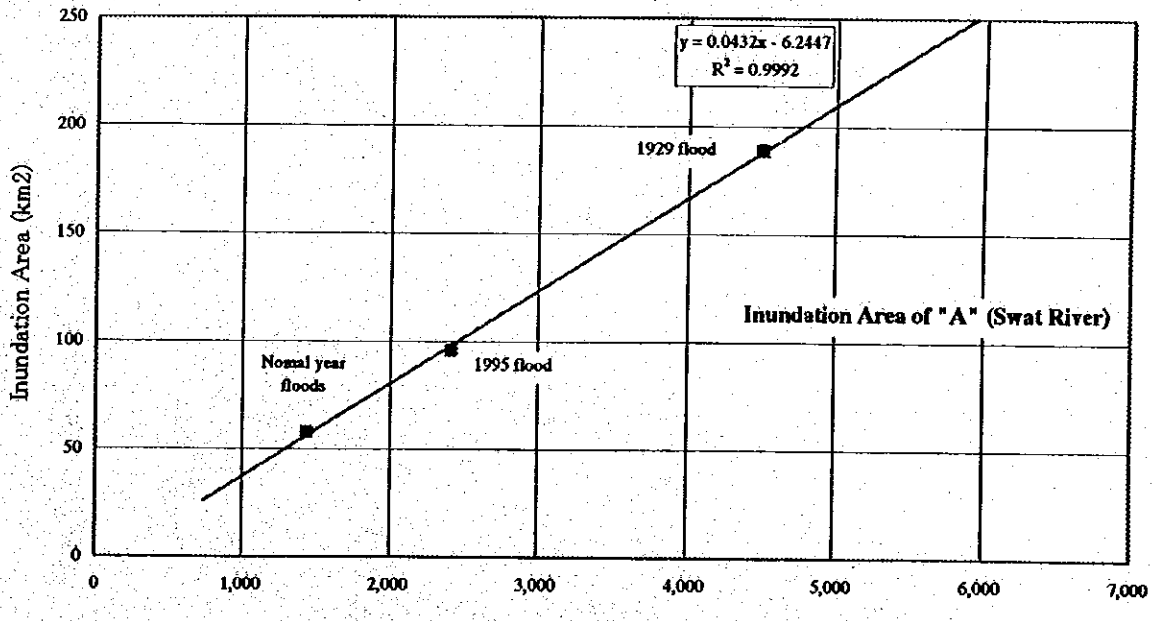
DISCHARGE - INUNDATION AREA OF SWAT RIVER AND KABUL RIVER (DOWNSTREAM OF MUNDA HEADWORKS AND WARSAK UPTO NOWSHERA)

(km²)

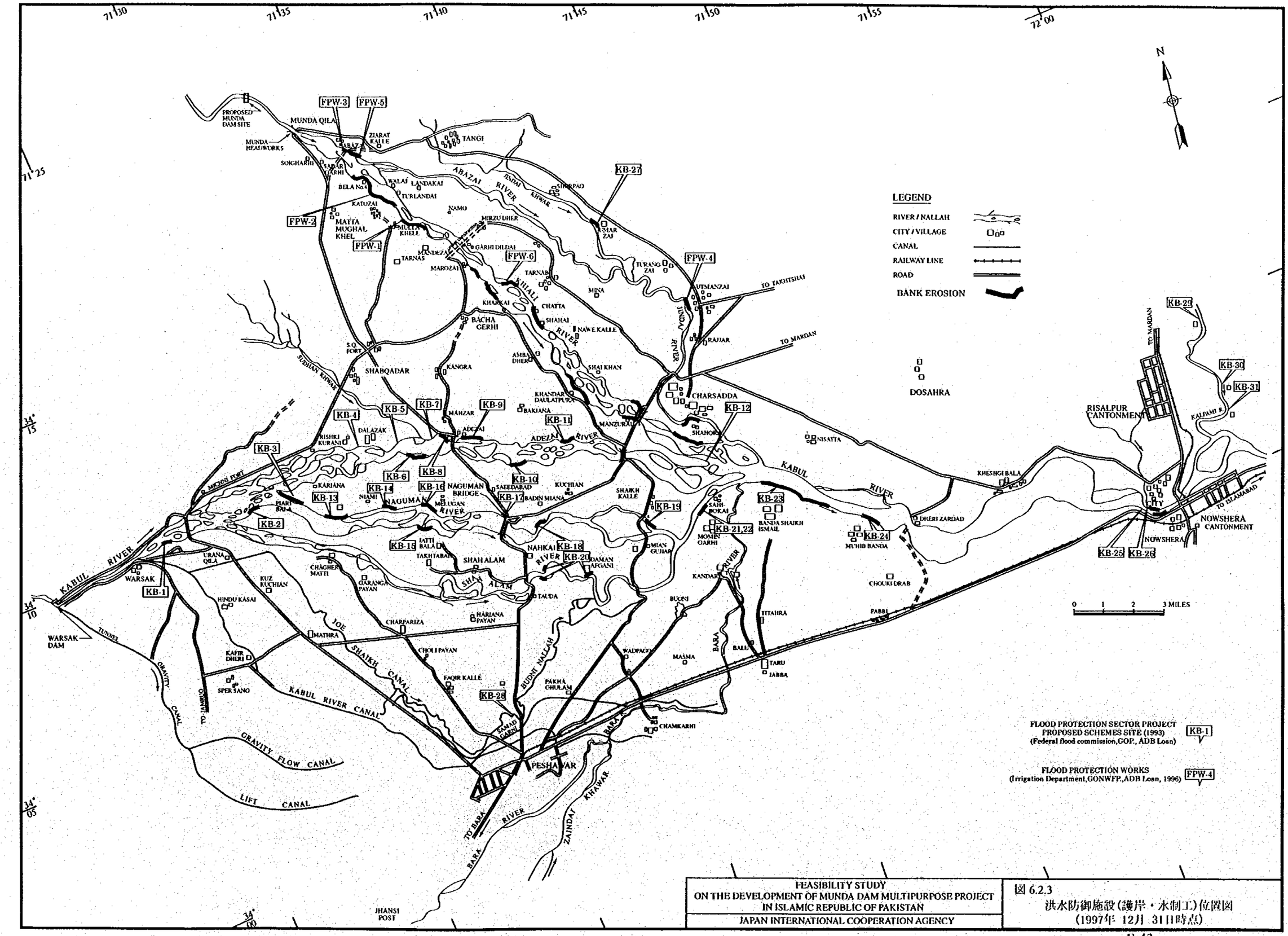
	River	Stretch	Historical (Maximum) class Flood 1929/8/28	Midium class Flood (ex.1995/7/25)	Low (Nomal year) class Floods (ex.1989/7/31)
A	Swat	From MUNDA H/W to Swat-Kabul confluence	188.75	95.75	57.50
B-1	Kabul	Kabul River from Warsak Dam to Influence line of Swat River backwater	227.25	149.50	72.00
B-2	Kabul	Kabul River from Influence line of Swat River backwater to confluence	112.50	97.25	50.75
C	Kabul	From Swat-Kabul confluence to Nowshera	169.25	105.75	64.00
		Total inundation area	697.75	448.25	244.25

		Station	Peak discharge (m³/s)		
A	Swat	at Munda H/W (Swat River)	*1) 4,500	*1) 2,413	*1) 1,441
B	Kabul	at Warsak (Kabul River)	*1) 3,471	*1) 1,861	*1) 1,183
C	Kabul	at Nowshera (Kabul River)	*1) 7,531	*1) 4,039	*1) 2,478

*1) Source : Irrigation Dept. NWFP., Q from observed water lebel at Munda Headworks.
*2)&3) Source : WAPDA.
*4) : estimated by using 19995 Flood Discharge at MundaHW and Warsak (=1861*4500/2413)
*5) : estimated by using 19995 Flood Discharge at MundaHW and Nowshera (=4039*4500/2413)



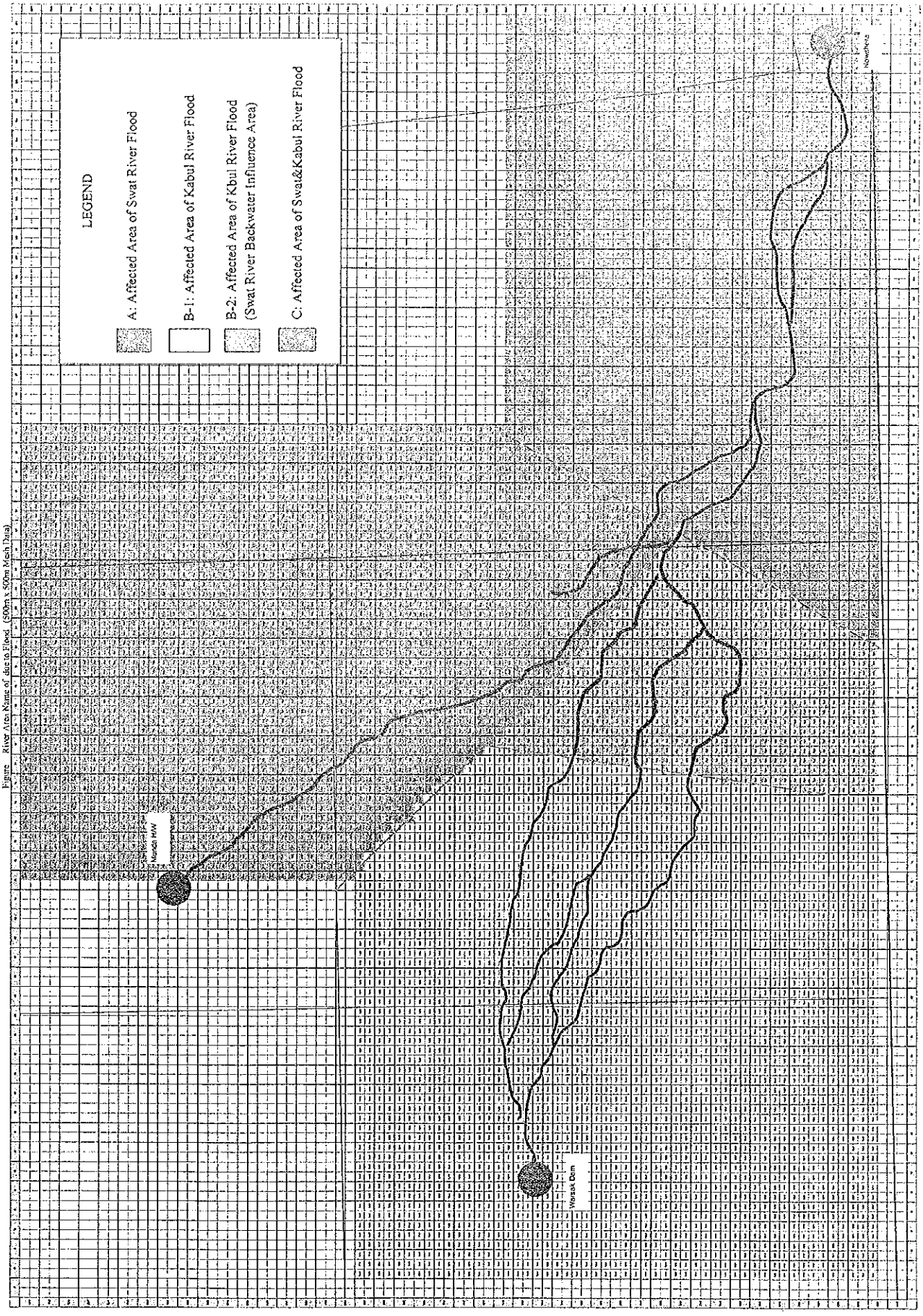
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 6.2.2 流量－氾濫面積曲線 (ムンダ頭首工～スワット川・カブール川合流点)



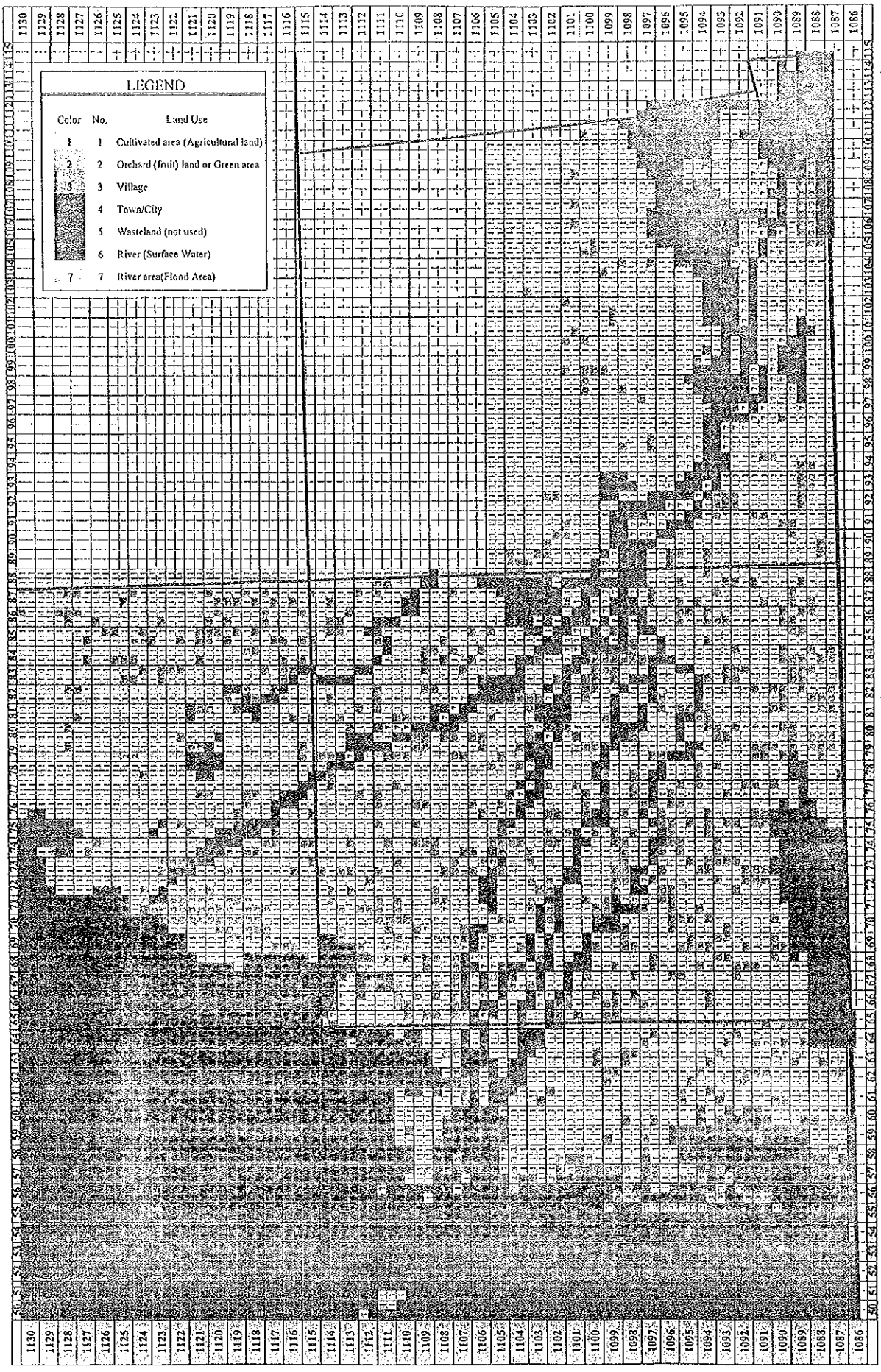
FLOOD PROTECTION SECTOR PROJECT
PROPOSED SCHEMES SITE (1993) KB-1
(Federal flood commission,GOP., ADB Loan)

FLOOD PROTECTION WORKS
(Irrigation Department,GONWFP.,ADB Loan, 1996) FPW-4

FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 6.2.3 洪水防御施設(護岸・水制工)位置図 (1997年 12月 31日時点)



FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 6.4.1 スワット川及びカブール川の洪水の影響範囲設定図 (500×500 m メッシュ)



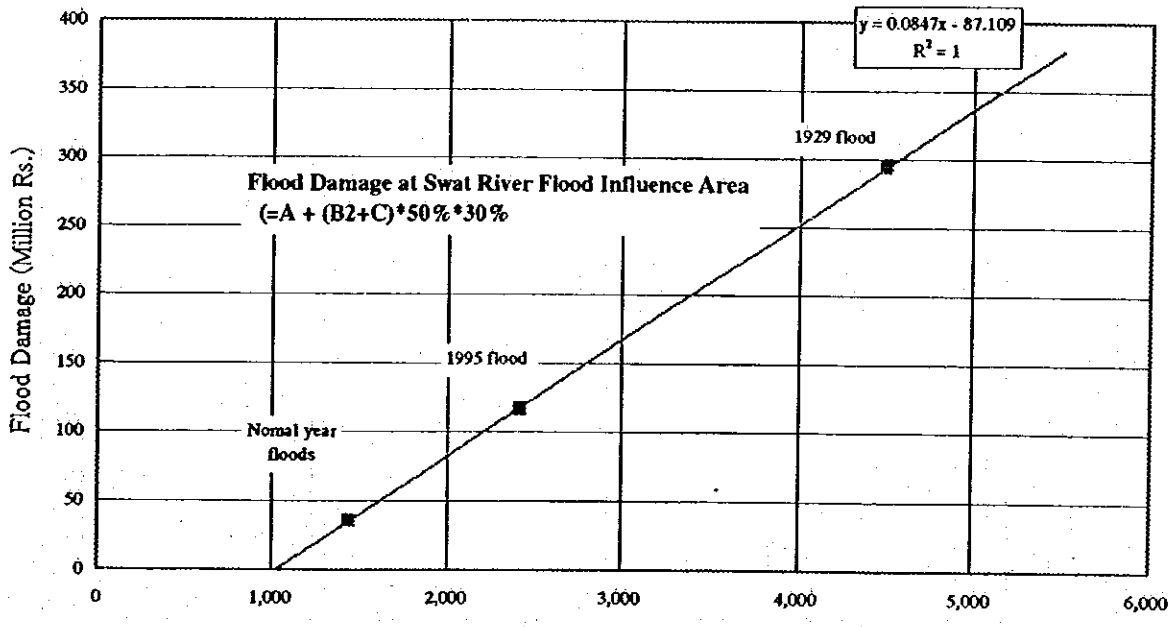
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN	図 6.6.1 現況土地利用図（500×500 m メッシュ）
JAPAN INTERNATIONAL COOPERATION AGENCY	

DISCHARGE AND FLOOD DAMAGE RELATION OF SWAT RIVER FLOOD PLAIN

	River	Stretch	Flood Damage (Million Rs.) Historical (Maximum) class Flood 1929/8/28	Medium class Flood (ex.1995/7/25)	Low class (Nomal year) Floods (ex.1989/7/31)
A	Swat	From MUNDA H/W to Swat-Kabul confluence	483.68	217.80	82.23
B1	Kabul	Kabul River from Warsak Dam to Influence line of Swat river backwater	789.66	456.57	86.04
B2	Kabul	Kabul River from Influence line of Swat river backwater to confluence	376.92	298.82	65.91
C	Kabul	Kabul River from Swat&Kabul confluence to Nowshera	294.31	116.54	35.53
Total Flood Damage (A++B1+B2+C)			1,944.56	1,089.72	269.70
Flood Damage at Swat River Flood Influence Area (=A+(B2+C)*0.5*0.3)			**584.36**	**280.10**	**97.44**

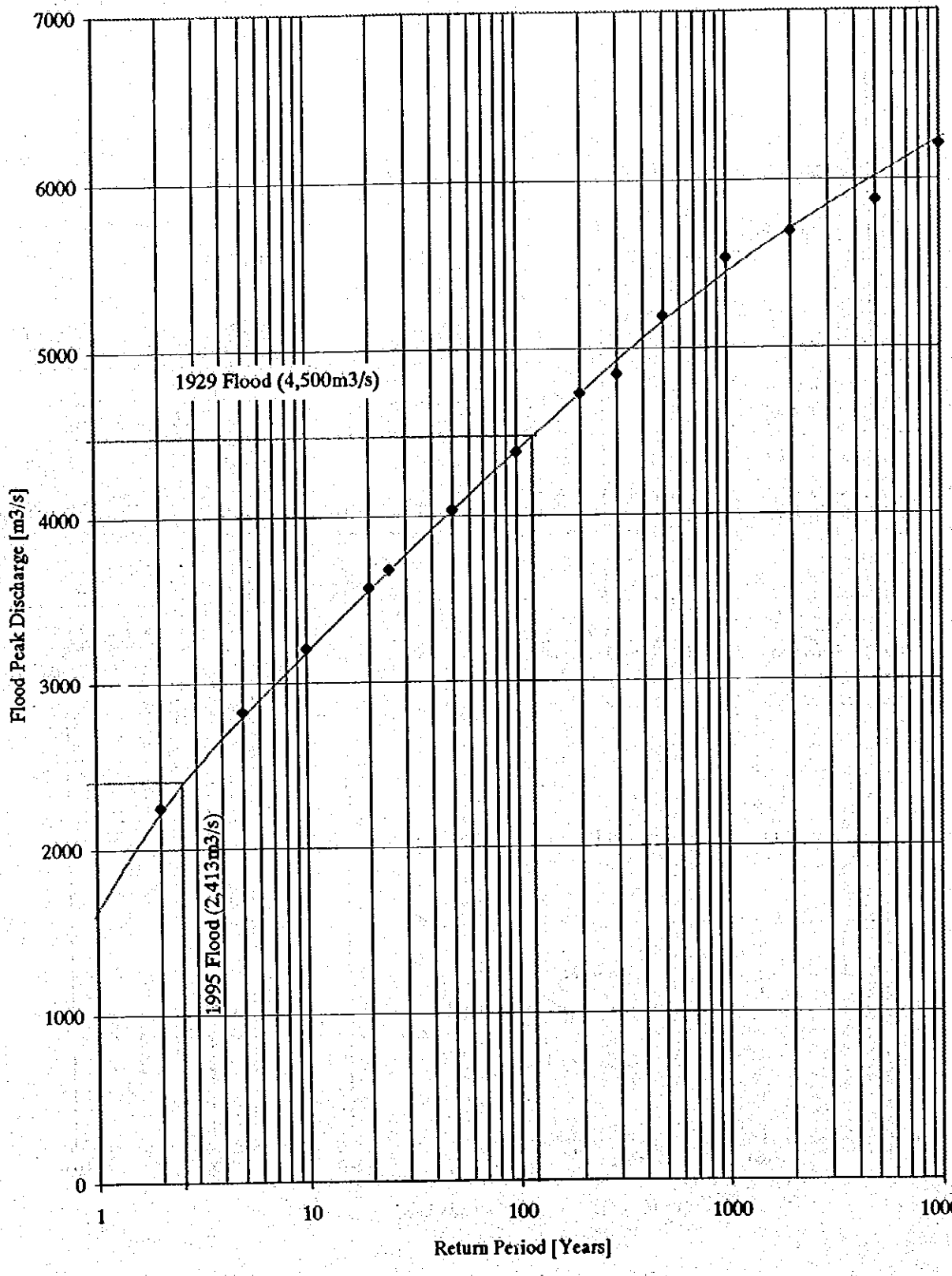
		Station	Peak discharge (m^3/s)		
A	Swat	at Munda H/W (Swat River)	*1) 4,500	*1) 2,413	*1) *1,441*

*1) Source : Irrigation Dept. NWFP., Q from observed water lebel at Munda Headworks.



Q : Peak Discharge at Munda headworks (m3/s)

FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 6.6.2 流量--洪水被害額曲線

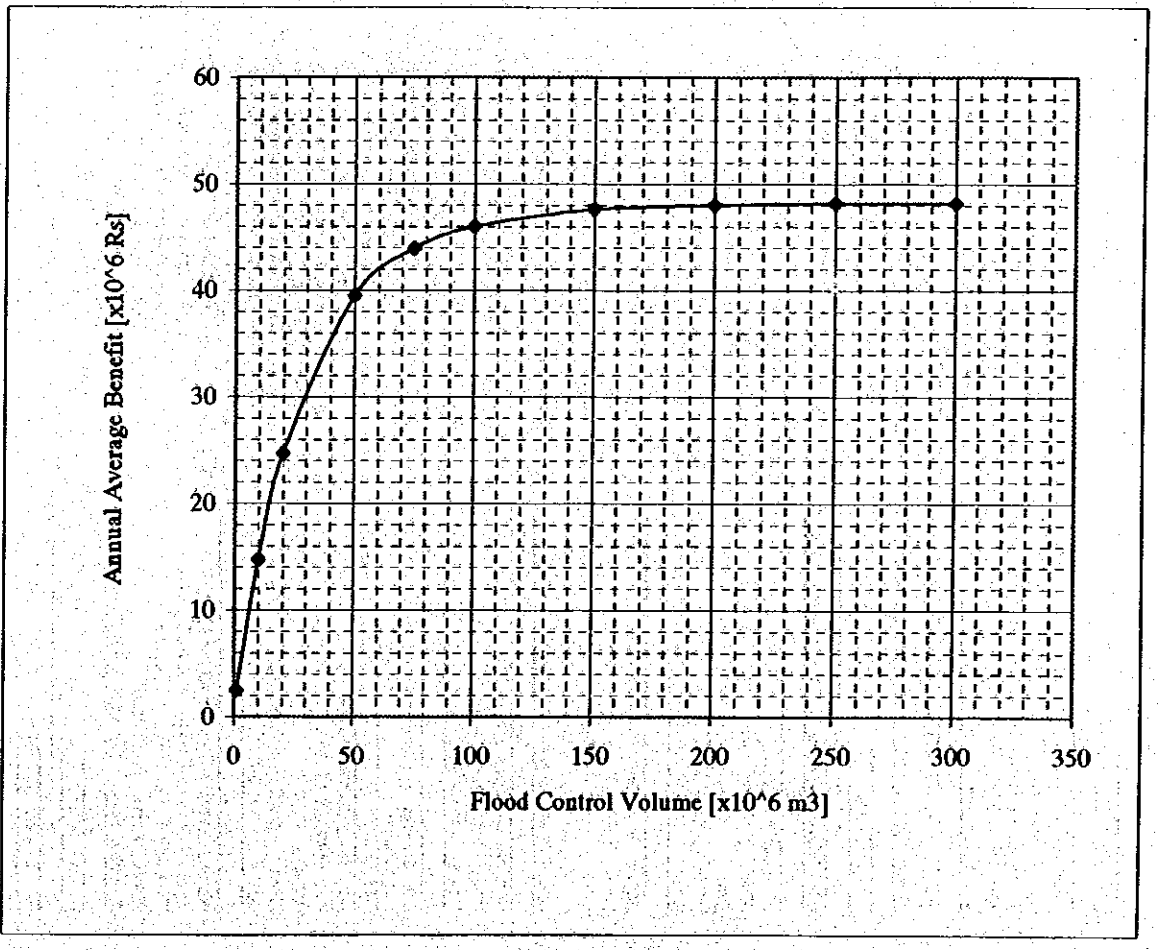


FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 6.7.2 ムンダダム地点の洪水ピーク流量の超過確率曲線

Restricted WL [El.m]= 576.0

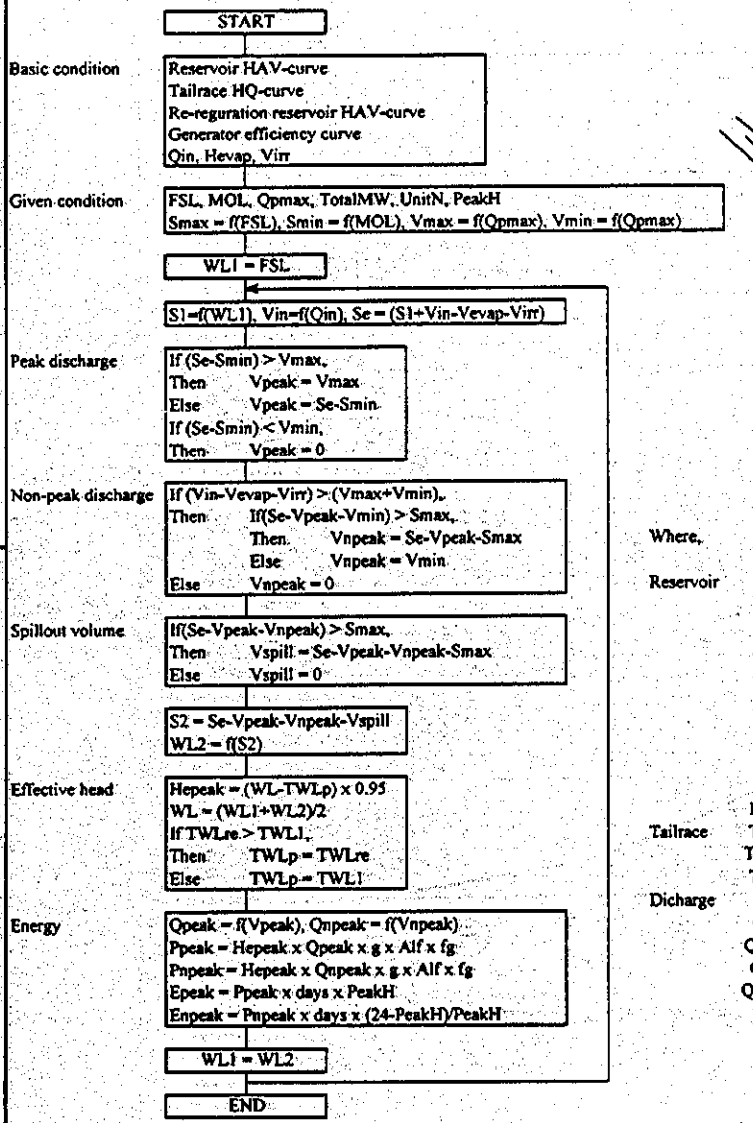
Case No.	Flood Control Volume [x10^6 m^3]	Total Annual Average Damage [x10^6 Rs.]	Flood Control Benefit [x10^6 Rs.]	Flood Control Benefit [x10^6 US.$]
1	0	48.223		
2	1	45.743	2.481	0.050
3	10	33.518	14.705	0.294
4	20	23.557	24.666	0.493
5	50	8.743	39.480	0.790
6	75	4.338	43.885	0.878
7	100	2.246	45.977	0.920
8	150	0.634	47.589	0.952
9	200	0.214	48.009	0.960
10	250	0.084	48.139	0.963
11	300	0.046	48.177	0.964

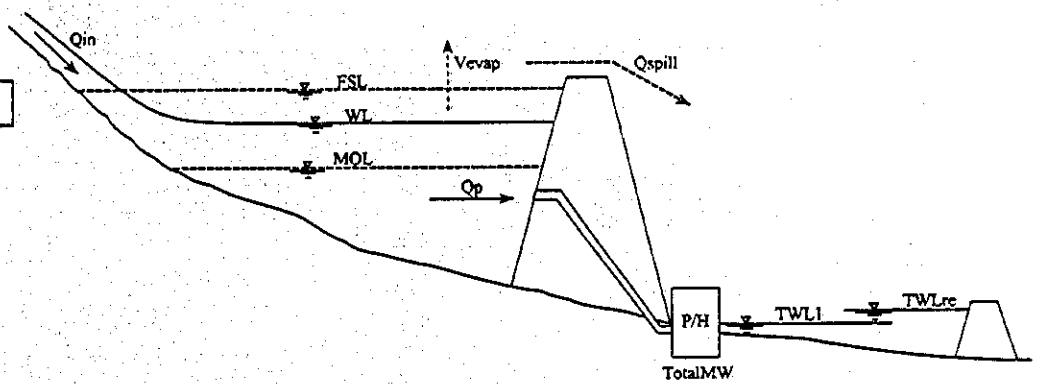
US $1.0 (1999 price) = Rs.50.00



FEASIBILITY STUDY
ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN ISLAMIC REPUBLIC OF PAKISTAN
JAPAN INTERNATIONAL COOPERATION AGENCY

図 6.8.1
洪水調節容量－洪水調節便益曲線

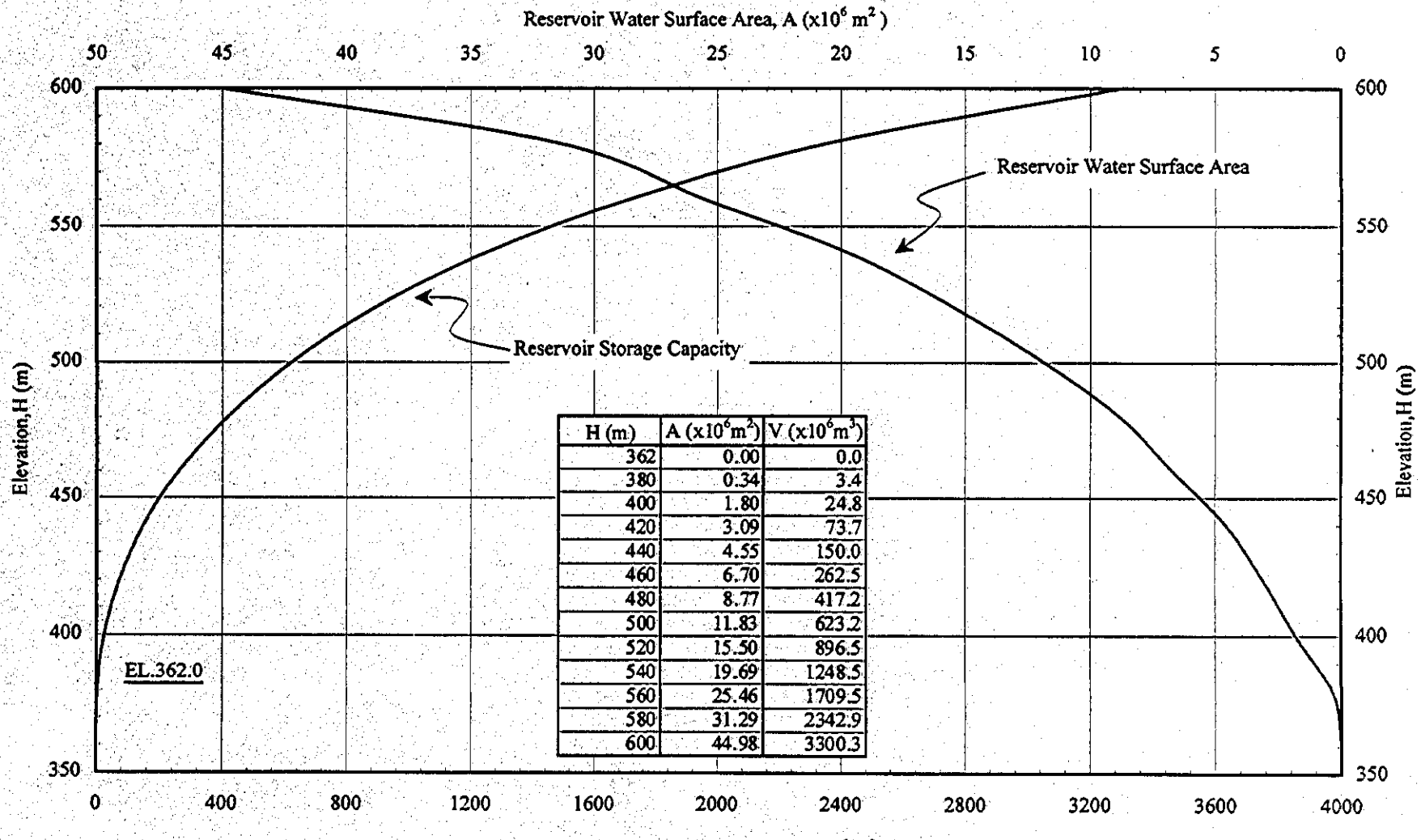




Where,

Reservoir	FSL: Full supply level	(El.m)	Volume	Vin: Inflow volume	(mill.m3)
	MOL: Minimum operating level	(El.m)		Vevap: Evaporation volume	(mill.m3)
	WL1: Water level at the beginning of month	(El.m)		Virr: Irrigation volume	(mill.m3)
	WL2: Water level at the end of month	(El.m)		Vspill: Spillout volume	(mill.m3)
	WL: Monthly average water level	(El.m)		Vmax: Maximum volume for power generation	(mill.m3)
	Smax: Maximum storage volume (at FSL)	(mill.m3)		Vmin: Minimum volume for power generation	(mill.m3)
	Smin: Minimum storage volume (at MOL)	(mill.m3)		Vpeak: Peak generation volume	(mill.m3)
	S1: Storage volume at the beginning of month	(mill.m3)		Vnpeak: Non-peak generation volume	(mill.m3)
	S2: Storage volume at the end of month	(mill.m3)	Hydropower	otalMW: Total installed capacity	(MW)
	Se: Effective storage volume	(mill.m3)		UnitN: Number of generator unit	(nos.)
	Hevap: Evaporation depth	(m)		PeakH: Peak generation hour	(hour)
Tailrace	TWLp: Tail water level for genetaion	(El.m)		Hepeak: Effective water head	(m)
	TWLre: Water level of re-regulation pond	(El.m)		fg: Combined efficiency	(-)
	TWL1: Tail water level of maximum discharge	(El.m)		Ppeak: Peak power	(MW)
Dicharge	Qin: Inflow discharge	(m3/sec)		Pnpeak: Non-peak power	(MW)
	Qspill: Spillout discharge	(m3/sec)		Epeak: Peak energy	(GWh)
	Qpmax: Maximum discharge for power generation	(m3/sec)		Enpeak: Non-peak energy	(GWh)
	Qpeak: Peak generation discharge	(m3/sec)			
	Qnpeak: Non-peak generation discharge	(m3/sec)			

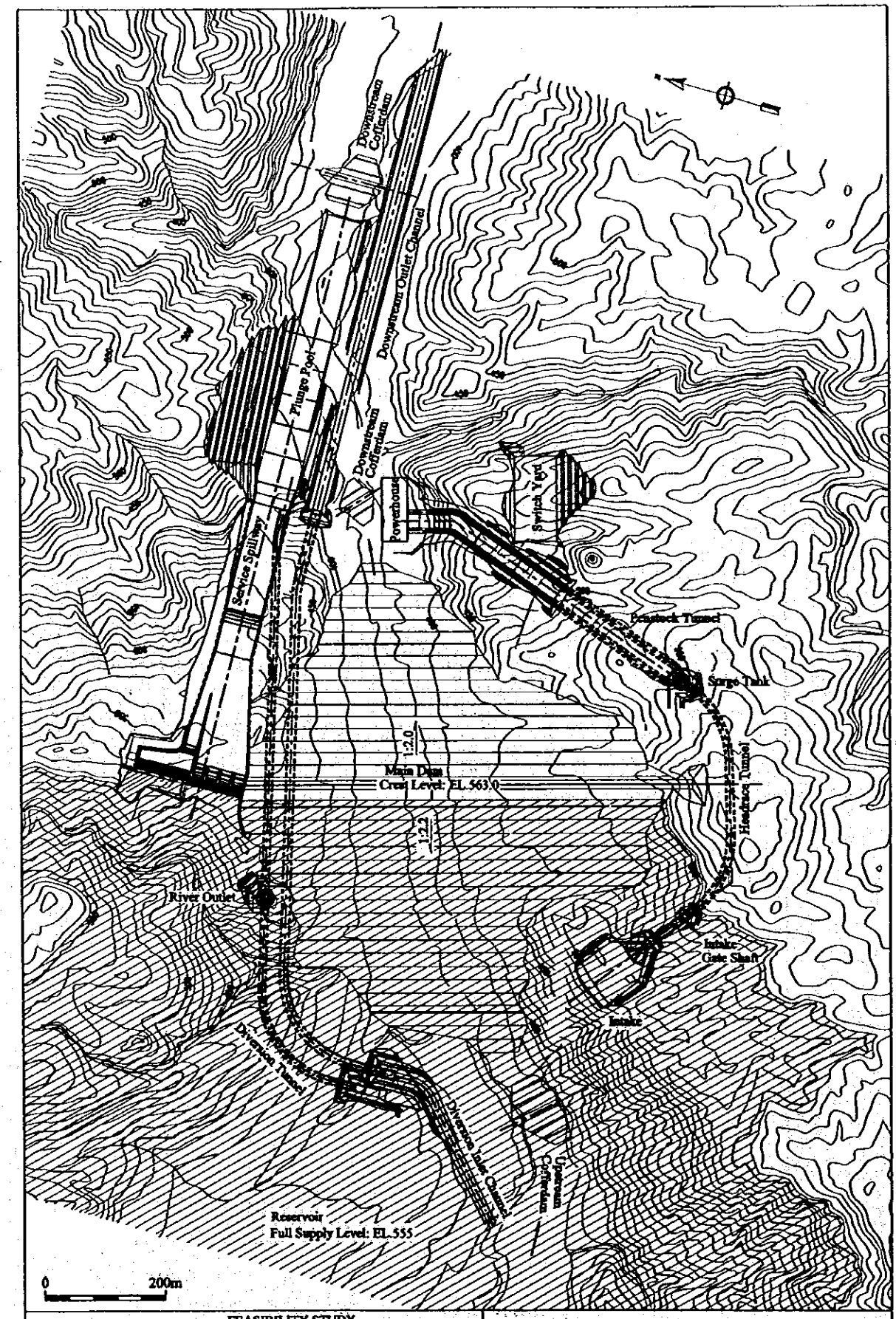
図 7.2.1 貯水池運用シミュレーションモデルのフローチャート



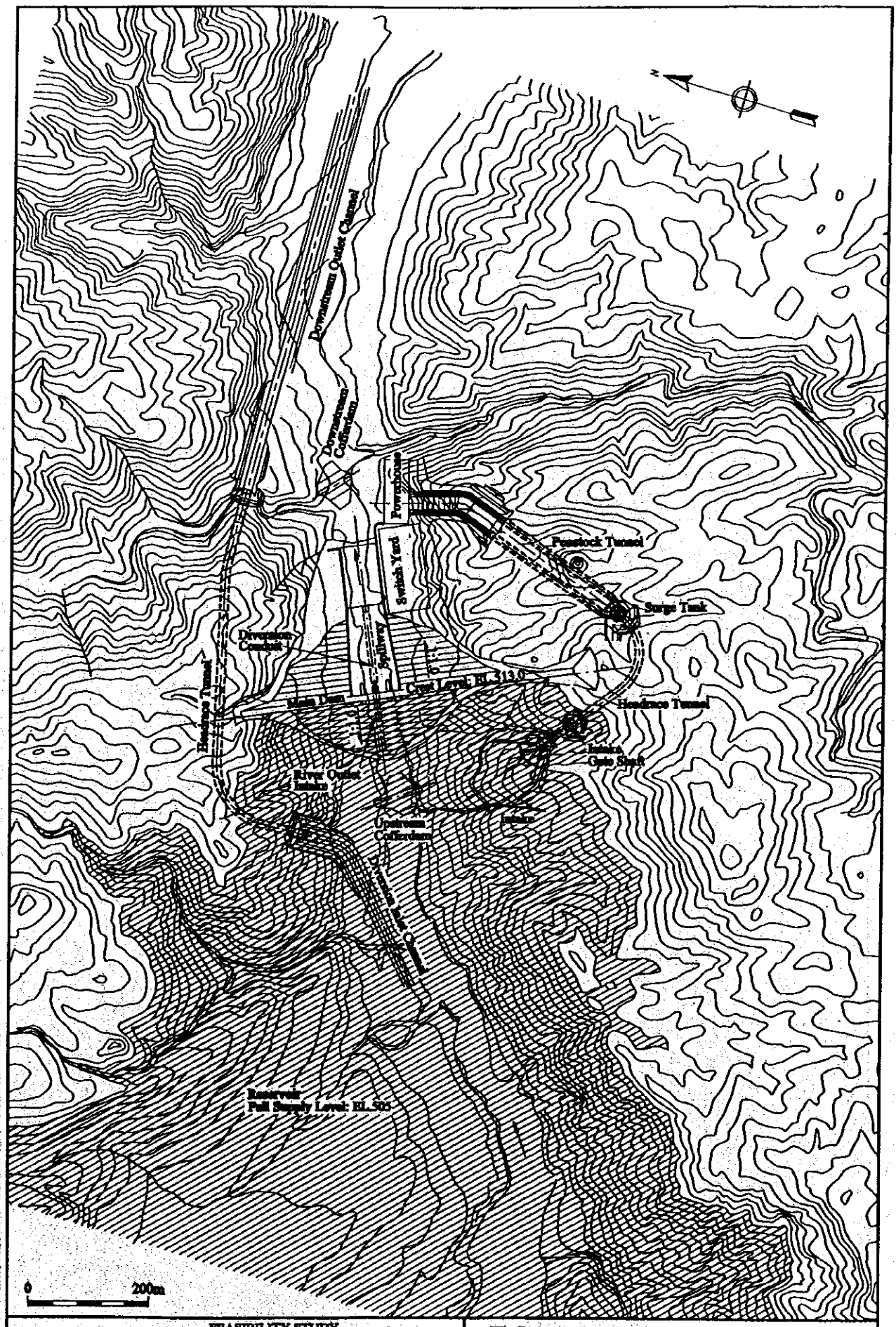
H (m)	A (x10^{6}m^2)	V (x10^{6}m^3)
362	0.00	0.0
380	0.34	3.4
400	1.80	24.8
420	3.09	73.7
440	4.55	150.0
460	6.70	262.5
480	8.77	417.2
500	11.83	623.2
520	15.50	896.5
540	19.69	1248.5
560	25.46	1709.5
580	31.29	2342.9
600	44.98	3300.3

Note: The curves are derived from the aerophoto maps of 1/10,000 (WAPDA-JICA,1999)

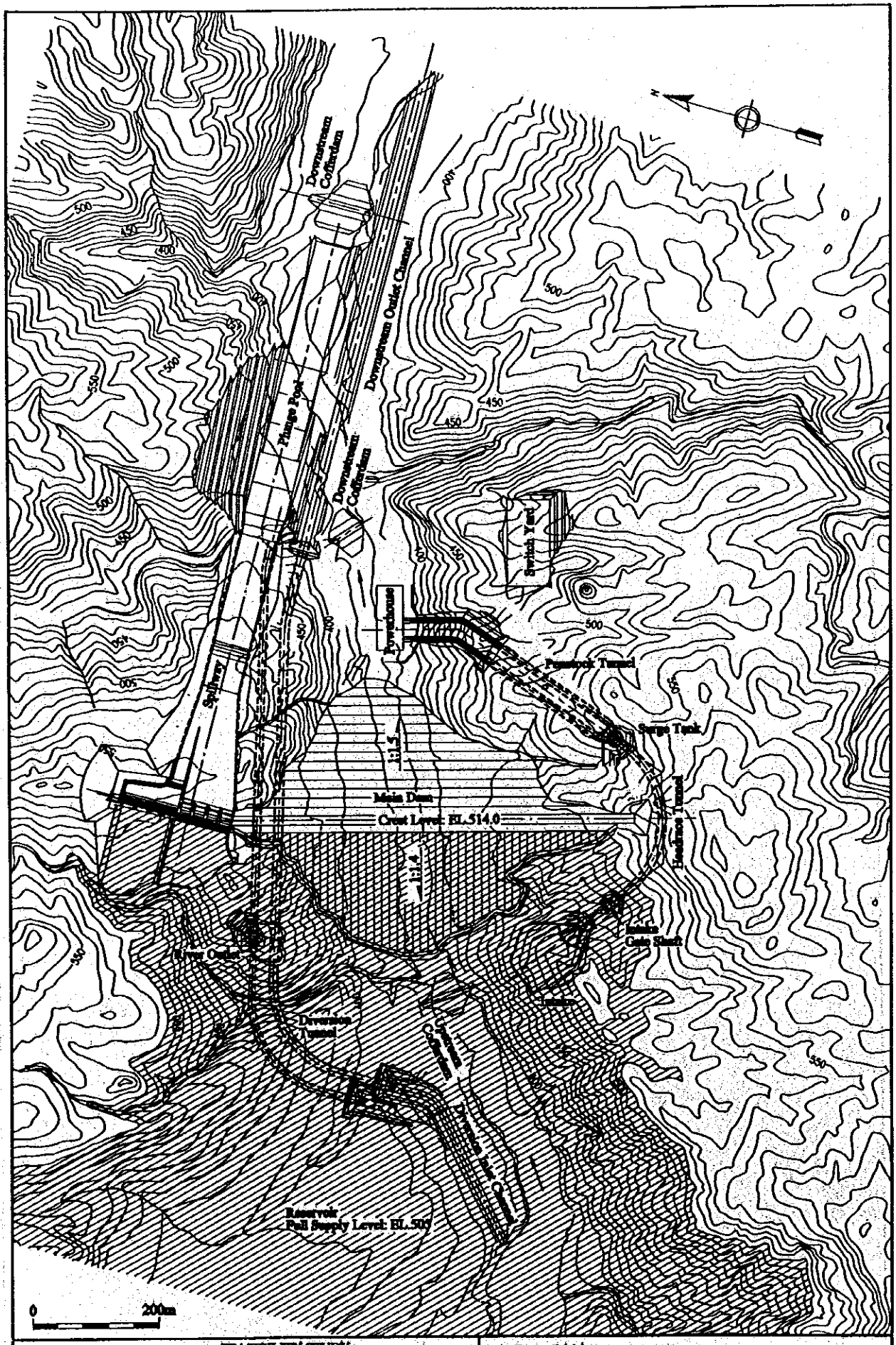
図 7.2.2
ムンダダム貯水池の水位容量曲線



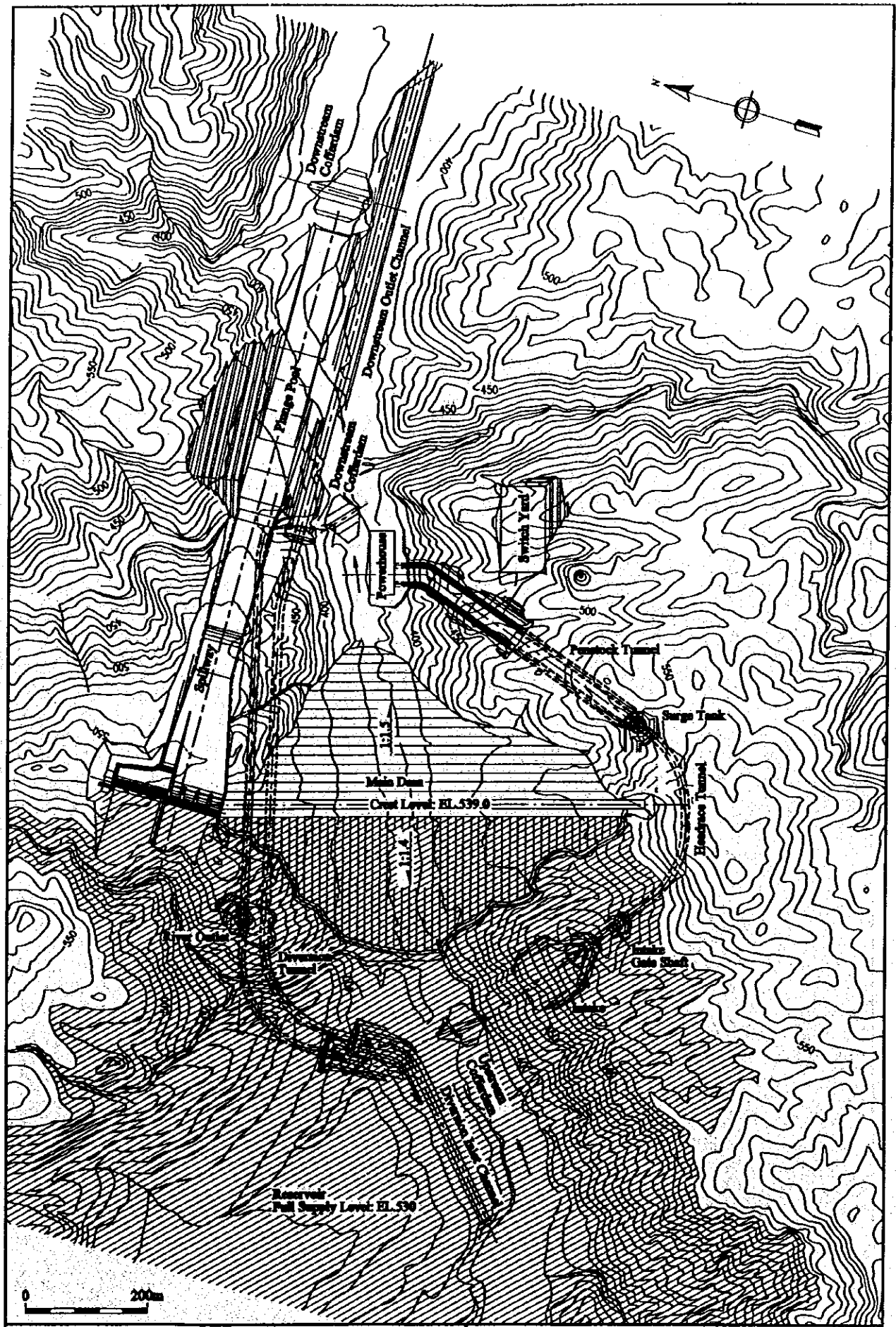
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN	図 7.2.3
JAPAN INTERNATIONAL COOPERATION AGENCY	センターコアロックフィルダム代替レイアウト



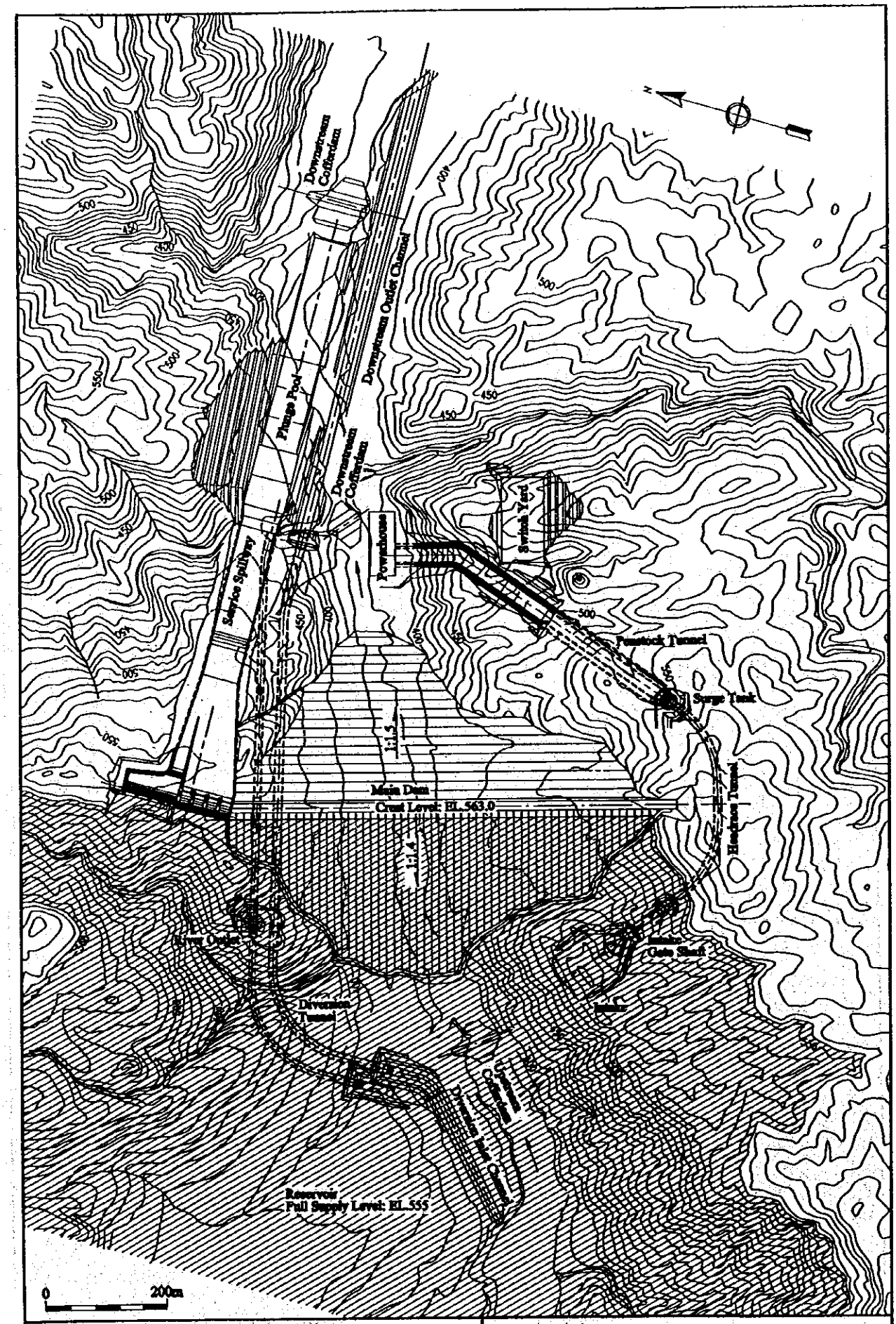
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 7.2.4 RCCダム代替レイアウト



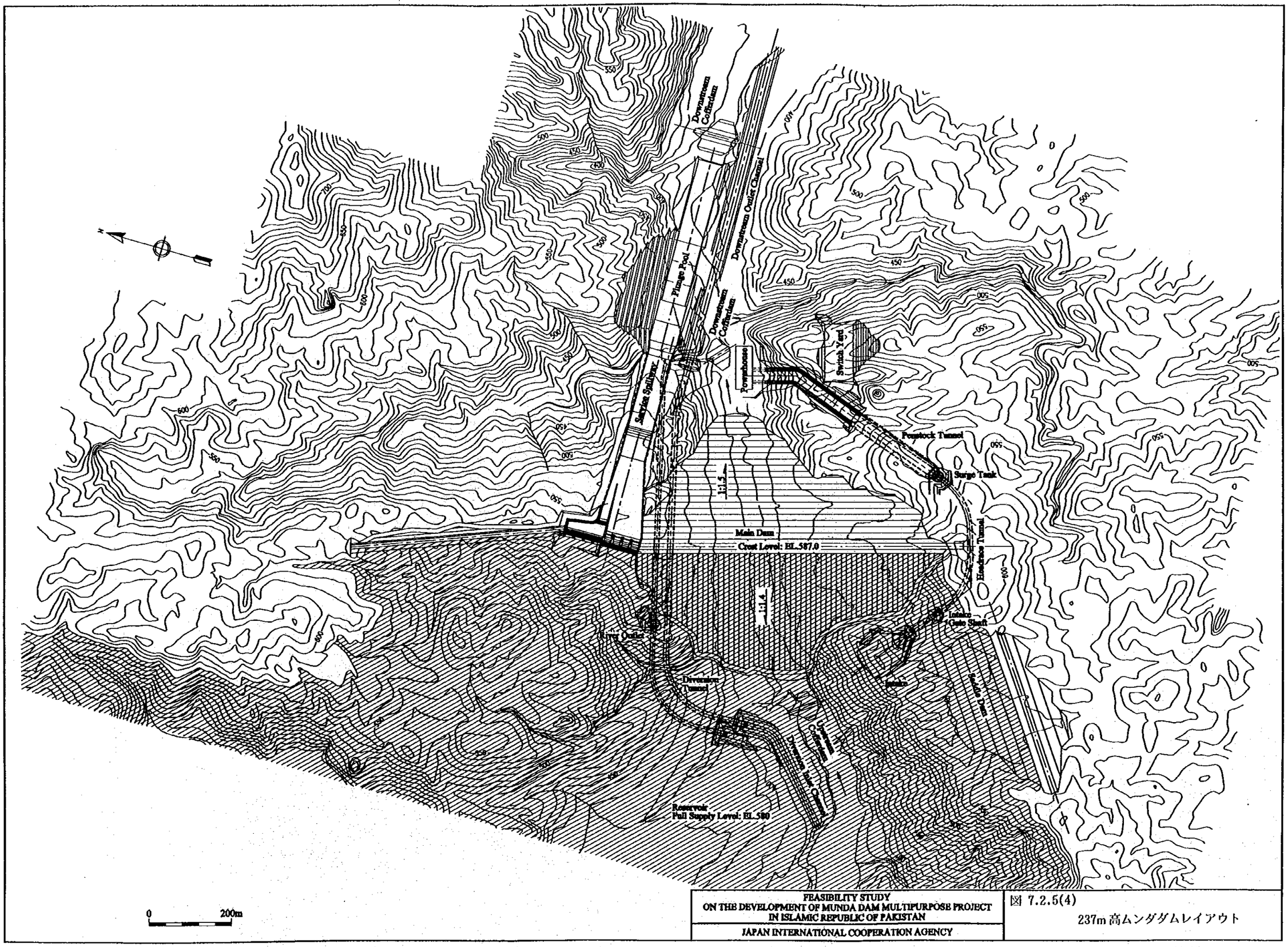
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN	図 7.2.5(1) 164m 高ムンダダムレイアウト
JAPAN INTERNATIONAL COOPERATION AGENCY	



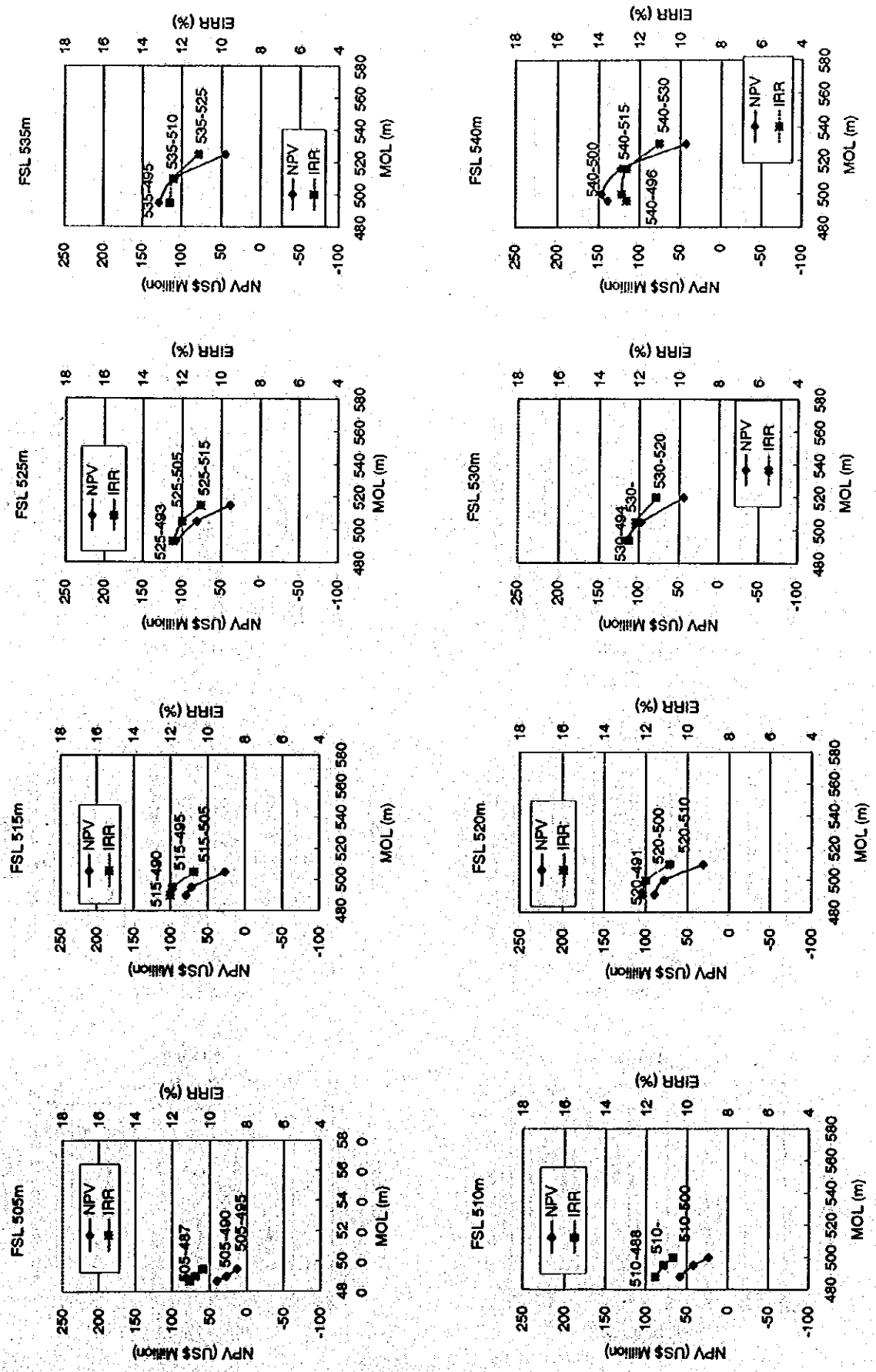
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 7.2.5(2) 189m 高ムンダダムレイアウト



FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN	図 7.2.5(3) 213m 高ムンダダムレイアウト
JAPAN INTERNATIONAL COOPERATION AGENCY	

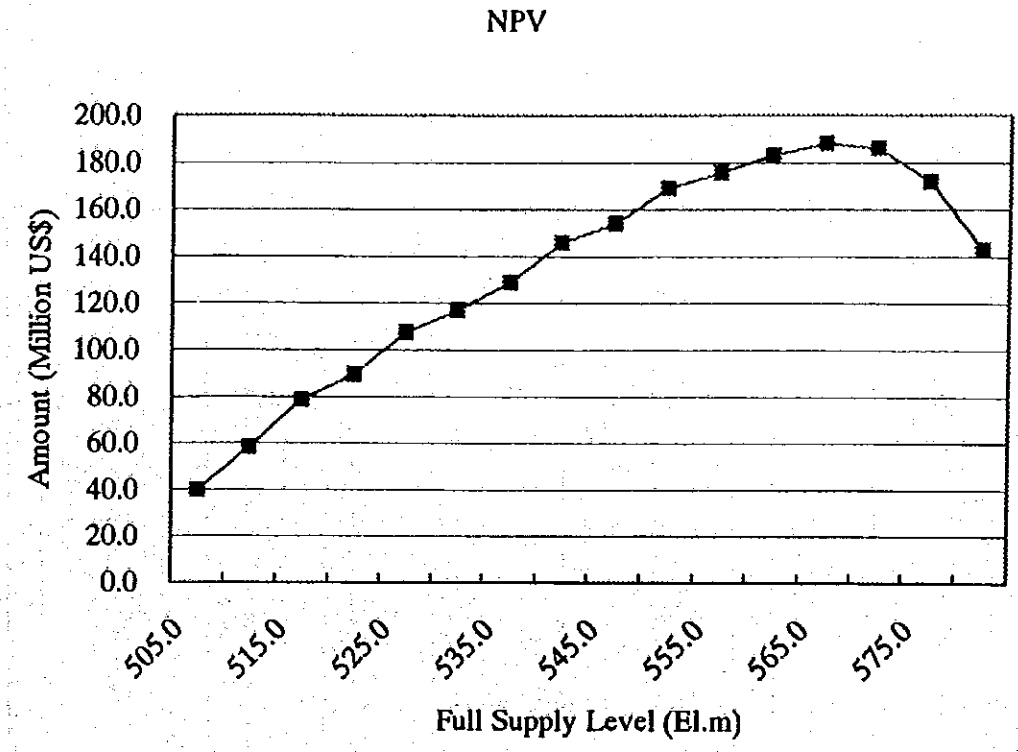


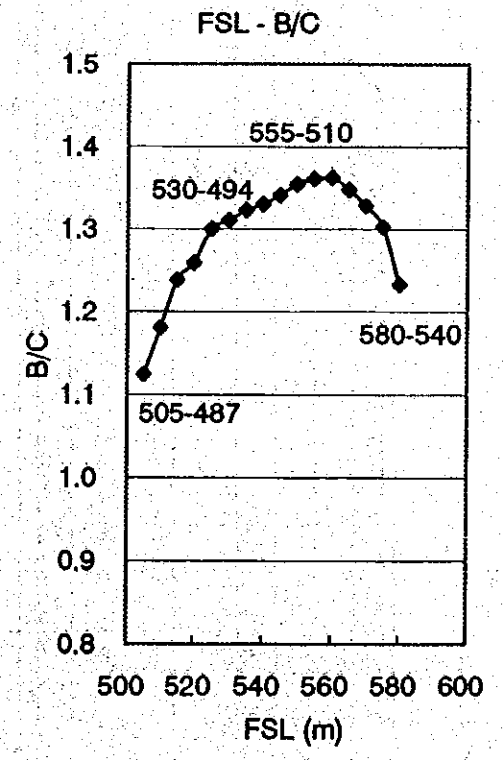
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN	図 7.2.5(4) 237m 高ムンダダムレイアウト
JAPAN INTERNATIONAL COOPERATION AGENCY	

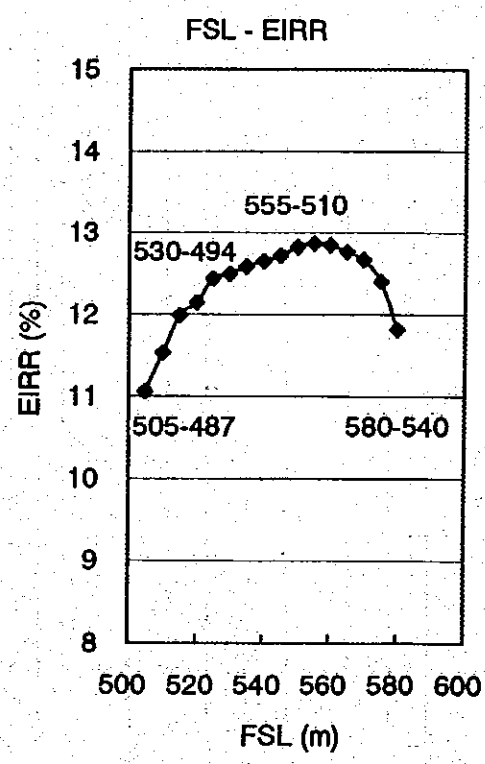


FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 7.2.6 各代替案の純便益及び経済的内部収益率 (1/2)

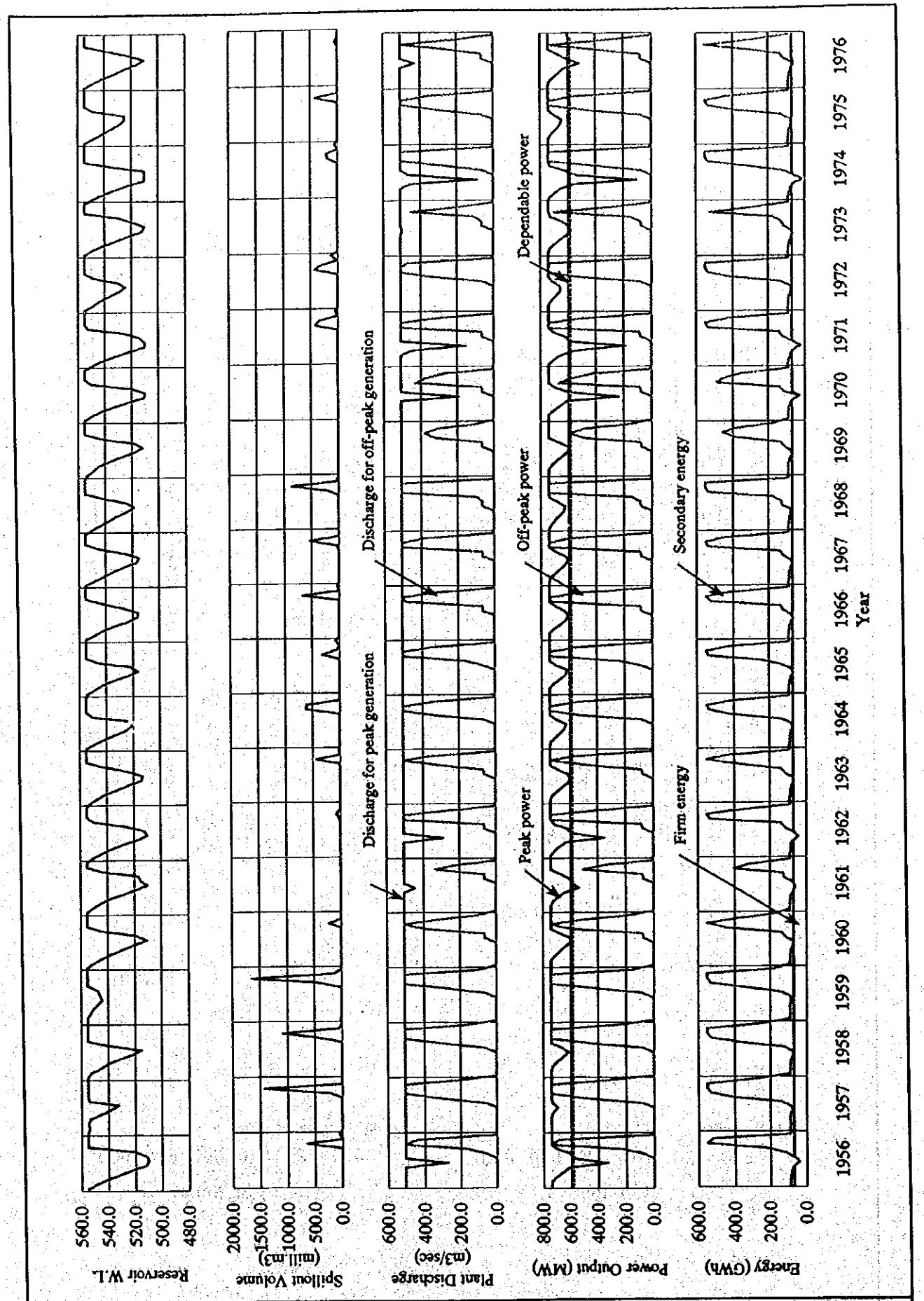
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 7.2.6 各代替案の純便益及び経済的内部収益率 (2/2)







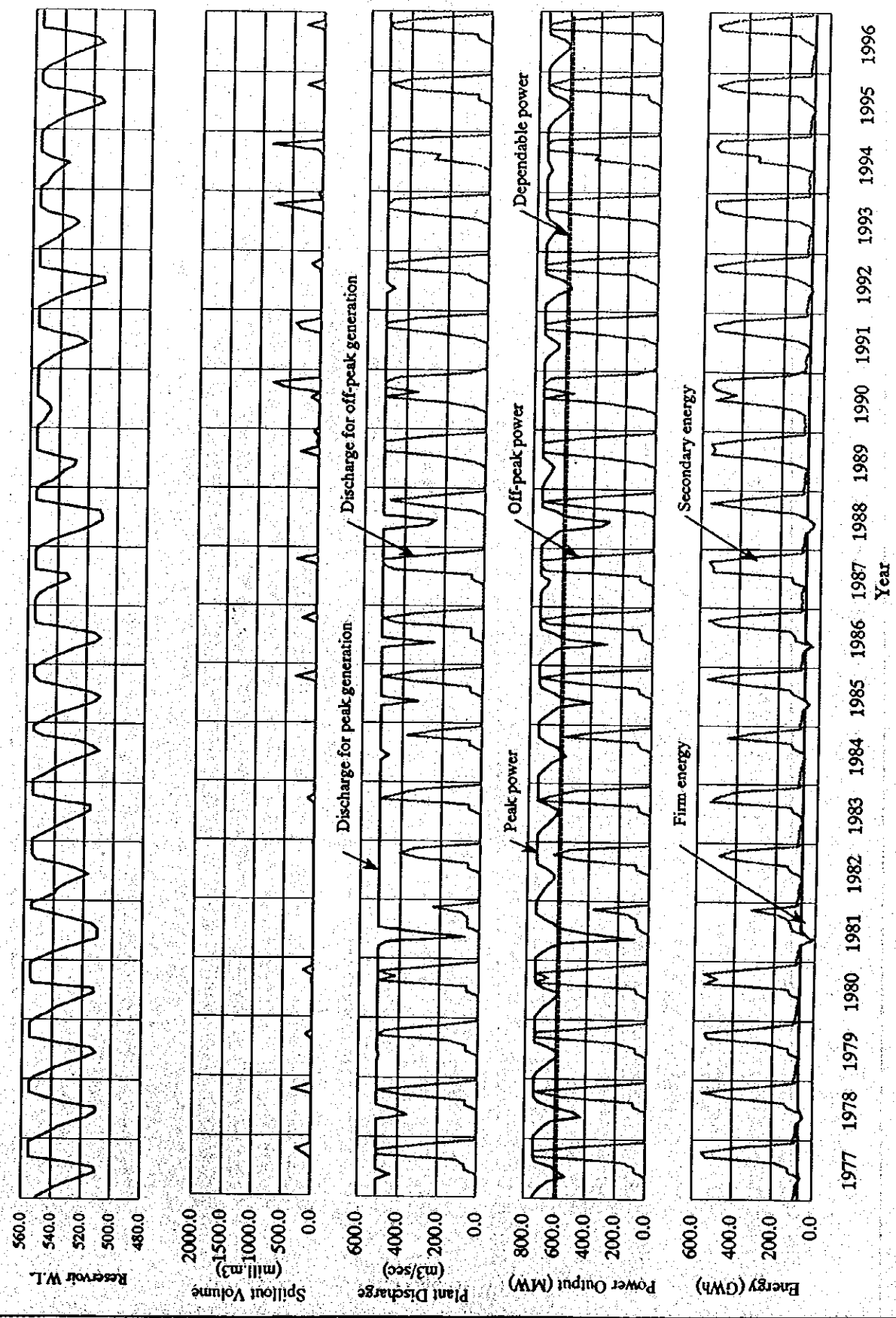
FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 7.2.7 各ダム高代替案の経済指標



FEASIBILITY STUDY
ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT
IN ISLAMIC REPUBLIC OF PAKISTAN

JAPAN INTERNATIONAL COOPERATION AGENCY

図 7.2.8
最適開発規模の貯水池運用シミュレーション結果 (1/2)



FEASIBILITY STUDY ON THE DEVELOPMENT OF MUNDA DAM MULTIPURPOSE PROJECT IN ISLAMIC REPUBLIC OF PAKISTAN JAPAN INTERNATIONAL COOPERATION AGENCY	図 7.2.8 最適開発規模の貯水池運用シミュレーション結果 (2/2)