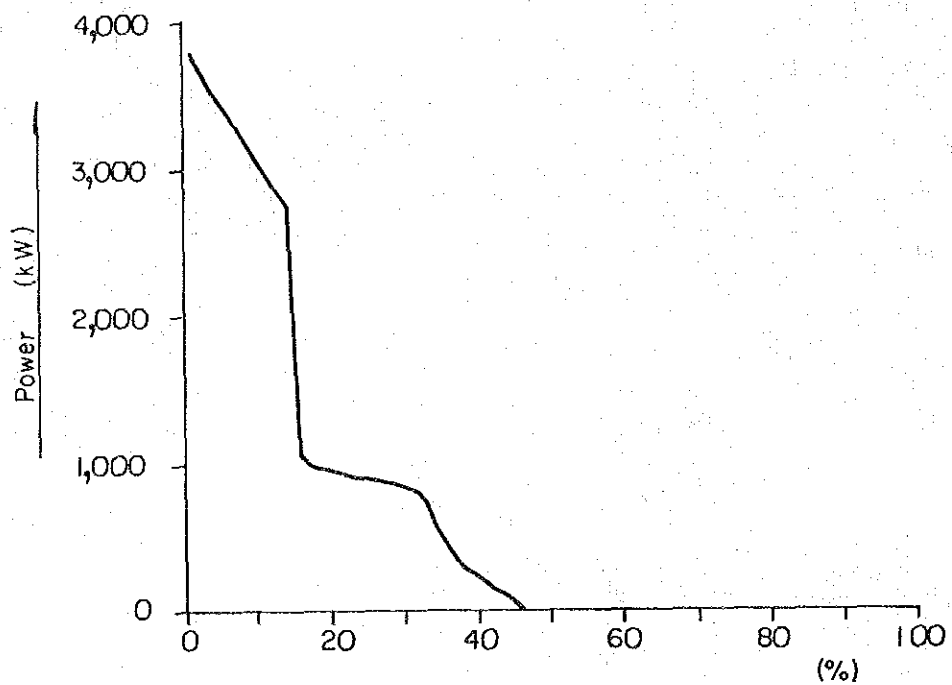
	Unit	Quantity	Unit Price (M\$)	Amount (M\$ 10 ³)
ii) River diversion works				
Excavation, common	m ³	2,620	5	13
Excavation, weathered rock	m ³	7,860	9	71
Excavation, rock	m ³	2,620	20	52
Excavation, tunnel	m ³	2,100	90	189
Concrete in tunnel	m ³	1,100	260	286
Backfill grouting	m	160	160	26
Curtain and consolidation grouting	m	2,280	250	570
Diversion gate	ton	10	12,000	120
Care of river	L.S.		-	42
Miscellaneous	L.S.		-	2,790
Sub-total				30,600
6. Relocation Road				
Load	km	2.5	390,000	975
Power line	km	2.5	15,000	38
Miscellaneous	L.S.		-	107
Sub-total				1,120
7. Preparatory Works	L.S.		-	5,600
8. Compensation	L.S.		-	14,400
9. Engineering Services and Government Administration (Design and Supervision)	L.S.		-	8,700
10. Contingencies				
Physical contingencies	L.S.		-	18,300
Price escalation	L.S.		-	28,300
Sub-total				46,600
Grand Total				138,000
Foreign Currency Portion				29,200
Local Currency Portion				108,800

FIGURES



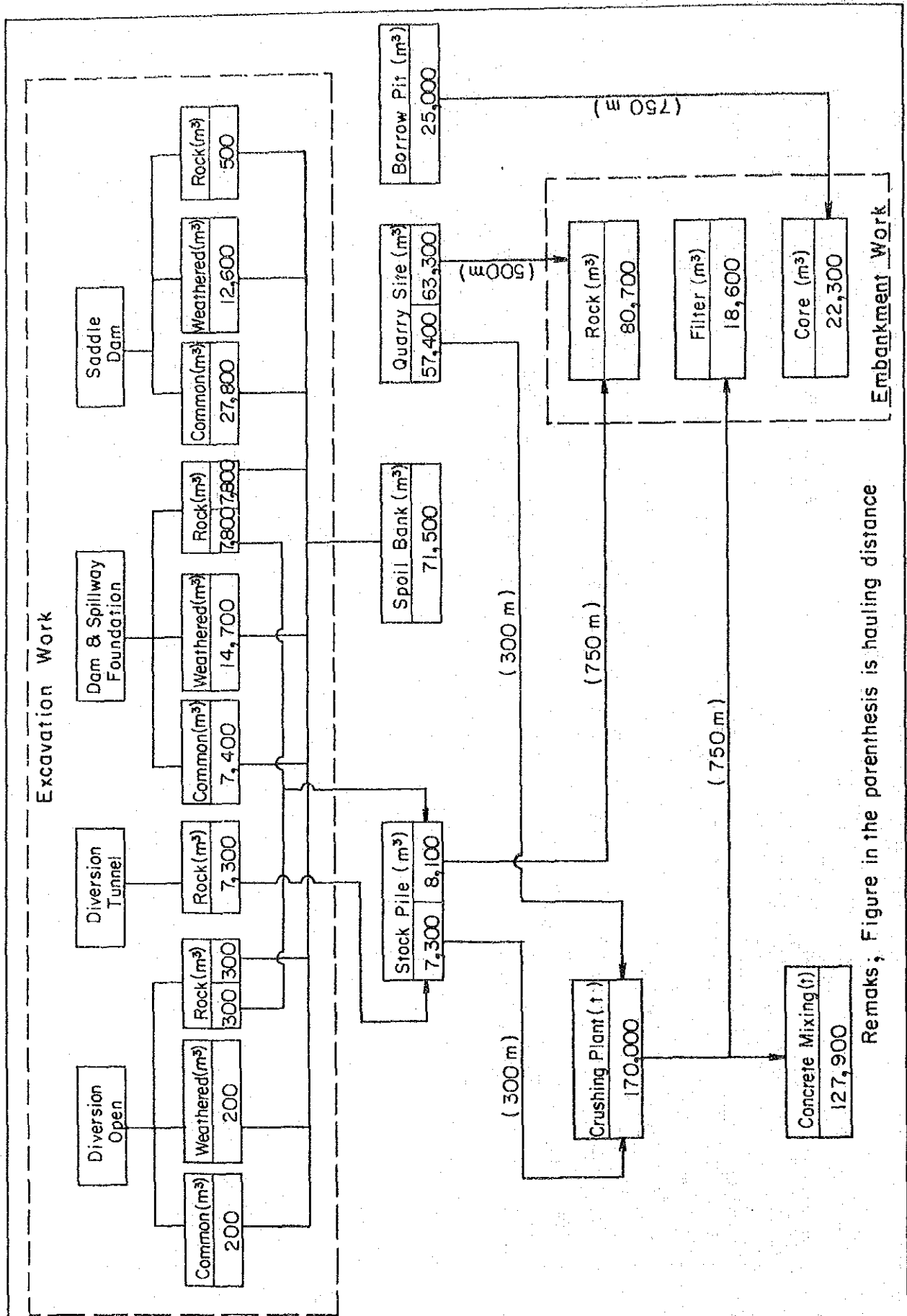
Remarks; 1) High is drawn based on the highest estimate of unit water present value.
 2) Low is drawn based on the lowest estimate of unit water present value.

Fig. 1 Relation Between Project Scale and Net Present Value of (B - C)



Remark : The power outputs are calculated on the basis of water outputs of the Beris dam for 2000 demand assuming that Alternative 3, Kedah priority, is applied for the operation rule of the Jeniang Weir described in Annex F

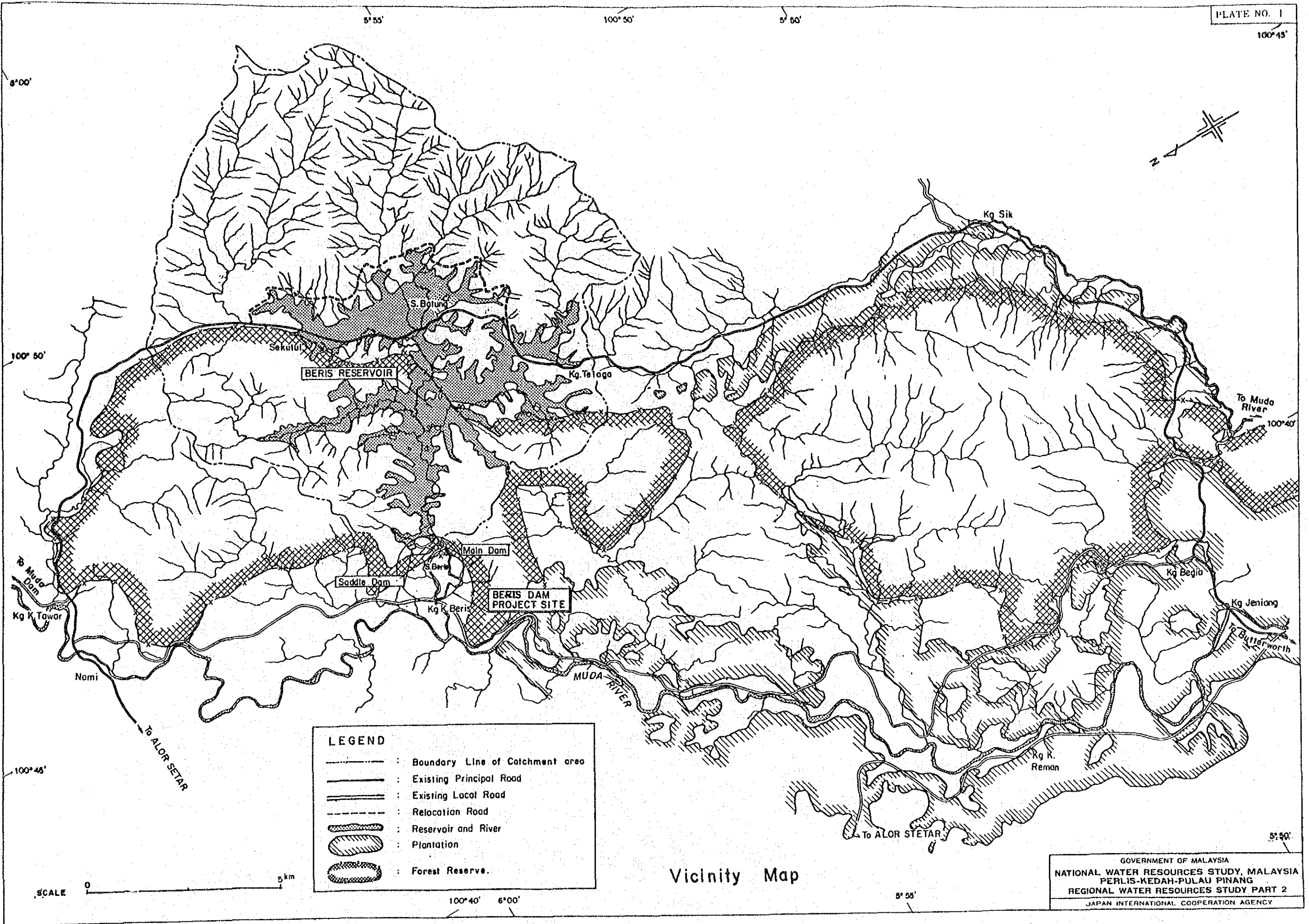
Fig.2 Power Output Duration Curve
at Beris Damsite
(For 23 Y ; 1961 - 1983)



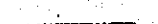



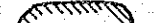


Remarks; Figure in the parenthesis is hauling distance

Fig.4 Construction Material Source and Distribution Chart

PLATES

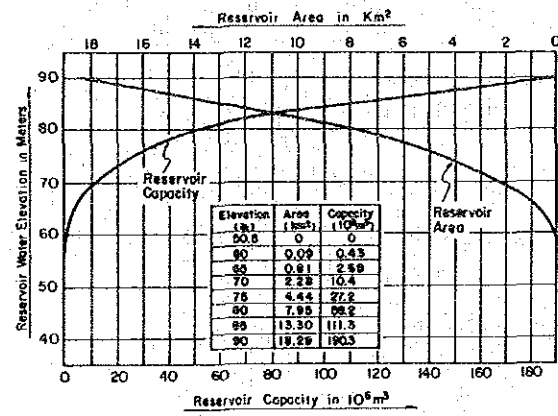
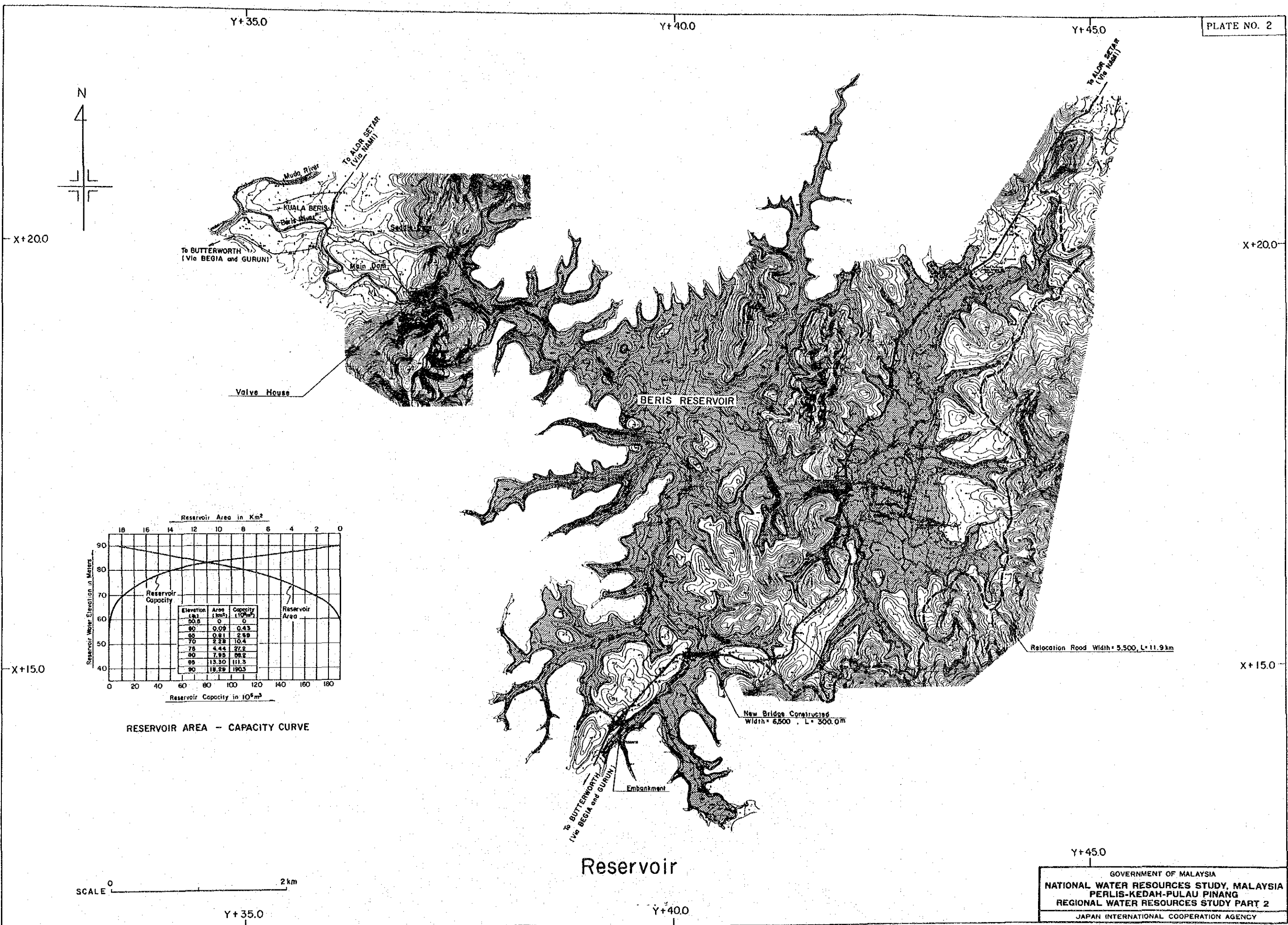
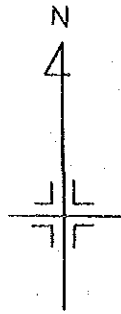


LEGEND

-  : Boundary Line of Catchment area
-  : Existing Principal Road
-  : Existing Local Road
-  : Relocation Road
-  : Reservoir and River
-  : Plantation
-  : Forest Reserve.

Vicinity Map

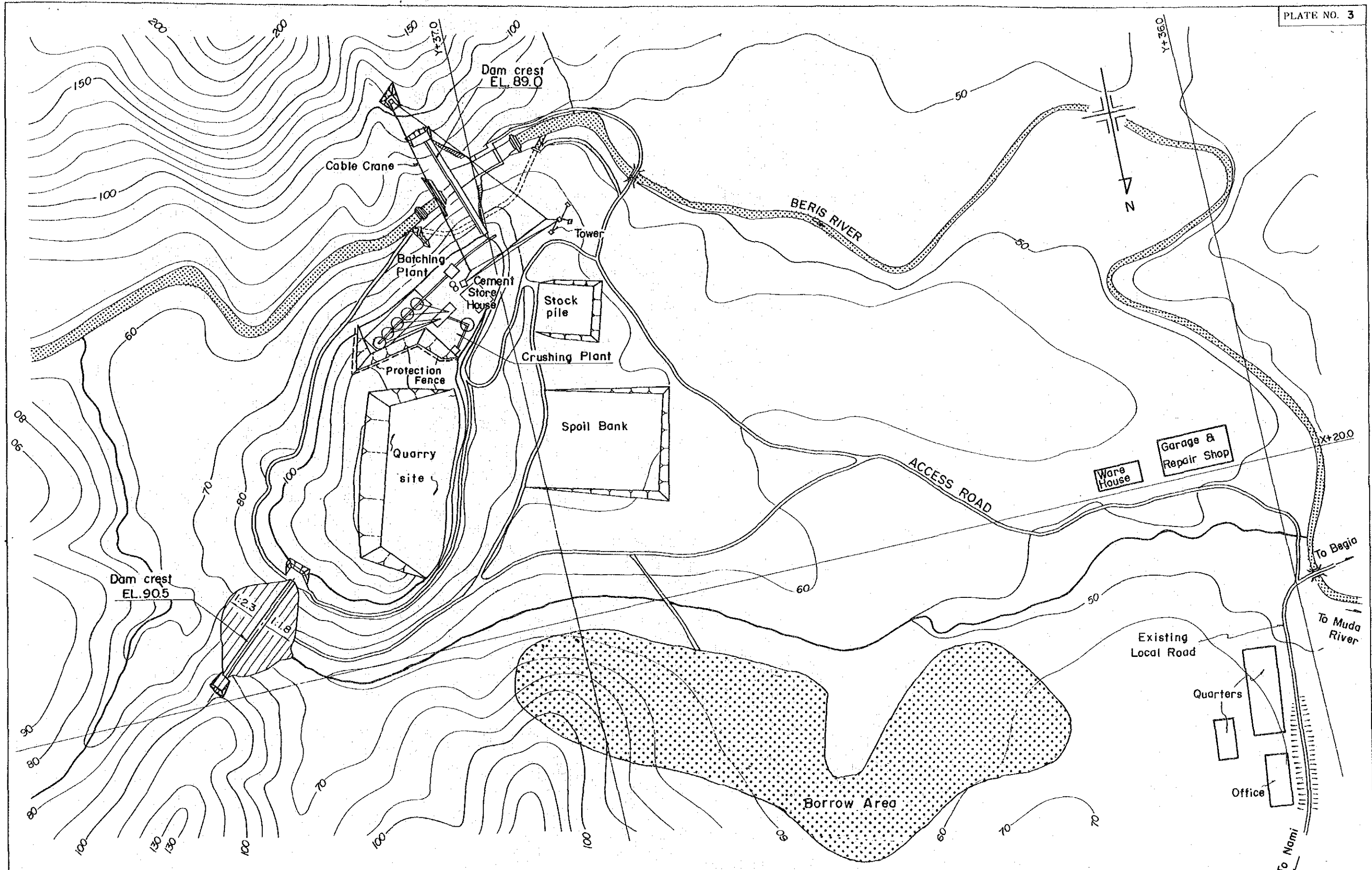
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RESERVOIR AREA - CAPACITY CURVE

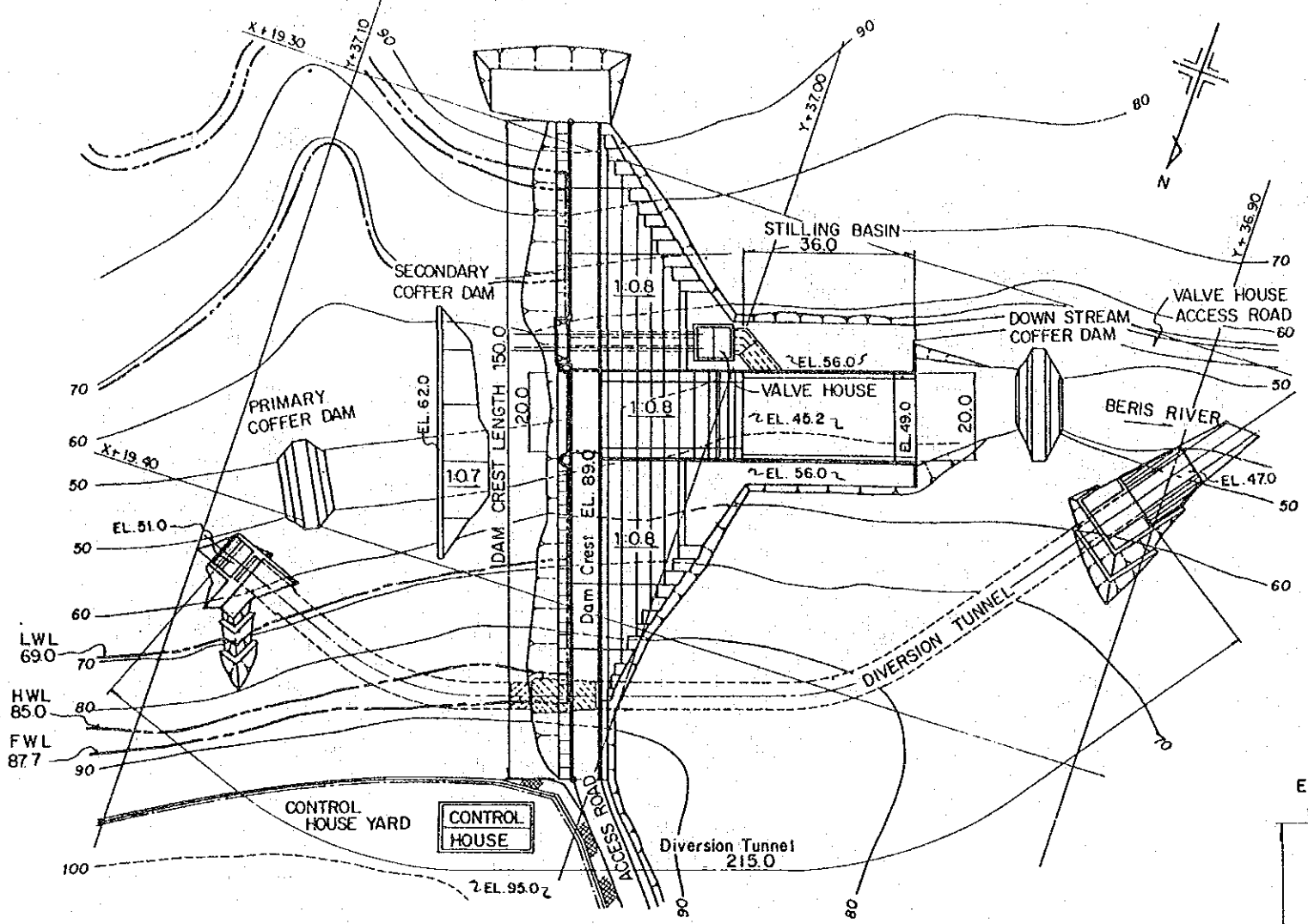
SCALE 0 2 km

Reservoir

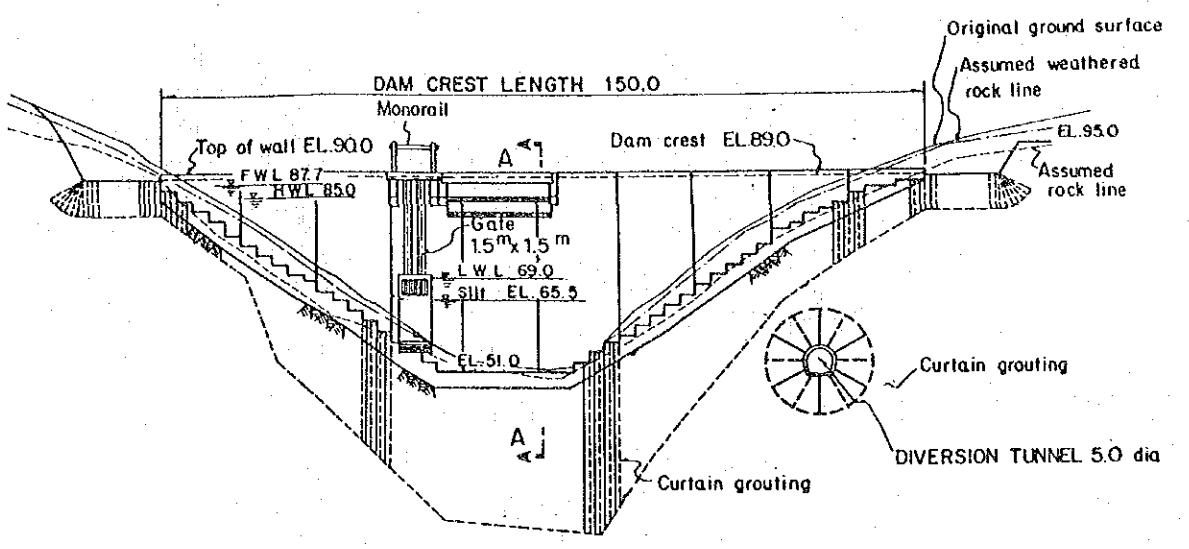


General Plan of Damsite

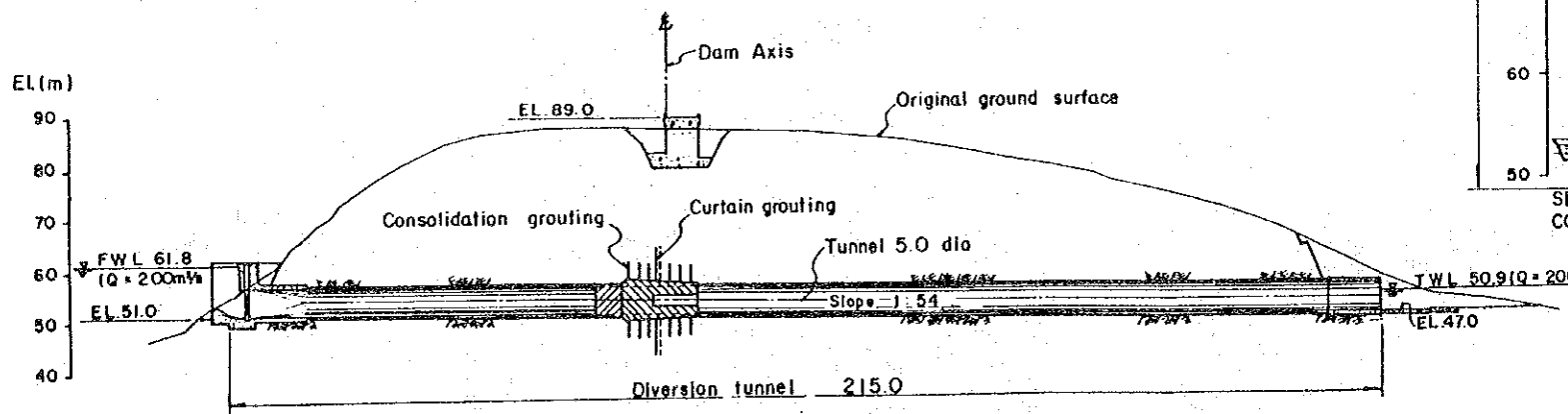
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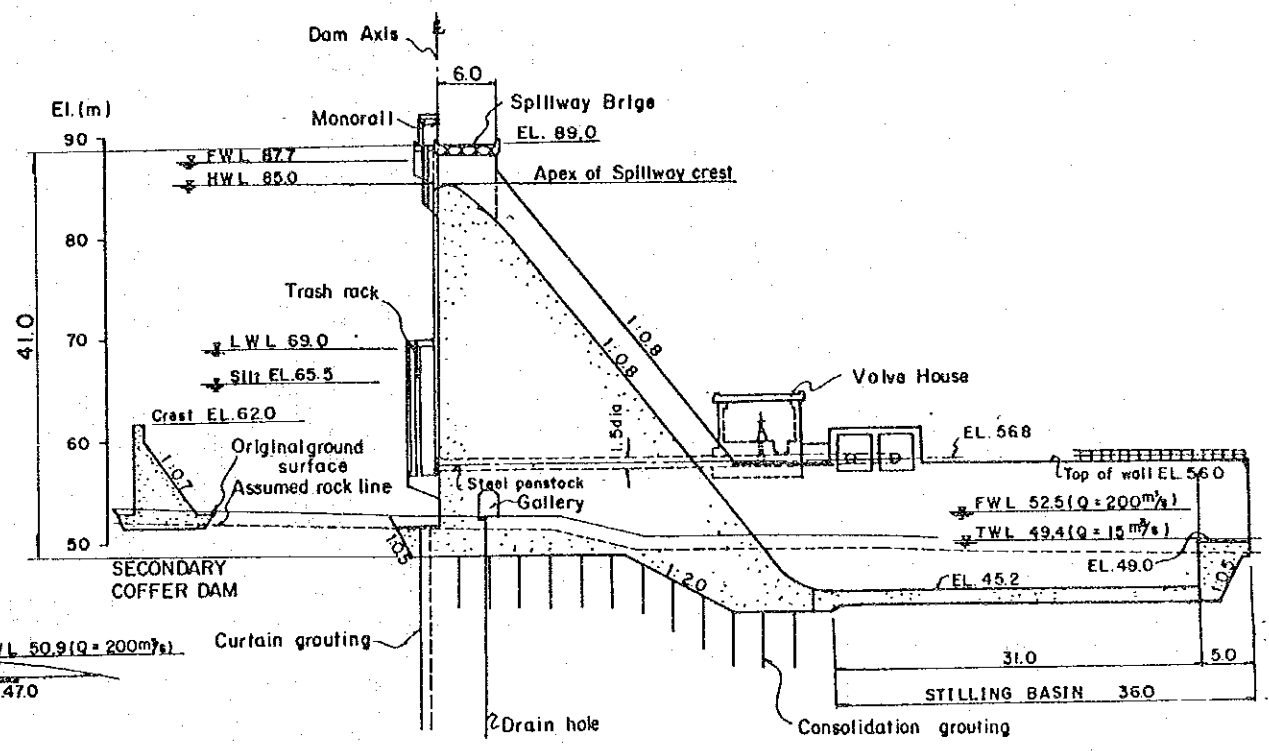
PLAN SCALE A



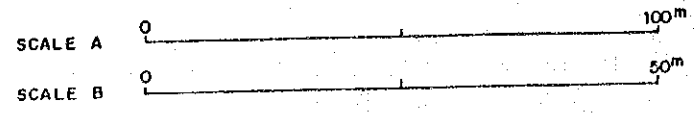
ELEVATION (UPSTREAM SIDE) SCALE A



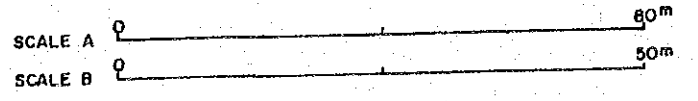
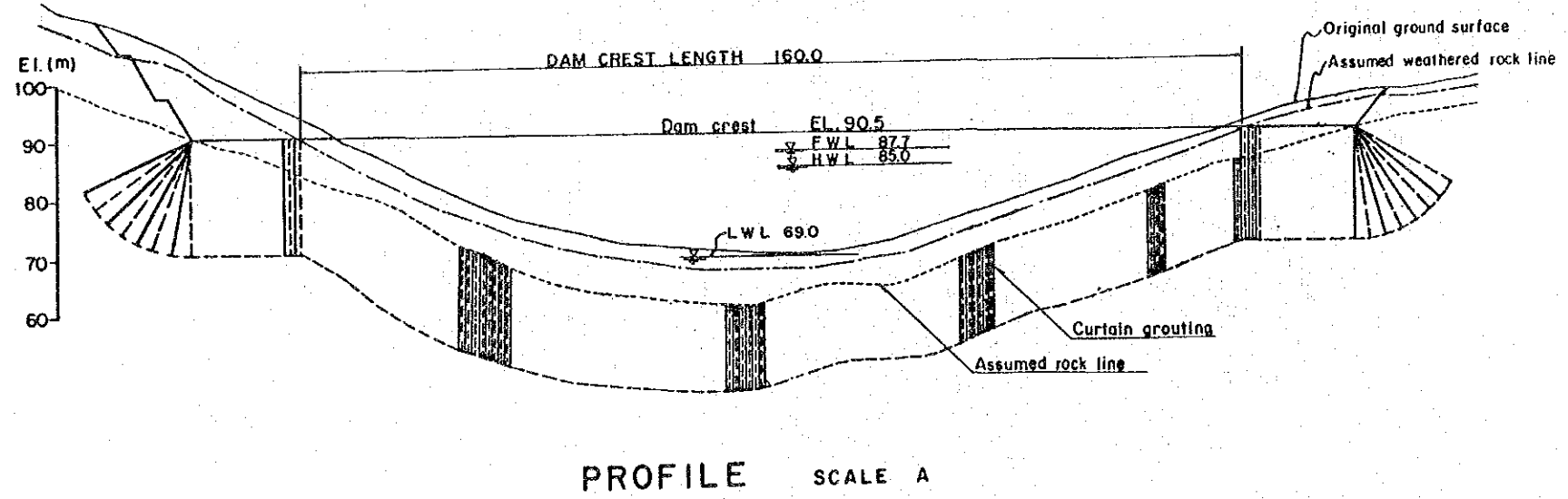
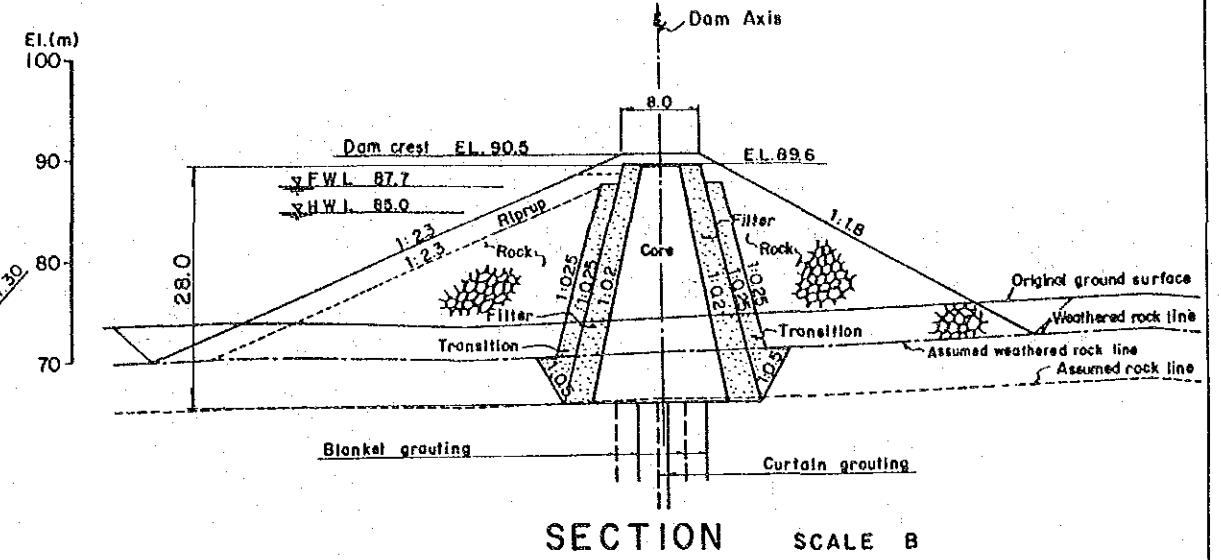
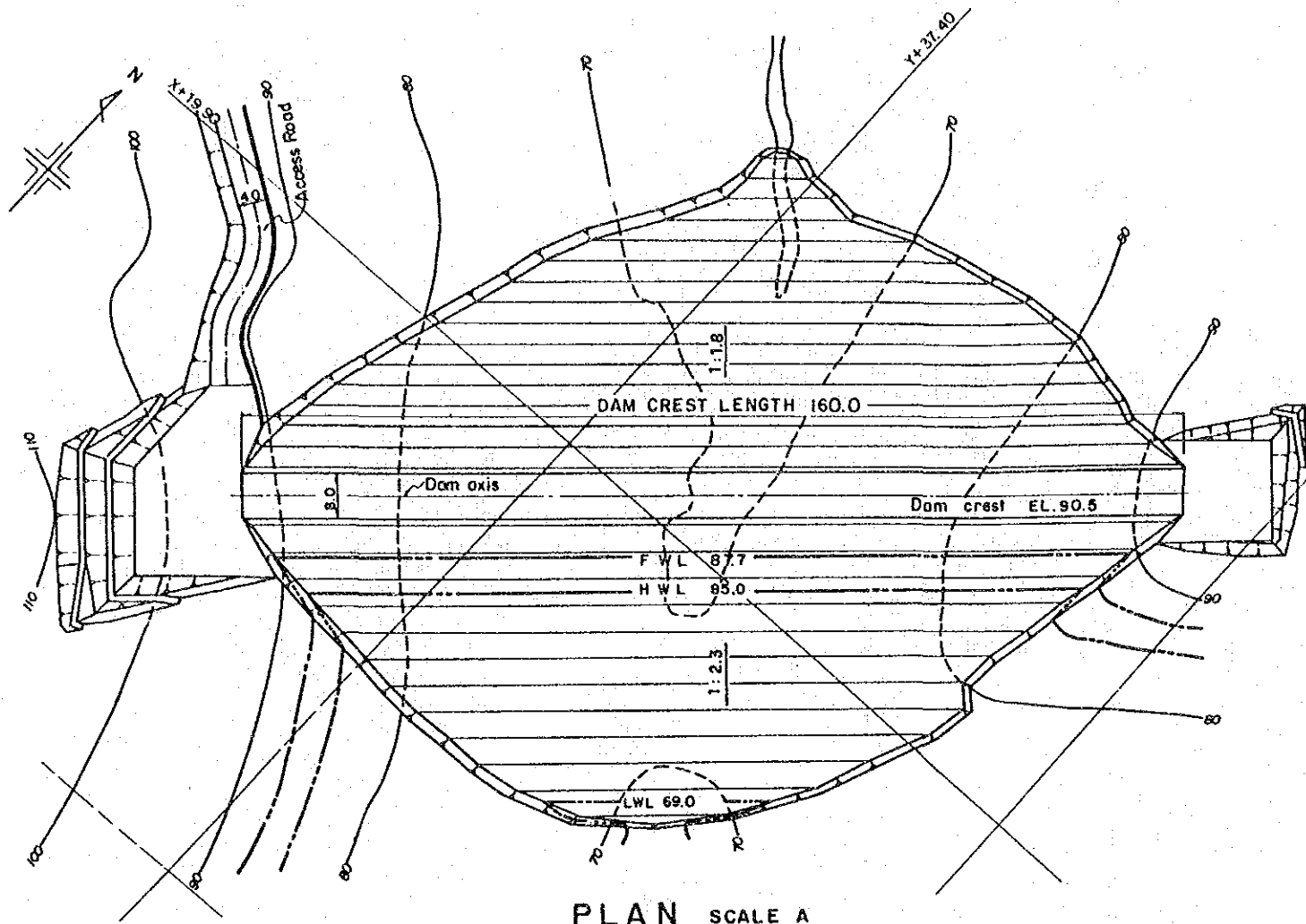
PROFILE OF DIVERSION TUNNEL SCALE A



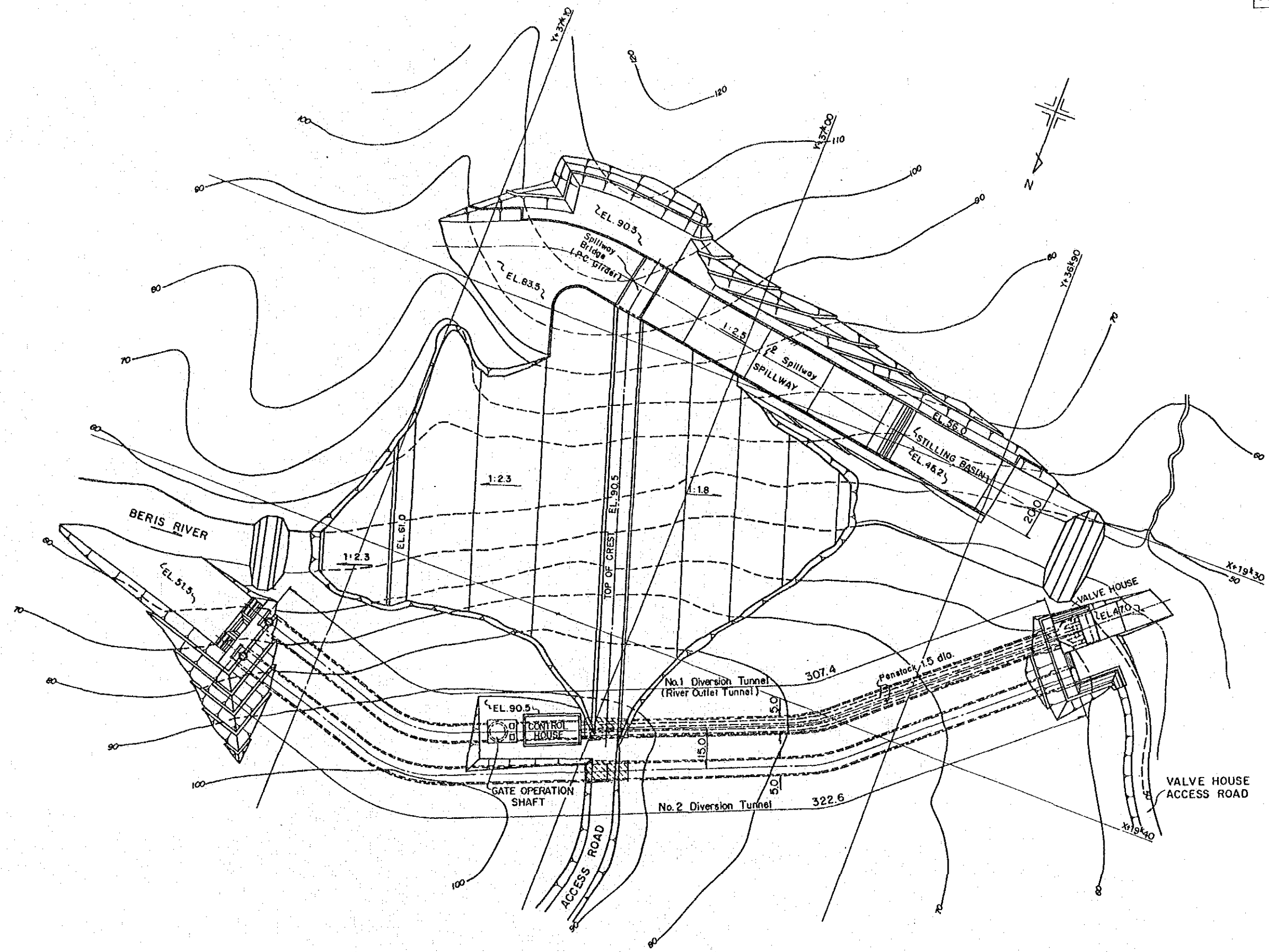
SECTION A-A SCALE B



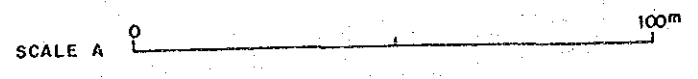
Main Dam



Saddle Dam

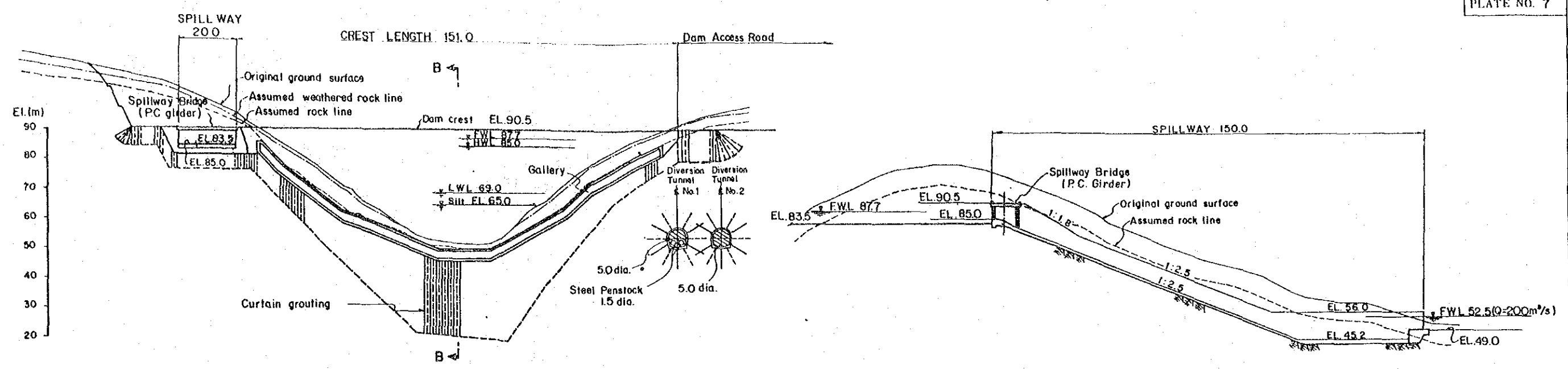


PLAN



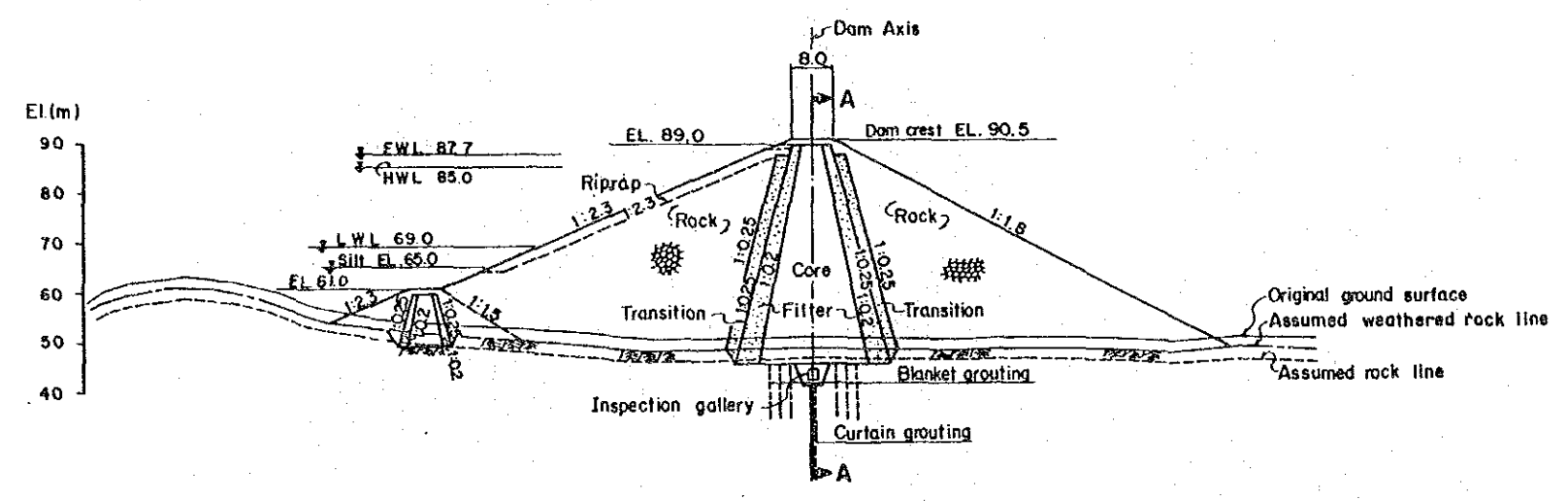
Main Dam Alternative (1/2)

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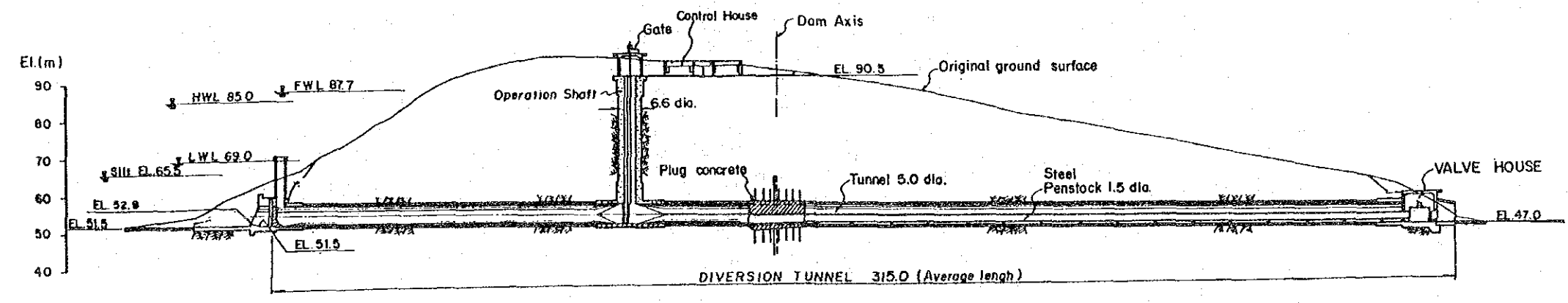


SECTION A-A SCALE A

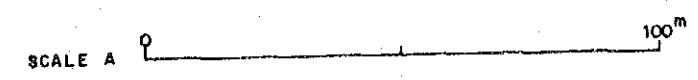
PROFILE OF SPILLWAY SCALE A



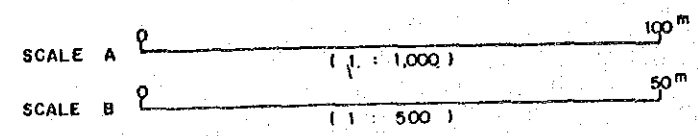
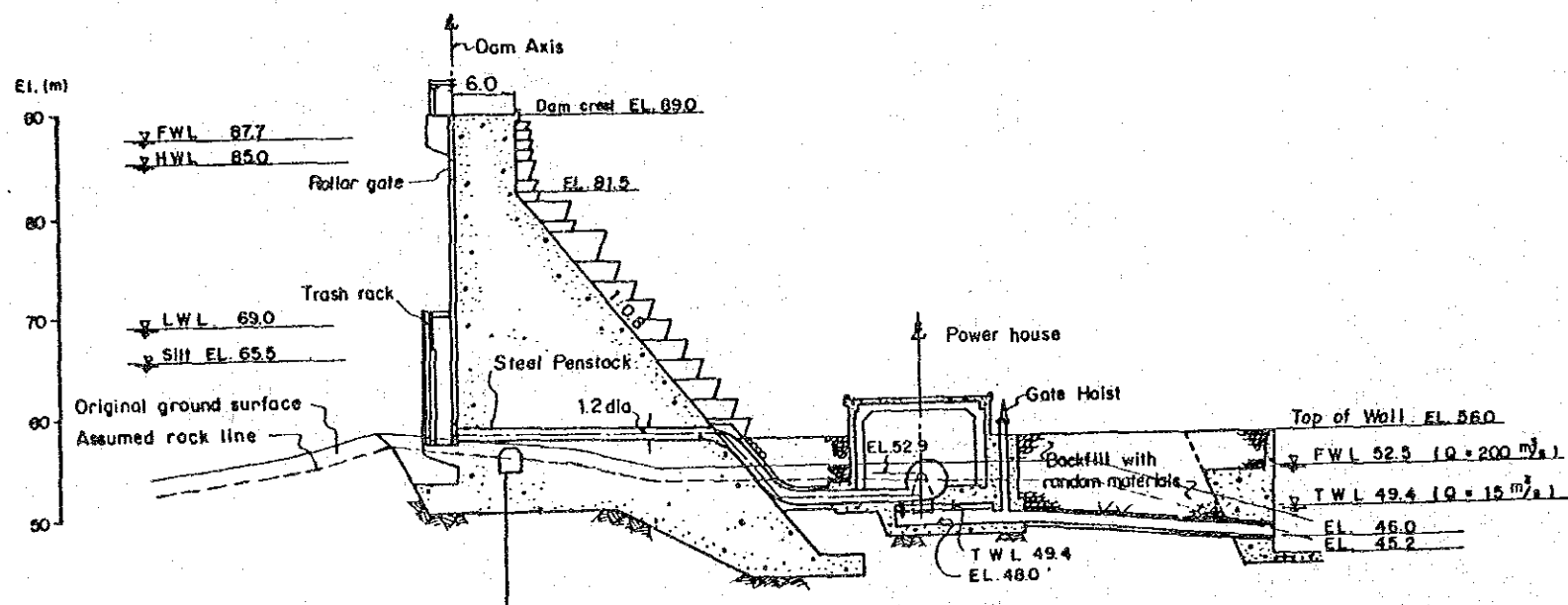
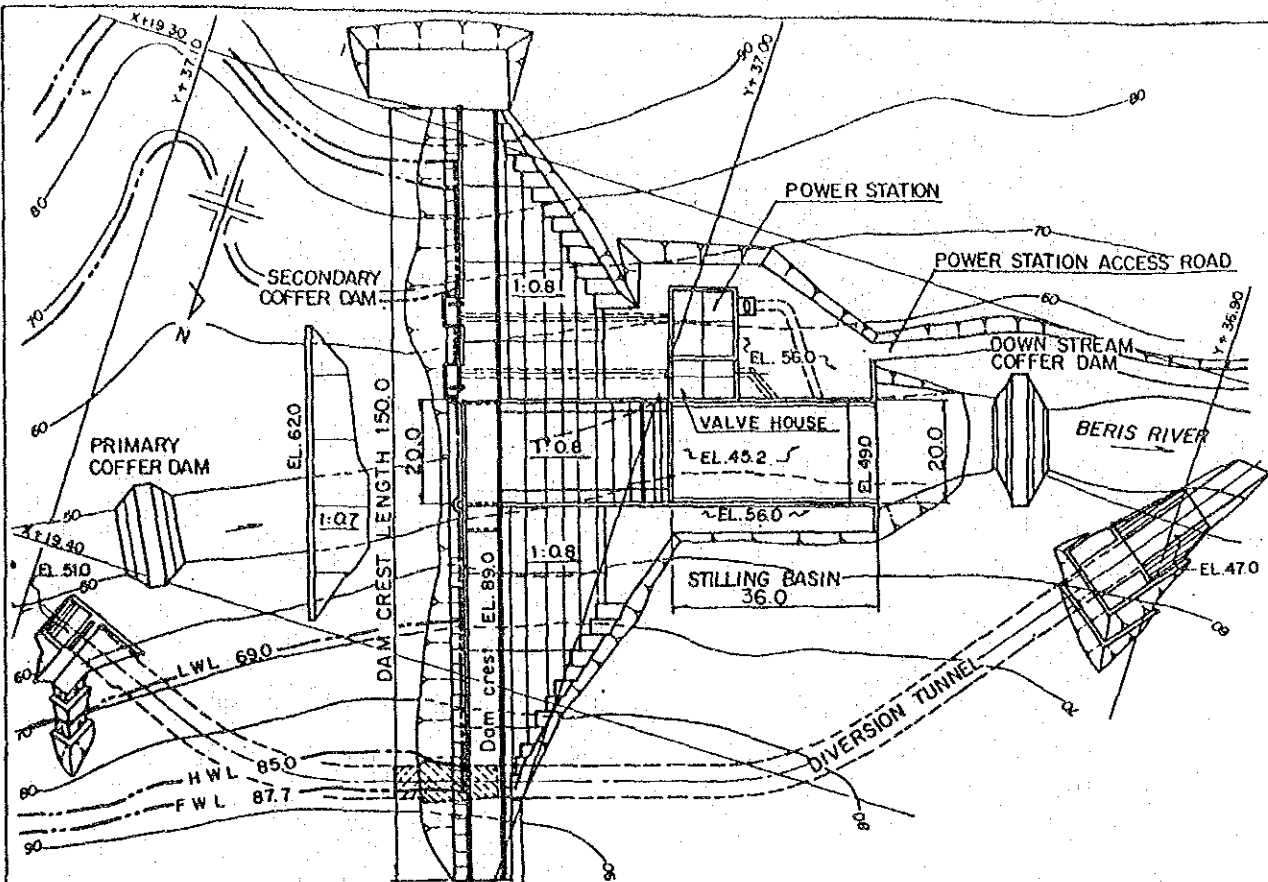
SECTION B-B SCALE A



PROFILE OF DIVERSION TUNNEL SCALE A
(After Construction Completion)



Main Dam Alternative (2/2)



Power Station And Valve House (Alternative.)

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