TABLES

Table 1 BASIN NO., RIVER SYSTEM AND CATCHMENT AREA (1/3)

Basin No.	Name of Basin	Total Catchment Area of the Basin (km^2)	Name of River System	Catchment Area of River System (km^2)	River Length (km)
1	Perlis	790	Perlis Others	710 80	40* -
2	P. Langkawi	475	Islands	-	-
3	Kedah	3,695	Kedah Others	3,060 635	80* -
4	Merbock & Others	520	Merbock Others	475 45	40* -
5	Muda	4,300	Muda	4,300	155*
6	Perai & Others	895	Perai Others	450 445	45* -
7	P. Pinang	300	Islands	300	-
8	Kerian	1,420	Kerian	1,420	80*
9	Kurau & Others	3,255	Kurau Beruas & Others	965 2,290	90* Beruas 40*
10	Perak	14,700	Perak	14,700	397*
11	Bernam	3,335	Bernam	3,335	175
12	Tengi & Others	565	Tengi & Others	565	60
13	Selangor	1,820	Selangor	1,820	100
14	Buloh & Others	560	Buloh & Others	560	Bulor 45*
15	Kelang	1,425	Kelang	1,425	95
16	Langat	1,815	Langat	1,815	165
17	Sepang & Others	640	Sepang & Others	90 550	20 -
18	Linggi & Others	1,420	Lingi & Others	1,270 150	70 -

Remarks; The length without '*' is measured in 1:250,000 maps and that with '*' is measured in 1:500,000 maps.

Table 2 BASIN NO., RIVER SYSTEM AND CATCHMENT AREA (2/3)

Basin No.	Name of Basin	Total Catchment Area of the Basin (km^2)	Name of River System	Catchment Area of River System (km^2)	River Length (km)
19	Melaka & Others	1,010	Melaka	635	55
			Others	375	-
20	Kesang	705	Kesang	705	65
21	Muar & Others	6,595	Muar	6,160	245
			Others	435	-
22	Batu Pahat & Others	2,600	Batu Pahat	2,230	125
			Others	370	-
23	Pontian Kechil & Others	2,660	Pontian Kechil & Others	730	Pontian Kechil 25*
			Pulai & Others	1,220	Pulai 50
			Benut & Others	710	Benut 30
24	Johor & Others	3,250	Johor	2,890	100
			Others	360	-
25	Sedili Besar & Sedili Kechil	1,820	Sedili Besar	1,445	85
			Sedili Kechil	375	30*
26	Mersing & Others	880	Mersing	335	30*
			Others	545	-
27	Endau	4,740	Endau	4,740	160
28	Rompin & Pontian	4,285	Rompin	3,980	250
			Pontian	305	35*
29	Bebar & Merchong	1,895	Bebar	1,190	85
			Merchong	705	70
30	Pahang & Penor	29,300	Pahang	29,140	440
			Penor	160	20*
31	Kuantan & Others	2,025	Kuantan	1,710	90
			Others	315	-

Table 3 BASIN NO., RIVER SYSTEM AND CATCHMENT AREA (3/3)

Basin No.	Name of Basin	Total Catchment Area of the Basin (km^2)	Name of River System	Catchment Area of River System (km^2)	River Length (km)
32	Kemaman & Others	2,570	Kemaman	1,775	70*
			Kerteh	280	30*
			Chukai & Others	515	30*
33	Paka	850	Paka	850	40*
34	Dungun	1,875	Dungun	1,875	100*
35	Marang & Others	760	Marang	490	40*
			Others	270	-
36	Trengganu	4,650	Trengganu	4,650	150
37	Setiu & Others	1,035	Setiu	415	40
			Chalok	485	35
			Others	135	-
38	Besut & Keluang	1,230	Besut	965	70
			Keluang	265	30*
39	Kemasin & Semarak	1,020	Kemasin	500	45*
			Semarak	520	40*
40	Kelantan & Others	13,100	Kelantan	12,900	280*
			Others	200	-
41	Golock	Malaysian Territory 895	Golock	895	-
	Total	131,680		131,680	

Table 4 EFFECTIVE AREA, RAINFALL AND RUNOFF BY BASIN (1/2)

Basin No.	Total Catchment Area (km^2)	Effective Area (km^2)	Mean Annual Rainfall (mm/yr)	Mean Runoff Depth (mm/yr)	Mean Annual Runoff in Effective Area ($10^6 m^3$/year)
1	790	550	1,903	846	465
2	475	350	2,500	1,301	455
3	3,695	2,510	2,274	1,130	2,837
4	520	340	2,433	1,253	426
5	4,300	4,200	2,528	1,326	5,569
6	895	600	2,780	1,488	893
7	300	220	2,700	1,413	311
8	1,420	1,360	2,790	1,498	2,037
9	3,255	1,155	2,634	1,350	1,560
10	14,700	13,555	2,342	948	12,848
11	3,335	2,325	2,490	1,103	2,564
12	565	420	2,142	826	347
13	1,820	1,685	2,498	1,182	1,992
14	560	295	2,068	752	222
15	1,425	1,150	2,246	930	1,070
16	1,815	(1,800)	2,207	891	1,604
17	640	260	2,176	860	224
18	1,420	1,310	2,082	919	1,204
19	1,010	(775)	1,910	752	583
20	705	675	1,778	530	358
21	6,595	6,170	1,796	624	3,849
22	2,600	2,255	2,088	929	2,095
23	2,660	1,800	2,521	1,078	1,940
24	3,250	2,490	2,395	949	2,362
25	1,820	1,495	2,534	1,091	1,632
26	880	465	2,795	1,359	632
27	4,740	4,350	2,601	1,160	5,046
28	4,285	3,730	2,343	895	3,340
29	1,895	570	2,659	1,219	695
30	29,300	27,650	2,127	877	24,238

Table 5 EFFECTIVE AREA, RAINFALL AND RUNOFF BY BASIN (2/2)

Basin No.	Total Catchment Area (km^2)	Effective Area (km^2)	Mean Annual Rainfall (mm/yr)	Mean Runoff Depth (mm/yr)	Mean Annual Runoff in Effective Area ($10^6 m^3$/year)
31	2,025	1,635	2,629	1,034	1,691
32	2,570	2,245	3,097	1,501	3,369
33	850	815	2,923	1,327	1,082
34	1,875	1,760	3,309	1,712	3,013
35	760	650	3,414	1,816	1,181
36	4,650	4,600	3,549	1,951	8,974
37	1,035	875	3,273	1,676	1,466
38	1,230	940	3,239	1,642	1,544
39	1,020	310	2,795	1,715	532
40	13,100	12,600	2,558	1,470	18,522
41	895	835	2,966	1,892	1,580
	131,680	113,775			126,898
	Peninsular Malaysia	86% of the total			

Table 6 INTER-BASIN WATER USAGE

Basin No.	Inter-basin Water Usage
1	Inter-basin water diversion for Muda Scheme from Basin 3 to Basin 1
2	
3	Inter-basin water diversion from Basin 5 (Muda dam) to Basin 3 (Pedu dam)
4	
5	Domestic and industrial water supply from Basin 5 (Muda river) to Basins 6 & 7
6	
7	
8	Inter-basin water diversion for Kerian irrigation project from Basin 8 to Basin 9
9	
10	
11	Inter-basin water diversion for Tanjong Karang irrigation project from Basin 11 to Basin 12
12	
13	
14	
15	
16	
17	
18	
19	
20	Asahan dam
21	
22	
23	Domestic and industrial water supply from Basins 23 and 24 to Singapore
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	Inter-basin water diversion for irrigation project from Basin 40 to Basin 39
40	
41	

Table 7 THE NUMBER OF EXISTING AND POTENTIAL DAM SITES

States		In Operation (Existing)	Under Construction	Proposed	Identified by Study Reports	Identified by Team	Total of Potential Sites	Total of Dam Sites
PERLIS	A	0	0	1	3	0	4	4
	B	0	0	0	0	0	0	0
KEDAH	A	3	0	6	16	1	23	26
	B	0	0	0	0	0	0	0
P. PINANG	A	2	2	1	2	0	3	7
	B	1	0	0	0	0	0	1
PERAK	A	5	2	0	3	5	8	15
	B	9	0	0	1	0	1	10
SELANGOR	A	2	1	3	3	1	7	10
	B	1	0	0	0	0	0	1
NEGERI SEMBILAN	A	0	0	2	0	9	11	11
	B	0	0	0	0	0	0	0
MELAKA	A	4	0	0	0	2	2	6
	B	0	0	0	0	0	0	0
JOHOR	A	9	5	2	1	17	20	34
	B	0	0	0	0	0	0	0
PAHANG	A	1	0	9	51	4	64	65
	B	5	0	0	3	0	3	8
TRENGGANU	A	1	1	1	19	5	25	27
	B	0	0	0	0	0	0	0
KELANTAN	A	1	0	3	9	0	12	13
	B	1	0	0	0	0	0	1
Total of Peninsular	A	28	11	28	107	44	179	218
	B	17	0	0	4	0	4	21
	C	45	11	28	111	44	183	239

Remarks; (1) A = Dams; B = Run-of-river hydropower stations; C = A + B

(2) Small intake weirs are excluded.

Table 8 PURPOSE AND NUMBER OF WATER RESOURCES FACILITIES IN OPERATION AND UNDER CONSTRUCTION

State		Multi-purpose Dams	Hydropower Dams	D/I Water Supply Dams	Irriga-tion Dams	Flood Mitigation Dams	Drainage
PERLIS	OP	0	0	0	0	0	0
	UC	0	0	0	0	0	0
KEDAH	OP	0	0	0	3	0	0
	UC	0	0	0	0	0	0
P. PINANG	OP	1	(*1)	2	0	0	0
	UC	0	0	1	0	0	1
PERAK	OP	1	2 (*9)	0	1	0	0
	UC	0	2	0	0	0	0
SELANGOR	OP	1	(*1)	1	0	0	0
	UC	0	0	1	0	0	0
NEGERI SEMBILAN	OP	0	0	0	0	0	0
	UC	0	0	0	0	0	0
MELAKA	OP	0	0	3	0	0	1
	UC	0	0	0	0	0	0
JOHOR	OP	0	0	8	1	0	0
	UC	3	0	1	0	1	0
PAHANG	OP	0	1 (*5)	0	0	0	0
	UC	0	0	0	0	0	0
TRENGGANU	OP	0	0	1	0	0	0
	UC	1	0	0	0	0	0
KELANTAN	OP	0	(*1)	0	1	0	0
	UC	0	0	0	0	0	0
Total of Peninsula	OP	3	3 (*17)	15	6	0	1
	UC	4	2	3	0	1	1
	Total	7	5 (*17)	18	6	1	2

Intakes for D/I Water Supply: 216 Operated in 1978

Intakes for Irrigation : 635 Operated in 1975

Remarks; (1) OP = In operation; UC = Under Construction

(2) (*) means run-of-river hydropower stations

Table 9 BASIN STATE CORRELATION

Basin No.	Basin Name	River System	State Concerned
1	Perlis	Perlis	Perlis, Kedah
2	P. Langkawi	Islands	Kedah
3	Kedah	Kedah	Kedah, Perlis
4	Merbok & Others	Merbok	Kedah
5	Muda	Muda	Kedah, P. Pinang
6	Perai & Others	Perai	P. Pinang, Kedah
7	Pulau Pinang	Islands	P. Pinang
8	Kerian	Kerian	Kedah, P. Pinang, Perak
9	Kurau & Others	Kurau, Beruas	Perak
10	Perak	Perak	Perak
11	Bernam	Bernam	Perak, Selangor
12	Tengi & Others	Tengi	Selangor
13	Selangor	Selangor	Selangor
14	Buloh & Others	Buloh	Selangor
15	Kelang	Kelang	Selangor
16	Langat	Langat	Selangor, N. Sembilan
17	Sepang & Others	Sepang	Selangor, N. Sembilan
18	Linggi & Others	Linggi	N. Sembilan, Melaka
19	Melaka & Others	Melaka	Melaka, N. Sembilan
20	Kesang	Kesang	Melaka, N. Sembilan, Johor
21	Muar & Others	Muar	Johor, N. Sembilan, Melaka, Pahang
22	Batu Pahat & Others	Batu Pahat	Johor
23	Pontian Kechil & Others	Kechil	
24	Johor	Johor	Johor
25	Sedili Besar & Sedili Kechil	Sedili Besar	Johor
26	Mersing & Others	Mersing	Johor
27	Endau	Endau	Johor, Pahang
28	Rompin & Pontian	Rompin, Pontian	Pahang, Johor
29	Bebar & Merchong	Bebar, Merchong	Pahang
30	Pahang & Penor	Pahang, Penor	Pahang, N. Sembilan
31	Kuantan & Others	Kuantan	Pahang
32	Kemaman & Others	Kemaman, Kerteh, Chukai	Trengganu
33	Paka	Paka	Trengganu
34	Dungun	Dungun	Trengganu
35	Merchang & Others	Marang	Trengganu
36	Trengganu	Trengganu	Trengganu
37	Setiu & Others	Setiu, Chalok	Trengganu
38	Besut & Keluang	Besut, Keluang	Trengganu, Kelantan
39	Kemasin & Semerak	Kemasin, Semarak	Kelantan, Trengganu
40	Kelantan & Others	Kelantan	Kelantan
41	Golok	Golok	Kelantan, (Thailand)

Table 10 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (1/42)

State: PERLIS

Name of Dam or Project	Dams Proposed or Identified			
	Timah Tasoh	Buloh	Serai	Arau
Organization Concerned	(EPU)	(EPU)	(EPU)	(EPU)
Basin No.	1	1	1	1
River System	Perlis	Perlis	Perlis	Perlis
Year of Completion or Plan	Pd (1985)	Id	Id	Id
Purpose	MT: IR, FM	FM	FM	FM
Catchment Area (km^2)	150	13	10	50
Full Supply Level (El. m)	9.1			
Drawdown (m)	0.6			
Storage Volume (10^6m^3): Gross	38			
Active				
Reservoir Area (km^2)				
Dam Type	Earthfill			
Height of Main Dam (m)	5 - 10			
Volume of Main Dam (10^3m^3)				
Discharge (m^3/s): Maximum				
Average				
Rated Head (m)				
Hydropower Installed Capacity (MW)				

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 11 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (2/42)

State: KEDAH (1)

Name of Dam or Project	Dams In-operation			Dams Proposed	
	Pedu	Muda	Kedah Barrage	Badak-Temin	Sari
Organization Concerned	MADA	MADA	DID	(EPU)	(EPU)
Basin No.	3	5	3	3	3
River System	Kedah	Muda	Kedah	Kedah	Kedah
Year of Completion or Plan	1968	1969	Op	Pd (1990)	Pd (1995)
Purpose	IR	IR	IR	MT: IR, HY	MT: IR, HY
Catchment Area (km^2)	171	984		114	61
Full Supply Level (El. m)	100			MWL 45.75	MWL 76
Drawdown (m)					
Storage Volume (10^6m^3): Gross	1,087	156		144	75
Active				(140)	(73)
Reservoir Area (km^2)					
Dam Type	Rockfill	Concrete butress			
Height of Main Dam (m)	60	37		17	
Volume of Main Dam (10^3m^3)	580,000	30,000		1,144	1,642
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 12 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (3/42)

State: KEDAH (2)

Name of Dam or Project	Dams Proposed or Identified				
	Durian Chorok Chong Hon	Ahning	Tok Kassin	Agon	Kechil
Organization Concerned	(EPU)	(EPU)	(EPU)	(EPU)	(EPU)
Basin No.	3	3	3	3	3
River System	Kedah	Kedah	Kedah	Kedah	Kedah
Year of Completion or Plan	Pd (1995)	Pd (1990)	Id	Id	Id
Purpose	MT: IR, HY	MT: IR, HY	IR	IR	IR
Catchment Area (km^2)	75	120	14	25	19
Full Supply Level (El. m)	MWL 76	Max. W.L. 36.0			
Drawdown (m)					
Storage Volume (10^6m^3): Gross	90	120			
Active					
Reservoir Area (km^2)		3			
Dam Type	Earth	Earthfill			
Height of Main Dam (m)		38			
Volume of Main Dam (10^3m^3)	1,744	927			
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 13 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (4/42)

State: KEDAH (3)

Name of Dam or Project	Dams Proposed or Identified				
	Kah Ing	Ayan	Tawar-Muda	Reman	S. MA
Organization Concerned	(EPU)	(EPU)	(EPU)	(DID)	(EPU)
Basin No.	3	3	5	5	5
River System	Kedah	Kedah	Muda	Muda	Muda
Year of Completion or Plan	Id	Id	Pd (2000)	Pd (year?)	Id
Purpose	IR	IR	MT: IR, HY	HY	IR
Catchment Area (km^2)	18	16	135	31	24
Full Supply Level (El. m)			MWL 76	45.7	
Drawdown (m)				13.7	
Storage Volume (10^6m^3): Gross			128	101.6	
Active				95.1	
Reservoir Area (km^2)					
Dam Type			Earthfill		
Height of Main Dam (m)				21.3	
Volume of Main Dam (10^3m^3)			13,793		
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 14 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (5/42)

State: KEDAH (4)

Name of Dam or Project	Dams Identified				
	Beris	Kerik	Charok Kasai	Charok Sama Gajah	Weng
Organization Concerned	(EPU)	(EPU)	(EPU)	(EPU)	(EPU)
Basin No.	5	5	5	5	5
River System	Muda	Muda	Muda	Muda	Muda
Year of Completion or Plan	Id (1990)	Id	Id	Id	Id
Purpose	MT: IR, HY	IR	IR	IR	MT: IR, HY
Catchment Area (km^2)	115	20	10	23	37
Full Supply Level (El. m)	MWL 76				
Drawdown (m)					
Storage Volume (10^6m^3): Gross	80				
Active					
Reservoir Area (km^2)					
Dam Type					
Height of Main Dam (m)					
Volume of Main Dam (10^3m^3)	526				
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 15 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (6/42)

State: KEDAH (5)

Name of Dam or Project	Dams Identified				
	Legong	Beris Barrage	Merbok	Nook	Charok Tebar
Organization Concerned	(EPU)	(DID)		(DID)	(EPU)
Basin No.	5	5	(5)	(5)	5
River System	Muda	Muda		Nook	Muda
Year of Completion or Plan	Id	Id but abandoned	Id	Id	Id
Purpose	MT: IR, HY		WS	IR	MT: IR, HY
Catchment Area (km^2)	44				38
Full Supply Level (El. m)				43.6	
Drawdown (m)					
Storage Volume (10^6m^3): Gross				30.1	
Active					
Reservoir Area (km^2)					
Dam Type			Earth		
Height of Main Dam (m)				21.9	
Volume of Main Dam (10^3m^3)			755		
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 16 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (7/42)

State: PULAU PINANG (1)

	Dams In-operation		
Name of Dam or Project	Muda Tidal Barrage	Perai Barrage	Ayer Hitam
Organization Concerned	PWA	DID	PWA
Basin No.	5	6	7
River System	Muda	Perai	Ayer Hitam
Year of Completion or Plan	1976	Ud, 1981	1962
Purpose	WS	OT (Drainage)	MT: WS HY (secondary)
Catchment Area (km^2)	Some 4,200		
Full Supply Level (El. m)	FSL: 6 MWL: 4	0.6	235
Drawdown (m)			
Storage Volume (10^6m^3): Gross		5.1	2.59
Active			
Reservoir Area (km^2)			Approx 0.25
Dam Type	Floating Concrete Weir		Central Core Earth-Rock
Height of Main Dam (m)			61
Volume of Main Dam (10^3m^3)			
Discharge (m^3/s): Maximum			
Average			
Rated Head (m)			
Hydropower Installed Capacity (MW)			0.8

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 17 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (8/42)

State: PULAU PINANG (2)	Dams Under Construction	Dams Proposed or Identified	Dams Identified	
Name of Dam or Project	Mengkuang (1)	Mengkuang (2)	Kulim	Telok Bahng
Organization Concerned	PWA	PWA	(PWA)	(PWA)
Basin No.	6	6	6	7
River System	Perai	Perai	Perai	
Year of Completion or Plan	Ud	Pd	Id	Id, but abandoned
Purpose	WS	WS	WS	WS
Catchment Area (km^2)	3.84		128	
Full Supply Level (El. m)	31.2	43.3		
Drawdown (m)	14.6	23.66		
Storage Volume (10^6m^3): Gross				21.8
Active				
Reservoir Area (km^2)	0.6	1.2		
Dam Type	Earthfill	Earthfill		
Height of Main Dam (m)	21.3	27.4		
Volume of Main Dam (10^3m^3)				
Discharge (m^3/s): Maximum				
Average				
Rated Head (m)				
Hydropower Installed Capacity (MW)				

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 18 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (9/42)

State: PERAK (1)

Name of Dam or Project	Dams In-operation or Under Construction				
	Bukit Merah	Chenderoh	Kenering	Temengor	Bersia
Organization Concerned	DID	Perak Hydro-power Company	NEB	NEB	NEB
Basin No.	9	10	10	10	10
River System	Kurau	Perak	Perak	Perak	Perak
Year of Completion or Plan	Op	1930	Ud, 1983	1979	Ud, 1983
Purpose	IR	HY	HY	MT: HY, FM	HY
Catchment Area (km^2)		6,653	5,540	3,420	3,600
Full Supply Level (El. m)			111.3	248.4	141.5
Drawdown (m)		59.74		9.2	2.9
Storage Volume (10^6m^3): Gross		86	320	6,050	70
Active		66	70	1,270	10
Reservoir Area (km^2)		22	24	152	6
Dam Type		Gravity	Concrete gravity (combined dam)	Rockfill	Concrete gravity
Height of Main Dam (m)			41.0	127	32.0
Volume of Main Dam (10^3m^3)			260/470	7,280	110
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)		270	3x40=120	348	3x24=72

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 19 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (10/42)

State: PERAK (2)

Name of Dam or Project	Dams In-operation				
	Pong	Sultan Idris II	Pou Lou	Odar	Saltan Yussuf
Organization Concerned	Private Company	NEB	Private Company	NEB	NEB
Basin No.	10	10	10	10	10
River System	Perak	Perak	Perak	Perak	Perak
Year of Completion or Plan	1929	1968	1923	1968	1963
Purpose	RHY	RHY	RHY	RHY	RHY
Catchment Area (km^2)	63			393.94	See SULTAN ABU BAKAR Basin 30
Full Supply Level (El. m)					
Drawdown (m)					
Storage Volume (10^6m^3): Gross					
Active					
Reservoir Area (km^2)					
Dam Type					
Height of Main Dam (m)					
Volume of Main Dam (10^3m^3)					
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)	2.0	150	1.8	4.2	100

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 20 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (11/42)

State: PERAK (3)

Name of Dam or Project	Dams In-operation				
	BOY	RIAS	IHT	SEK	JOR
Organization Concerned	Private Company	Private Company	Private Company	Private Company	NEB
Basin No.	10	10	10	10	10
River System	Perak	Perak	Perak	Perak	Perak
Year of Completion or Plan	1910	1936	1905	1907	Op
Purpose	RHY	RHY	RHY	RHY	HY
Catchment Area (km^2)					
Full Supply Level (El. m)					
Drawdown (m)					
Storage Volume (10^6m^3): Gross					
Active					
Reservoir Area (km^2)					
Dam Type					
Height of Main Dam (m)					
Volume of Main Dam (10^3m^3)					
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)	1.0	0.43	0.70	0.50	100

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 21 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (12/42)

State: PERAK (4)

Name of Dam or Project	Dams Identified			
	Selama	Bintang	Sira	Tugoh-Tupai
Organization Concerned	(NEB & PWD)	(NEB & PWD)	(NEB & PWD)	(Private Company)
Basin No.	8	8	8	9
River System	Kerian	Kerian	Kerian	Tupai & C
Year of Completion or Plan	Id & Idt	Id & Idt	Id & Idt	Id
Purpose	HY, (WS)	HY, (WS)	HY, (WS)	RHY
Catchment Area (km^2)	78.9		28.6	
Full Supply Level (El. m)				
Drawdown (m)				
Storage Volume (10^6m^3): Gross				
Active				
Reservoir Area (km^2)				
Dam Type				
Height of Main Dam (m)				
Volume of Main Dam (10^3m^3)				
Discharge (m^3/s): Maximum				
Average				
Rated Head (m)				
Hydropower Installed Capacity (MW)				0.66

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 22 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (13/42)

State: SELANGOR (1)	Dams In-operation or Under Construction				Dams Proposed
Name of Dam or Project	Kelang Gate	Damansara	Ulu Langat 1 & 2	Langat	Upper Sg. Selangor Development
Organization Concerned	DID & SWW (& DID)	SWW	NEB	SWW	(SWW)
Basin No.	15	15	16	16	13
River System	Kelang	Kelang	Langat	Langat	Selangor
Year of Completion or Plan	End 1979	Op	1927	Ud, 1981	Pd Phase 1: 1990 Phase 2: 1994
Purpose	MT: WS, FM	WS	RHY	WS	WS
Catchment Area (km^2)	75.5			41.4	201
Full Supply Level (El. m)	Max.W.L.=97.84 FSL 96.7			+221.0	175.3
Drawdown (m)				+160.0	45.7
Storage Volume (10^6m^3): Gross	36	0.41		38.2	45.5
Active	31.6			38.2	43.5
Reservoir Area (km^2)	5.3			2.59	1.8
Dam Type	Gravity arch			Earthfill	Earthfill or E/R fill Phase I, Phase II
Height of Main Dam (m)				61.0	61 to 103.6
Volume of Main Dam (10^3m^3)				2,523	
Discharge (m^3/s): Maximum				509.4	
Average	1.9				6.3
Rated Head (m)				NA	
Hydropower Installed Capacity (MW)			2.46	NA	

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 23 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (14/42)

State: SELANGOR (2)

Name of Dam or Project	Dams Proposed or Identified				
	Sg. Batu Development	Sg. Gombak Reservoir	N. Hummack	Sg. Semenyih Development	Sg. Long Reservoir
Organization Concerned	(SWW)	(SWW)	(SWW)	(SWW)	(SWW)
Basin No.	15	15	(15)	16	16
River System	Kelang	Kelang	Subang	Langat	Langat
Year of Completion or Plan	Pd 1982 -1985	Id (cancelled)	Id	Pd Phase 1: 1984 Phase 2: 1986	Id
Purpose	MT: WS, FM	WS, FM	WS	MT: WS, IR	WS
Catchment Area (km^2)	50.0	88	7.7	56	12.8
Full Supply Level (El. m)	102.8			+109.7	
Drawdown (m)	18.6				
Storage Volume (10^6m^3): Gross	36.62	42.6	3.55	58	
Active	27.53	29.6			
Reservoir Area (km^2)	2.84	3.65			
Dam Type					
Height of Main Dam (m)	45	25		43	
Volume of Main Dam (10^3m^3)				$2.98x10^3$	
Discharge (m^3/s): Maximum					
Average	26MGD=1.37m^3/s =43.2x$10^6m^3/y$			6.3	
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 24 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (15/42)

State: NEGERI SEMBILAN

Name of Dam or Project	Dams Proposed	
	Terip	Pantai Headworks
Organization Concerned	(PWD)	(DID)
Basin No.	18	18
River System	Linggi	Linggi
Year of Completion or Plan	Pd Stage 1-1984 Stage 2-1994	Pd
Purpose	WS	(WS, IR)
Catchment Area (km^2)		
Full Supply Level (El. m)	Stage 1-96.0 Stage 2-102.2	
Drawdown (m)		
Storage Volume (10^6m^3): Gross	Stage 1-34.1 Stage 2-47.8	
Active		
Reservoir Area (km^2)		
Dam Type	Earth	
Height of Main Dam (m)	Stage 1-32m Stage 1-38	
Volume of Main Dam (10^3m^3)		
Discharge (m^3/s): Maximum		
Average	Stage 1-0.48 Stage 2-0.96	
Rated Head (m)		
Hydropower Installed Capacity (MW)		

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 25 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (16/42)

State: MELAKA

Name of Dam or Project	Dams in-operation			
	Durian Tunggal Scheme	Ayer Keroh	Tidal Barrage	Asahan in Johor
Organization Concerned	MWB	(MWB)	(MWB)	(MWB)
Basin No.	19	19	19	21
River System	Melaka	Melaka	Melaka	Muar
Year of Completion or Plan	1978-79	1890	Op	1930
Purpose	WS	WS	OT: Tide	WS
Catchment Area (km^2)	70.7		Some 690	
Full Supply Level (El. m)	25.9			
Drawdown (m)	1			
Storage Volume (10^6m^3): Gross	20.5			
Active	18.2			
Reservoir Area (km^2)	4			
Dam Type	Center core earth dam			
Height of Main Dam (m)				
Volume of Main Dam (10^3m^3)				
Discharge (m^3/s): Maximum	Water withdrawal Design drought 1/50 years	$0.016m^3/s$ for WS		Diverted $0.0529m^3/s$ for W.S. from Johor State
Average	$1.53m^3/s$ for WS			
Rated Head (m)				
Hydropower Installed Capacity (MW)				

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A. = Not available

Table 26 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (17/42)

State: JOHOR (1)

Name of Dam or Project	Dams In-operation			Dams Under Construction	
	Gunong Ledang	Pengkalan Bukit	Batu Pahat	Semberong	Bekok
Organization Concerned	PWD	PWD	PWD	DID	DID
Basin No.	21	21	22	22	22
River System	Muar	Muar	Batu Pahat	Batu Pahat	Batu Pahat
Year of Completion or Plan	Op	Op	Pre-world War II	Ud (1983	T/D (1984)
Purpose	WS	WS	WS	MT: WS, FM	MT: WS, FM
Catchment Area (km^2)				130	350
Full Supply Level (El. m)			No record	8.5	10.5
Drawdown (m)				2.4	1.0
Storage Volume (10^6m^3): Gross				18	18
Active				13	10
Reservoir Area (km^2)				8.5	11.0
Dam Type				Earth	Earth
Height of Main Dam (m)				10	12
Volume of Main Dam (10^3m^3)				630	600
Discharge (m^3/s): Maximum				360	600
Average					1/25=2.4m^3/s 1/10=2.6m^3/s
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 27 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (18/42)

State: JOHOR (2)

Name of Dam or Project	Dams In-operation or Under Construction				
	Simpang Kiri	Pontian Kechil	Gunong Pulai	Pulai III	Machap
Organization Concerned	DID	Singapore Utilities Board (SUB)	SUB	SUB	DID
Basin No.	22	23	23	23	23
River System	Batu Pahat	Pontian Kechil	Pulai	Pulai	Benut
Year of Completion or Plan	T/D (1984)	Under British Colonization	Pre-World War II (1927)	Pre-World War II	Ud Oct. 1981
Purpose	FM	WS to Singapore	WS to Singapore	WS to Singapore	MT: FM, WS
Catchment Area (km^2)	440	12.4	6.2	1.8	77.7
Full Supply Level (El. m)	6.4	TWL 66.75	TWL 166.13	TWL 171.92	NSL 15.86
Drawdown (m)		N.A.	N.A.	N.A.	
Storage Volume (10^6m^3): Gross	130	11.4	5.54	0.25	36.9 at Max. Design Level
Active	Tentative (128)	N.A.	N.A.	N.A.	
Reservoir Area (km^2)	68	1.93 at TWL	0.53 at TWL	0.15 at TWL	9.07 at MDL
Dam Type	Earth	Earth dam with concrete core	Masonry	Concrete	Earthfill
Height of Main Dam (m)	Approx 5m, 10km	17.07	38.10	8.84	9.15
Volume of Main Dam (10^3m^3)	(780)	N.A.	N.A.	N.A.	390
Discharge (m^3/s): Maximum	Note: Dam embankment is used for a highway.	Original Plan: 90,900m^3/day Present: 45,500m^3/day			
Average					Compensation 1.42
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 28 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (19/42)

State: JOHOR (3)

Name of Dam or Project	Dams In-operation or Under Construction			
	Lebam	Layang	Tenglu Mersing	Labong
Organization Concerned	PWD	PWD	PWD	DID
Basin No.	24	24	26	27
River System	Lebam	Johor	Mersing	Endau
Year of Completion or Plan	1978	Ud (1981)	Approx 1960	Op
Purpose	WS	WS	WS	IR
Catchment Area (km^2)	18.9	30.5		
Full Supply Level (El. m)	11.6	(26.6?)	No record	
Drawdown (m)				
Storage Volume (10^6m^3): Gross	4.0	45.0		
Active	2.96			
Reservoir Area (km^2)	2.63	6.6		
Dam Type	Earthfill	Earthfill	Earth dam	
Height of Main Dam (m)	11.6	20.2	3.7-4.6	
Volume of Main Dam (10^3m^3)	229.37			
Discharge (m^3/s): Maximum	212.25			
Average	0.313	1.04		
Rated Head (m)				
Hydropower Installed Capacity (MW)				

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 29 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (20/42)

State: JOHOR (4)

Name of Dam or Project	Dams Proposed or Identified	Dams Proposed or Identified	
	Palong	Lenggor	Kahang
Organization Concerned	(PWD)	DID	PWD
Basin No.	21	27	27
River System	Muar	Endau	Endau
Year of Completion or Plan	Id	Pd	Pd (1985)
Purpose	WS	IR	WS
Catchment Area (km^2)	152		
Full Supply Level (El. m)			
Drawdown (m)	280		
Storage Volume (10^6m^3): Gross			
Active			
Reservoir Area (km^2)			
Dam Type			
Height of Main Dam (m)			
Volume of Main Dam (10^3m^3)			
Discharge (m^3/s): Maximum			
Average	26		
Rated Head (m)			
Hydropower Installed Capacity (MW)			

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 30 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (21/42)

State: PAHANG (1)

Name of Dam or Project	Dams In-operation				
	Kg. Raja	K. Terla	Sempam	Robinson Falls	Habu
Organization Concerned	NEB	NEB	NEB	NEB	NEB
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	1964	1964	1910	1959	1963
Purpose	RHY	RHY	RHY	RHY	RHY
Catchment Area (km^2)	30.82		78	21.50	132.61
Full Supply Level (El. m)					
Drawdown (m)					
Storage Volume (10^6m^3): Gross					
Active					
Reservoir Area (km^2)					
Dam Type					Weir
Height of Main Dam (m)					
Volume of Main Dam (10^3m^3)					
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)			Gross 230		
Hydropower Installed Capacity (MW)	0.7 (0.5)	0.5 (0.8)	6.6	0.9	5.5

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 31 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (22/42)

State: PAHANG (2)	Dams In-operation	Dams Proposed			
Name of Dam or Project	Sultan Abu Baker	Anak Endau Dam	Anak Endau Weir	Kemelai	Pontian (Weir)
Organization Concerned	NEB	(DID)	(DID)	(DID)	(DID)
Basin No.	10-30	27	27	27	28
River System	Pahang	Endau	Endau	Endau	Pontian
Year of Completion or Plan	1963	Pd	Pd	Pd	Pd
Purpose	HY	IR	IR	IR	IR
Catchment Area (km^2)	183.11	36	180	44	170
Full Supply Level (El. m)	1,070	18.5	3.5		4.1
Drawdown (m)		6			
Storage Volume (10^6m^3): Gross		35			15
Active	4.55	5			
Reservoir Area (km^2)		7			11.5
Dam Type	Concrete butless	Earthfill	Earthfill/ Low conc.	Earthfill	
Height of Main Dam (m)	39.6	18			
Volume of Main Dam (10^3m^3)	52.02	467			
Discharge (m^3/s): Maximum			700		
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)	See SULTAN YUSSUF, Basin 10				

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 32 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (23/42)

State: PAHANG (3)

Name of Dam or Project	Dams Proposed or Identified						
	Jeram (Lower)			Sekin	Jekatih	Pukin	Kepasing
Organization Concerned	(DARA)			(PWD)	(PWD)	(PWD)	(PWD)
Basin No.	28			28	28	28	28
River System	Rompin			Rompin	Rompin	Rompin	Rompin
Year of Completion or Plan	Pd			Id	Id	Id	Id
Purpose	HY/WS			WS	WS	WS	WS
Catchment Area (km^2)	470			138	214	130	149
Full Supply Level (El. m)	61	61	45.7				
Drawdown (m)							
Storage Volume (10^6m^3): Gross	326	325	116	110	30	100	150
Active	210	210	100				
Reservoir Area (km^2)	171	170	110				
Dam Type	Low weir concrete	Con-crete	Rock/ earth				
Height of Main Dam (m)	53.3	53.3	38				
Volume of Main Dam (10^3m^3)	111	1125	605				
Discharge (m^3/s): Maximum							
Average		8.7		4.7	3.6	2.2	2.5
Rated Head (m)	30	30	25				
Hydropower Installed Capacity (MW)	3-7	307	3				

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 33 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (24/42)

State: PAHANG (4)

Name of Dam or Project	Dams Proposed or Identified				
	Jeram (Middle)	Jeram (Upper)	Aur	Kembar Weir	Tekai (Upper)
Organization Concerned	(DARA)	(DARA)	(PWD)	(DID)	(NEB)
Basin No.	28	28	28	(30)	30
River System	Rompin	Rompin	Rompin	Kembar	Pahang
Year of Completion or Plan	Id	Id	Id	Pd	Pd
Purpose	WS/HY	WS	WS	IR	MT:HY
Catchment Area (km^2)	400	335	97		1200
Full Supply Level (El. m)	45.7	45.7		3.5	
Drawdown (m)					
Storage Volume (10^6m^3): Gross	760	570	75		5000
Active	620	470			
Reservoir Area (km^2)	63	48			
Dam Type	Earthfill	Earthfill		Earthfill/ Low conc.	
Height of Main Dam (m)	36.5	33.5			100
Volume of Main Dam (10^3m^3)	600	400		9.1	
Discharge (m^3/s): Maximum				320	
Average			2.0		
Rated Head (m)	21				
Hydropower Installed Capacity (MW)	3				74MW

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 34 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (25/42)

State: PAHANG (5)

Name of Dam or Project	Dams Proposed or Identified				
	Tekai Lower (Penut)	Mengtiga (Weir)	Maran	Bera Lower	Bera Upper
Organization Concerned	(NEB)		On the shelf (NEB)		
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Pd	Id	Id	Id	Id
Purpose	MT:HY	WS	HY	WS	WS
Catchment Area (km^2)	1,390	125	25,000	316	86
Full Supply Level (El. m)	122				
Drawdown (m)	22				
Storage Volume (10^6m^3): Gross	1,820			200	140
Active	1,070				
Reservoir Area (km^2)	68				
Dam Type	Earth & Rockfill		R.O.R.		
Height of Main Dam (m)	75				
Volume of Main Dam (10^3m^3)	1,800				
Discharge (m^3/s): Maximum					
Average	63	2.5		5.6	1.5
Rated Head (m)	45 (min)				
Hydropower Installed Capacity (MW)	2x33MW		120		

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 35 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (26/42)

State: PAHANG (6)

Name of Dam or Project	Dams Identified				
	Teris 1	Teris 2	Teris 3	Kelau 1	Kelau 2
Organization Concerned					
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose	FM	FM	FM	FM	FM
Catchment Area (km^2)	190	150	120	710	330
Full Supply Level (El. m)		60			80
Drawdown (m)					
Storage Volume (10^6m^3): Gross	680	32	580	140	50
Active	N.A.				
Reservoir Area (km^2)		6			8.7
Dam Type		Earth			Earthfill
Height of Main Dam (m)	35	25	35	15	25
Volume of Main Dam (10^3m^3)		200			N.A.
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 36 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (27/42)

State: PAHANG (7)

Name of Dam or Project	Dams Identified				
	Kelau 3	Bentong Lower	Bentong Upper	Telemong	Benus
Organization Concerned					(NEB)
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Id	Id	Id	Id	Id (& Idt)
Purpose	FM	FM	FM	FM	HY (WS)
Catchment Area (km^2)	320	650	590	360	93
Full Supply Level (El. m)		90	90	80	Bentong scheme
Drawdown (m)		N.A.			
Storage Volume (10^6m^3): Gross	285	80	25	54	
Active					
Reservoir Area (km^2)		8.0	4.6	5.75	
Dam Type		Earthfill/ Conc. grav.	Earthfill/ Conc. grav.	Earth/Rock-fill	
Height of Main Dam (m)	25	40	25	30	
Volume of Main Dam (10^3m^3)				500	
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					Gross 224
Hydropower Installed Capacity (MW)					8

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 37 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (28/42)

State: PAHANG (8)

Name of Dam or Project	Dams Identified				
	Perting	Tekam	Tembeling Lower	Tembeling Upper	Tahan
Organization Concerned	(NEB)	(NEB)	(NEB)	(NEB)	
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Id (& Idt)	Id	Id	Id	Id
Purpose	HY (WS)	MT:HY	MT:HY	MT:HY	FM
Catchment Area (km^2)	88	400	5,150	2,850	380
Full Supply Level (El. m)	Bentong scheme	95	105	135	125
Drawdown (m)			15	12	
Storage Volume (10^6m^3): Gross		1,000	7,400	4,000	75
Active			4,200	1,730	
Reservoir Area (km^2)		72	400	250	4
Dam Type		Earth and/or Rockfill	Earth & Rockfill	(Rockfill)	Earthfill or Conc. gravity
Height of Main Dam (m)		40	65	80	60
Volume of Main Dam (10^3m^3)			18,000	1,200	
Discharge (m^3/s): Maximum					
Average			230	132	
Rated Head (m)	Gross 207		38 (min)	57 (min)	
Hydropower Installed Capacity (MW)	12	9	Proposed 3x67MW	Proposed 3x50MW	

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 38 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (29/42)

State: PAHANG (9)

Name of Dam or Project	Dams Identified				
	Lipis	Dayang	Sia	Liang (1)	Liang (2)
Organization Concerned		(EPU)	(NEB)	(NEB)	(NEB)
Basin No.	30	30	30	30	30
River System	Pahang	Tahan river Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose	FM	OT (Recreation)	RHY	MT:HY	MT:HY
Catchment Area (km^2)	450	7	62	240	N.A.
Full Supply Level (El. m)	150	(83.5)		165	160
Drawdown (m)					
Storage Volume (10^6m^3): Gross	118	9.6		71	86
Active					
Reservoir Area (km^2)	9.6	1		4.1	5.75
Dam Type	Earthfill or Conc. gravity	Earthfill		Earthfill/ Conc. gravity	Earthfill
Height of Main Dam (m)	50	21.6		35	35
Volume of Main Dam (10^3m^3)	1,100	73		600	500
Discharge (m^3/s): Maximum	N.A.	70			
Average		0.1			
Rated Head (m)			Gross 255	Gross 268	
Hydropower Installed Capacity (MW)			8.8	15	

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 39 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (30/42)

State: PAHANG (10)

Name of Dam or Project	Dams Identified				
	Sempam Baru	Tanum 1	Tanum 2	Tanum 3	Jelai Kechil
Organization Concerned					(NEB)
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose	RHY	FM	FM	FM	MT:HY
Catchment Area (km^2)		730	600	460	890
Full Supply Level (El. m)		115			135
Drawdown (m)					12
Storage Volume (10^6m^3): Gross		150	590	160	N.A.
Active					N.A.
Reservoir Area (km^2)		18			70
Dam Type		Earth/Rock-fill			Earth/Rock-fill
Height of Main Dam (m)		30	50	25	70
Volume of Main Dam (10^3m^3)					N.A.
Discharge (m^3/s): Maximum					N.A.
Average					90
Rated Head (m)					35
Hydropower Installed Capacity (MW)					2x30

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 40 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (31/42)

State: PAHANG (11)

Name of Dam or Project	Dams Identified				
	Telom	K. Bertam	Ulu Lemoi	K. Serau	Kechau
Organization Concerned					
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose	MT:HY	HY	HY	HY	
Catchment Area (km^2)	1,200	352	62	111	540
Full Supply Level (El. m)	135				
Drawdown (m)	12				
Storage Volume (10^6m^3): Gross	N.A.				430
Active	N.A.				
Reservoir Area (km^2)	28				
Dam Type	Earth/Rock-fill				
Height of Main Dam (m)	60				35
Volume of Main Dam (10^3m^3)	1,000				
Discharge (m^3/s): Maximum	1,000				
Average	N.A.				
Rated Head (m)		Gross 352	Gross 367	Gross 149	
Hydropower Installed Capacity (MW)		98	12	6	

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 41 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (32/42)

State: PAHANG (12)

Name of Dam or Project	Dams Identified				
	Lompat 1	Lompat 2	Kerau	Tembeling Upper 2	Tekai Upper 2
Organization Concerned					
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose					
Catchment Area (km^2)	180	90	200	840	910
Full Supply Level (El. m)					
Drawdown (m)					
Storage Volume (10^6m^3): Gross	500	130	200	1,400	3,500
Active					
Reservoir Area (km^2)					
Dam Type					
Height of Main Dam (m)	30	25	25	100	100
Volume of Main Dam (10^3m^3)					
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 42 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (33/42)

State: PAHANG (13)

Name of Dam or Project	Dams Identified				
	Kiol	Seboi	Jenalik	Serau	Jelai
Organization Concerned					
Basin No.	30	30	30	30	30
River System	Pahang	Pahang	Pahang	Pahang	Pahang
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose					
Catchment Area (km^2)	60	70	100	670	3,060
Full Supply Level (El. m)				N.A.	
Drawdown (m)					
Storage Volume (10^6m^3): Gross	98	87	72	N.A.	N.A.
Active					
Reservoir Area (km^2)					
Dam Type					
Height of Main Dam (m)	50	45	15	N.A.	30
Volume of Main Dam (10^3m^3)					
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 43 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (34/42)

State: PAHANG (14)

Name of Dam or Project	Dams Proposed or Identified				
	Telom Upper	Kuantan Barrage	Chereh	Kuantan	Kenau
Organization Concerned		(PWD)			
Basin No.	30	31	31	31	31
River System	Pahang	Kuantan	Kuantan	Kuantan	Kuantan
Year of Completion or Plan	Id	Pd	Id	Id	Id
Purpose		Tidal barrage	WS	WS	WS
Catchment Area (km^2)	1,180		164	128	110
Full Supply Level (El. m)					
Drawdown (m)					
Storage Volume (10^6m^3): Gross	700		81.9	63.7	54.6
Active					
Reservoir Area (km^2)					
Dam Type					
Height of Main Dam (m)	70		29	52	24
Volume of Main Dam (10^3m^3)					
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 44 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (35/42)

State: TRENGGANU (1)	Dams In-operation or Under Construction		Dams Proposed or Identified		
Name of Dam or Project	Tenang	Kenyir (Trengganu)	Kemaman	Ulu Trengganu	Upper Trengganu 4
Organization Concerned	PWD	NEB	(NEB)	(NEB)	(NEB)
Basin No.	38	36	32	36	36
River System	Besut	Trengganu	Kemaman	Trengganu	Trengganu
Year of Completion or Plan	Op	Ud(1984-85)	Id & Idt	Pd(1988)	Id
Purpose	WS	MT=HY,FM,OT	(MT: HY,WS)	MT:HY	MT:HY
Catchment Area (km^2)		2,600	209		420
Full Supply Level (El. m)		145			285
Drawdown (m)		25			260
Storage Volume (10^6m^3): Gross		13,600		870	840
Active		7,400x1.22 =9,028			715
Reservoir Area (km^2)		369			45.8
Dam Type		Rockfill		Rockfill and Concrete grav.	Earth core rockfill
Height of Main Dam (m)		150			80
Volume of Main Dam (10^3m^3)		16,500			1,280
Discharge (m^3/s): Maximum					
Average					
Rated Head (m)					
Hydropower Installed Capacity (MW)		4x100 =400		2x50 =100	

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 45 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (36/42)

State: TRENGGANU (2)

Name of Dam or Project	Dams Identified				
	Upper Trengganu 5 (Diversion)	Nerus 1	Nerus 2	Kasar 1	Kasar 2
Organization Concerned	(NEB)				
Basin No.	36	36	36	36	36
River System	Trengganu	Trengganu	Trengganu	Trengganu	Trengganu
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose	MT:HY	MT:HY	MT:HY	MT:HY	MT:HY
Catchment Area (km^2)	100	86.7	63.7	40	30.8
Full Supply Level (El. m)			56.0		70.0
Drawdown (m)			11		20
Storage Volume (10^6m^3): Gross			147		24.8
Active			142.25		20
Reservoir Area (km^2)			11		1.4
Dam Type	Concrete		Earthfill		Rockfill
Height of Main Dam (m)	24	40	35 (50)	43.9	45
Volume of Main Dam (10^3m^3)	27		1,040		1,110
Discharge (m^3/s): Maximum					
Average			3.87		2.08
Rated Head (m)					
Hydropower Installed Capacity (MW)			0.8		0.5

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 46 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (37/42)

State: TRENGGANU (3)

Name of Dam or Project	Dams Identified				
	Telemong 1	Telemong 2	Telemong 3	Sekayu	Lalang
Organization Concerned		(NEB)	(NEB)		
Basin No.	36	36	36	36	36
River System	Trengganu	Trengganu	Trengganu	Trengganu	Trengganu
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose		MT:HY	HY	HY	MT:HY
Catchment Area (km^2)	96.3	58.3	50.4	45.3	72.3
Full Supply Level (El. m)		145	168	364.5	214.0
Drawdown (m)		25	22	52.5	39
Storage Volume (10^6m^3): Gross		65	37.7	61.8	58.8
Active			34	57.6	51.8
Reservoir Area (km^2)		3.4	2.8	369.1	
Dam Type		Earthfill	Rockfill	Concrete	Rockfill
Height of Main Dam (m)	25	95	50	95	110
Volume of Main Dam (10^3m^3)		8,062	604	670	
Discharge (m^3/s): Maximum					
Average				3.96	6.18
Rated Head (m)				Gross 330	Gross 170
Hydropower Installed Capacity (MW)		4.1	2.4	9.1	6.3

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 47 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (38/42)

State: TRENGGANU (4)

Name of Dam or Project	Dams Identified				
	Chah Diversion	Kelmin Diversion	Pelong 1	Pelong 2	Kelasah
Organization Concerned					
Basin No.	36	34 (to 36)	36	36	36
River System	Trengganu	Trengganu	Trengganu	Trengganu	Trengganu
Year of Completion or Plan	Id	Id	Id	Id	Id
Purpose	MT:HY	HY			
Catchment Area (km^2)	25.3	35.6	68.9	22.6	35.8
Full Supply Level (El. m)					
Drawdown (m)					
Storage Volume (10^6m^3): Gross					
Active					
Reservoir Area (km^2)					
Dam Type					
Height of Main Dam (m)	5	5	45	45	65
Volume of Main Dam (10^3m^3)					
Discharge (m^3/s): Maximum					
Average	2.11	3.23			
Rated Head (m)					
Hydropower Installed Capacity (MW)					

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 48 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (39/42)

State: TRENGGANU (5)

Name of Dam or Project	Dams Identified	
	Trengan	Jeneris
Organization Concerned		
Basin No.	36	36
River System	Trengganu	Trengganu
Year of Completion or Plan	Id	Id
Purpose	MT:HY	(HY)
Catchment Area (km^2)	1975	
Full Supply Level (El. m)	160	
Drawdown (m)	30	
Storage Volume (10^6m^3): Gross	12,080	
Active	7,210	
Reservoir Area (km^2)	304.10	
Dam Type	Rockfill	
Height of Main Dam (m)	125	
Volume of Main Dam (10^3m^3)	6,500	
Discharge (m^3/s): Maximum	310	
Average	900	
Rated Head (m)		
Hydropower Installed Capacity (MW)	2x110	

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 49 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (40/42)

State: KELANTAN (1)	Dams In-operation		Dams Proposed		
Name of Dam or Project	Pelau'ur	Bukit Kuang	Jeram Panjang (Lebir)	Pergau	Unknown
Organization Concerned	(NEB)	DID	NEB	(NEB)	(DID)
Basin No.	40	41	40	40	41
River System	Kelantan	Golok	Kelantan	Kelantan	Golok
Year of Completion or Plan	1964	June 1979	Pd(1990)	Pd(1989)	Pd
Purpose	RHY(nil)	(IR)	MT:HY,FM, OT	HY	(IR)
Catchment Area (km^2)		10.24	2,474	90+137	(20)
Full Supply Level (El. m)			69.5	637	
Drawdown (m)			8	32	
Storage Volume (10^6m^3): Gross			4,397	70	
Active			2,834		
Reservoir Area (km^2)		3.58	247		
Dam Type		Earth	Rockfill	Rockfill	
Height of Main Dam (m)		7.6	69.5	77	
Volume of Main Dam (10^3m^3)		Crest length =1,650m	5,214	1,170	
Discharge (m^3/s): Maximum			320	1,160	
Average		Water withdrawal =1.5m^3/s (648ha)	113		
Rated Head (m)			55.8	472	
Hydropower Installed Capacity (MW)			Max. 151	2x50= 100	

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 50 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (41/42)

State: KELANTAN (2)

Name of Dam or Project	Dams Identified				
	Barrage	Kembu	Sokor	Dabong (Galas)	Nenggiri
Organization Concerned	(NEB)	(DID)	(DID)	(EPU)	(NEB)
Basin No.	40	40	40	40	40
River System	Kelantan	Kelantan	Kelantan	Kelantan	Kelantan
Year of Completion or Plan	Id	Id	Id	Id (On the shelf)	Id
Purpose	MT:IR,HY	(IR)	IR	MT:HY,FM,WS	HY
Catchment Area (km^2)	12,100		220	7,480	
Full Supply Level (El. m)				57	
Drawdown (m)				7	
Storage Volume (10^6m^3): Gross					
Active					
Reservoir Area (km^2)				105	
Dam Type		Earth or Rockfill	Earthfill	Concrete gravity	
Height of Main Dam (m)				53	
Volume of Main Dam (10^3m^3)					
Discharge (m^3/s): Maximum	18,000				
Average				125	
Rated Head (m)					
Hydropower Installed Capacity (MW)	40			95	82

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 51 PRINCIPAL FEATURE OF MULTI PURPOSE DAM PROJECT IN PENINSULAR MALAYSIA (42/42)

State: KELANTAN (3)

Name of Dam or Project	Dams Identified			
	Rek	Jeram Kiak	Tualang	NAL
Organization Concerned	(NEB)	(NEB)	(NEB)	(DID)
Basin No.	40	40	40	40
River System	Kelantan	Kelantan	Kelantan	Kelantan
Year of Completion or Plan	Id	Id	Id	Id
Purpose	HY	HY	HY	IR
Catchment Area (km^2)		2,290	2,480	136
Full Supply Level (El. m)			77.5	
Drawdown (m)				
Storage Volume (10^6m^3): Gross			4,495	
Active			2,919	
Reservoir Area (km^2)			248	
Dam Type		Concrete	Concrete	Earthfill
Height of Main Dam (m)			77.5	
Volume of Main Dam (10^3m^3)				
Discharge (m^3/s): Maximum			320	
Average			113	
Rated Head (m)			Effective 59.4	
Hydropower Installed Capacity (MW)	1.0		Max. 162	

Remarks; (1): Purpose: MT = Multipurpose; IR = Irrigation; HY = Hydropower; RHY = Run-of-river hydropower station; WS = Water Supply; FM = Flood Mitigation; OT = Others

(2): F/S = Feasibility Study; Pd = Proposed; Id = Identified; Idt = Identified by the JICA study team; Op = In operation; Ud = Under construction; T/D = Tender design; N.A.= Not available

Table 52 WATER SHORTAGE, INDUCED PROBLEMS AND AGREEMENTS (1/4)

Fact of Water Shortage & Location	Induced Problems: DID V.S. PWD	Induced Problems: NEB V.S. DID & PWD	Induced Problems: Residents	Inter-State, Basin Water Diversion	Agreements
PERLIS STATE Yes, in drought season (Jan., Feb., Mar.) but not so serious comparing to Kedah state.	No	No	No	Diverted from MADA scheme (Kedah state) for water supply to Kangar (5 cusec = 0.14 m^3/s) from Papang Terap Barrage. International water diversion plan: 5 - 10 MGD (0.26 - 0.53 m^3/s) clean gravity water from the Reben Lake in Thailand.	Yes; Perlis pays some M$1,000 annually to Kedah for the water of 5 cusec to Kangar. Unofficial discussion on the international water diversion from Thailand.
KEDAH STATE Yes, three consecutive driest years have been experienced in 1977, 1978 and 1979. The return period is estimated to be once in 30 years. From statistical analysis over a period of 27 years (1953 - 1979), 1963 is the driest year for the Muda-Pedu whole system (once in 30 - 50 years) and 1968 is the driest year at Jeniang of the Muda river (once in 50 years). Refer to "Kedah-Perlis Water Resources Management Study", July 1980.					Agreement concerning water charge in MADA: M$15/acre/year for double cropping. The agreement between Kedah & P. Pinang to meet the future (2000 year) domestic water demand has not been signed yet, and it is still in negotiation under ADB. The minimum water withdrawal from the Muda river to Pinang is 100 - 120 MGD (5.3 - 6.4 m^3/s). Time scheduling of water withdrawal in dry spell from the Muda river is requested.
P. PINANG STATE				Diverted from Butterworth to Pinang island by twin 30" submarine pipelines (some 14 MGD at present). The total consumption is 32 MGD in Pinang island.	At present the total consumption of domestic water in Pinang state is some 60 MGD (3.2 m^3/s); 32 MGD in Pinang island and 28 MGD in Butterworth area. Some 30 MGD is withdrawn from the Muda river at present: 14 MGD to Pinang island and 16 MGD to Butterworth area. If the agreement of 100 - 120 MGD is made the 2000 year domestic water demand will be fulfilled.

Table 53 WATER SHORTAGE, INDUCED PROBLEMS AND AGREEMENTS (2/4)

Fact of Water Shortage & Location	Induced Problems: DID V.S. PWD	Induced Problems: NEB V.S. DID & PWD	Induced Problems: Residents	Inter-State, Basin Water Diversion	Agreements
PERAK STATE					
Yes, Typing area; Irrigation & water supply.	Yes, but not serious. (Report by PWD)			Since 1964 water from the Plau'ur river (catchment area 6 km^2) in Kelantan has been diverted to combine with the waters of Telom, Kial and Kodol rivers in Pahang for the Cameron Highlands Hydro-Electric Scheme, which was completed in 1963.	The agreement regarding the maintenance discharge of the Perak river, which was made around 1976 between NEB and DID, is not kept by NEB in drought spell. The second cropping season therefore is hit by water shortage. The Temengor and Chenderoh dam reservoir should be operated to keep the minimum maintenance discharge to be 4,000 cusec (113.2 m^3/s) at Iskandar Bridge through the year. The DID is afraid of the conditions after construction of the Bersia and Kenering dams.
Bernam river; Irrigation & water supply.	Yes, but not serious. (Report by PWD)				
The Perak river in drought spell after the Temengor dam construction.		Yes			
Water shortage was experienced in drought spell around 1977 at Kerian irrigation scheme.				As from November 1963, flow from the Ringlot Reservoir at the Bernam river in Pahang has been diverted through a series of tunnels into the Batang Padang river in Perak. The average discharge released through the Jor Tailrail in Perak was 725,000 m^3/day (8.39 m^3/s).	
SELANGOR STATE					
Yes, for three years in succession from 1976 to 1978 the Klang Valley area was suffered from 5 to 8% water shortage during the dry months. Drought conditions of frequency 1 in 60 years were experienced.				Sungei Benus Scheme, proposed to be operated by the end of 1981. Water of 6 MGD (0.32 m^3/s) is pumped some 900 feet (275 m) in 2 stages from the Benus river in Pahang and gravitates to the impounded area of the Klang Gates Dam along the Penulas river.	
NEGERI SEMBILAN STATE					
Yes, water shortage due to FELDA scheme.	Yes, at Pantai headworks. Multi-purpose dam projects will cause conflict in small rivers.				No agreement on the usage of the inter-state rivers.

Table 54 WATER SHORTAGE, INDUCED PROBLEMS AND AGREEMENTS (3/4)

Fact of Water Shortage & Location	Induced Problems: DID V.S. PWD	Induced Problems: NEB V.S. DID & PWD	Induced Problems: Residents	Inter-State, Basin Water Diversion	Agreements
MELAKA STATE					
Yes	Yes			After 1985, inter-state water diversion will be required. Water diversion from the Muar river at the intake near Gerisek is considered as one alternative. EPU Muar River Basin Study in ongoing.	At present there is no coordination body for planning between DID and LAM, then problems occurs during dry spell. The compensation flow of 10 MGD for Durian Tunggal reservoir is the value at planning stage and after the dam construction the discharge is not kept actually. No problem for the time being. No agreement (at present) on the usage of the inter-state rivers. One steering committee was established between Johor & Melaka for monitoring the world bank project of canalization of the Kesang river. It will be dissolved after the project (within 5 years). No documentary agreement on the priority of water usage during drought spell but the first priority of the domestic water supply is a habitual agreement or understanding among agencies.
JOHOR STATE					
Yes, the area from the suburbs of the Muar city to Batu Pahat along the coast is provided with domestic water supply pipeline system, but PWD often stops water supply during dry spell. Then domestic water is often supplied by tank trucks. The conditions are getting severe recently for the residents.				Johor PWD buys water from Negeri Sembilan, Melaka and Pahang to supply domestic water to towns located around the state boundary. Johor PWD also sends domestic water to Singapore.	Two management committees are established for the Muar river by Johor and Negeri Sembilan; Joint Consultative Committee (policy making) and Joint Management Committee (technical matters), but no agreement at present. It will be required in the near future. There is an agreement between Johor PWD and Singapore Utility Board for water supply to Singapore.
PAHANG STATE					
No water shortage.					The legal and management of DARA project is very controversial. DARA belongs to the Federal. No problems at present, but no information and no chance of discussion regarding hydropower-development project are provided until the project commencement.

Table 55 WATER SHORTAGE, INDUCED PROBLEMS AND AGREEMENTS (4/4)

Fact of Water Shortage & Location	Induced Problems: DID V.S. PWD	Induced Problems: NEB V.S. DID & PWD	Induced Problems: Residents	Inter-State, Basin Water Diversion	Agreements
TRENGGANU STATE					
No water supply dams at present and no future plan of dam construction.					
KELANTAN STATE					
Yes, shortage of domestic water supply at 5 schemes, one at Puala Kurai. The ground water capacity will not meet the demand after 1990.					

Table 56 WATER POLLUTION AND ENVIRONMENTAL IMPACT (1/3)

Pollutant Source						
Oil Palm Processing	Rubber Processing	Sugar Processing	Tin Mining	Pig Raising	Sewage and Sewerage System	Impact on Environment (Ecology, Fishery, Forestry, Irrigation, Domestic Water Supply)
PERLIS STATE		2 estates of sugarcane plantation in the northern part of Perlis river, each 10,000 acres (4,050 ha).	10 sites around the northern border of Thailand river is polluted during flood spell.	No	Cholera brokeout from 1977 to 1978. It usually occurs during dry spell. It is not clear whether the cause is well water or pipes water. No organized sewerage system at present but it must be necessary.	Effects on fish cultivation is reported in the Intesification Report.
KEDAH STATE	Yes, in the Merbok river.	Yes, only one sugar factory (Pdg. Sanai Sugar mill) in Anning river.			Sewage from towns & industry to the Merbok river is reported, especially pollutants from Yasua car battery and others were leaked into paddy at Tikan Batu industrial site.	Development plan of Brakish water fish cultivation (Projected aquiculture 5,000 ha) in the Merbok river. Report by EPU, Ministry of Environment "Recent Study on Water Pollution for Melbok Aquiculture".
P. PINANG STATE				The plan to establish a pig raising area at downstream of Jawi river is on the shelf because of the objection from fishery.	JICA (May 1978), "Master Plan for Sewerage and Drainage System Project Butterworth/Bukit Mertajam Metropolitan Area".	
PERAK STATE						
Yes, rather significant.	Yes		Yes	No problems because the water from pig raising is imponded in mining ponds.		

Table 57 WATER POLLUTION AND ENVIRONMENTAL IMPACT (2/3)

Pollutant Source						Impact on Environment (Ecology, Fishery, Forestry, Irrigation, Domestic Water Supply)
Oil Palm Processing	Rubber Processing	Sugar Processing	Tin Mining	Pig Raising	Sewage and Sewerage System	
SELANGOR STATE						
Yes, the smell from the water of oil palm processing in the Sepang river.				Waste water from pig raising is objected by the Moslems in the Sepang and Pang rivers and Gombak district. There is a report regarding pig pollution (1980).		The Environmental Conservation act is too old and does not meet the actual conditions at present. For example, the maximum penalty of M$50 is not effective to prevent from releasing pollutants. Change of vegetation by land development causes floods and drought especially in the Klang river basin.
MELAKA STATE	Yes, in the Melaka river.			Yes, in three area: (1) Paya Mengkuang (Sg. Tuang) (2) Sg. Udan (3) Kg. Tempoir Kg. Kuda.		
NEGERI SEMBIRAN STATE				No problems in the future. All pig raising in the Negeri Sembilan is tried to be gathered within the designated area, Bukit Pelandok of Port Dickson district.		
JOHOR STATE						One water supply project including one Barrage in the Terbau river was gave up because of water pollution.
PAHANG STATE						
Yes, need of pollution control and the minimum compensation flow is discussed in the Study of Water Resources Management in the Pahang Tenggara Region (Oct. 1979). Yes in Kuantan river.				No		

Table 58 WATER POLLUTION AND ENVIRONMENTAL IMPACT (3/3)

Pollutant Source						
Oil Palm Processing	Rubber Processing	Sugar Processing	Tin Mining	Pig Raising	Sewage and Sewerage System	Impact on Environment (Ecology, Fishery, Forestry, Irrigation, Domestic Water Supply)
TRENGGANU STATE						CHUKAI Industrial Development Plan. Refer to "Trengganu Coastal Region Study" 1980.
KELANTAN STATE					A sewerage system will be recommended by "Kota Bharu Urban Development Study", which will be finalized in the middle of 1981, because of a possibility of breakout of epidemics during flood season.	Present shallow wells might be polluted by surface pollutant source in the future.

Table 59 PROJECTS ON THE SHELF

Project on the Shelf	Purpose	Location	Organization Concerned	Problems & Cause
Kangar Flood Mitigation	Flood mitigation for Kangar, Perlis river	Kangar City, Perlis State	DID Perlis & DID H.Q.	Land acquisition & resettlement
Tebrau Water Supply Barrage	Water supply for Johor Bahru	Tebrau River, Johor State	PWD Johor	Water is heavily polluted
Ulu Gombak Water Supply Dam	Water supply & flood mitigation	Gombak River, Selangor State	Selangor Water Works & PWD H.Q.	Land acquisition
Maran Barrage	Hydropower & flood mitigation	Pahang River, Pahang State	NEB & DID Pahang, H.Q.	Land acquisition & resettlement
Dabong (Galas) Dam	Flood mitigation, Hydropower & Irrigation	Kelantan River, Kelantan State	DID Kelantan, H.Q. & NEB	Land acquisition & resettlement

Table 60 CONSTRAINTS AND ISSUES AFFECTING IMPLEMENTATION OF PROPOSED HYDROPOWER PROJECT

Source: TH'NG YONG HUAT (AUG 1980) NEB

PROJECT NAME (Implementation Year Basin No, State)	PHYSICAL AND TECHNICAL CONSTRAINTS				ADVERSE RESERVOIR EFFECTS AND ISSUES					Remarks
	No Access to Project Sites	Location within 'Security Area'	Poor Foundation Condition	Scarcity of Data and Others	Loss of Potential Agricultural Land	Loss of Forestry Resources	Possible Loss of Mineral Resources	Submergence of Human Settlements	Adverse Effects on Ecology	
Ulu Trengganu (1988), Basin 36, Trengganu	(C) Significant			(C) Significant						Further site Study be scheduled at 1980/81
	↑ Future Access is impounded by Kenyir reservoir. The bridge piers be constructed by mid 1983.									
Pergau (1989) Basin 40, Kelantan	(B) Serious	(B) Serious								Additional site investigation required
Lebir (1990), Basin 40, Kelantan					(B) Serious	(B) Serious				Be delayed to 1990
					↑ Proposals are at hand to develop certain land schemes in the Catchment.					
Tembeling, (Possible in late 1980's), Basin 30, Pahang	(C) Significant	(C) Significant			(C) Significant	(B) Serious		(B) Serious	(B) Serious	Early Implementation be Recommended
Tekai & Penut, Basin 30, Pahang	(B) Serious			(C) Significant		(C) Significant				
Nenggiri, Basin 40, Kelantan	(B) Serious	(B) Serious	(B) Serious	(C) Significant		(C) Significant	(C) Significant			
Telom Hilir, Basin 30, Pahang										
Maran (Barrage), Basin 30, Pahang			(C) Significant		(B) Serious			(A) Insurmountable		
								↑ Rejected by the State		
Galas (Dabong), Basin 40, Kelantan		(C) Significant			(A) Insurmountable	(B) Serious	(C) Significant	(A) Insurmountable	(C) Significant	
					↑ Rejected by the State because of Land loss and Submergence of settlements					

NOTE: (A);Insurmountable (?) > (B); Serious > (C); Significant

Table 61 AVERAGE MONTHLY WHOLESALE PRICES AND PRICE INDICES AT KUALA LUMPUR, MALAYSIA

Period	Mild Steel Round Bars, 1/2" (M$/ton)	Index	Ordinary Portland Cement BS12 (M$/50 kg bag)	Index
Jan. 1975	710.87	100	5.28	100
Jan. 1976	656.77	92	5.28	100
Jan. 1977	656.00	92	5.28	100
Jan. 1978	656.05	92	5.28	100
Jan. 1979	657.41	92	5.28	100
Mar. 1979	723.27	102	5.38	102
June 1979	723.27	102	5.38	102
Sep. 1979	723.27	102	7.30	138
Jan. 1980	726.00	102	7.30	138
Mar. 1980	726.00	102	7.30	138
June 1980	804.00	113	7.30	138
Sep. 1980	804.00	113	7.30	138
Dec. 1980	804.00	113	8.20	155

Source; Average Monthly Wholesale Prices for Steel and Cement, Department of Statistics, Issues of Jan. 1975 - Dec. 1980

Table 62 AVERAGE YEARLY RATES AND PRICE INDICES OF PWD SMALL WORKS AT KUALA LUMPUR

Item	1975 - 1978 Rate M$	Unit	1979 Rate M$	1979 Index	1980 Rate M$	1980 Index
Skilled labour	14.40	8 hrs/day	20.80	144	24.75	172
Unskilled labour	7.80	8 hrs/day	10.00	128	13.00	167
Sand	4.50	cyd	5.00	111	7.00	156
Aggregates	13.10	cyd	18.00	137	21.60	165
Reinforced steel bars	0.37	lb	0.42	114	0.65	176
Cement	7.50	cwt	8.00	107	8.70	116
Nominal Simple Average	-	-	-	124	-	159

Remarks; The value of 1975 is assumed to be 100.

Table 63 STANDARD LAND MARKET VALUE AND CLASSIFICATION (1/3)

Land Use Classification	Land Market Value 10^3 M$/ha			
	Selangor	Federal Territory	Sembilan	Melaka
AGRICULTURAL LANDS				
a. Paddy Lands - Class I	44 - 49			
- Class II	12 - 25			
b. Rubber Lands - Class A	17 - 37		11 - 17	12 - 37
- Class B	7 - 17		5 - 11	9 - 15
c. Oil Palm Lands - Class A	17 - 37			
- Class B	7 - 17		10 - 12	
d. Orchard Lands - Class A				
- Class B				
e. General A	30 - 99	258 - 291		
B	17 - 49	49 - 74		
STATE LANDS				
a. Forest Reserve	(Generally $120 - $500/ha)			
b. Mining Lands				
OTHER RESERVE				
DEVELOPMENT LANDS - Class A				30 - 3633
- Class B				22 - 344
INDUSTRIAL LANDS				
URBAN LANDS - Commercial				108 - 1292
- Residential				108 - 344

Remarks; Classification of land market value:
Paddy Class I ; lands situated within irrigation scheme and are used for double cropping
Paddy Class II; lands line outside irrigation scheme and are used for single cropping
Village Land Class I ; lands with road frontage and with water and electricity supplies
Class II; interior lands with poor access
Class A ; lands with good access or road frontage
Class B ; lands with poor access or interior lands

Source; Property Market Report, Valuation Division, Ministry of Finance

Table 64 STANDARD LAND MARKET VALUE AND CLASSIFICATION (2/3)

Land Use Classification		Land Market Value 10^3 M$/ha			
		Perlis	Kedah	Pinang	Perak
AGRICULTURAL LANDS					
a. Paddy Lands	- Class I	14 - 18	(A) 16 - 46 (B) 13 - 29	10 - 25	
	- Class II	11 - 14	(A) 11 - 16 (B) 7 - 11	11 - 17	6 - 10
b. Rubber Lands	- Class A	5 - 11	14 - 36	10 - 25	7 - 44
	- Class B	5 - 7	6 - 18	9 - 15	5 - 25
c. Oil Palm Lands	- Class A		16 - 20	20	10 - 25
	- Class B		13 - 14	15	7 - 17
d. Orchard Lands	- Class A			10 - 30	
	- Class B			12 - 37	
e. Coconut				17 - 25	
STATE LANDS					
a. Forest Reserve					
b. Mining Lands					
OTHER RESERVE					
DEVELOPMENT LANDS	- Class A	71 - 107			
	- Class B	54 - 71			
INDUSTRIAL LANDS					
URBAN LANDS	- Commercial				
	- Residential				
VILLAGE LANDS	- Class I	36 - 54			
	- Class II	18 - 32			

Table 65 STANDARD LAND MARKET VALUE AND CLASSIFICATION (3/3)

Land Use Classification		Land Market Value 10^3 M$/ha			
		Johor	Pahang	Trengganu	Kelantan
AGRICULTURAL LANDS				No Land Information	
a. Paddy Lands	- Class I				5 - 20
	- Class II				
b. Rubber Lands	- Class A	10 - 25			7 - 11
	- Class B	4 - 15	4 - 11		
c. Oil Palm Lands	- Class A	11 - 20			
	- Class B	10 - 12	15		
d. Orchard Lands	- Class A	17 - 49			4 - 20
	- Class B				
e. General A			11 - 49		
B			5 - 10		
STATE LANDS					
a. Forest Reserve					
b. Mining Lands					
OTHER RESERVE					
DEVELOPMENT LANDS	- Class A				
	- Class B				
INDUSTRIAL LANDS					
URBAN LANDS	- Commercial				
	- Residential				
VILLAGE LANDS	- Class I				
	- Class II	4 - 6			

Table 66 ACTUAL LAND ACQUISITION COST OF DAM PROJECT

Dam Project	Price Level	Acquisition Cost
PULAU PINANG STATE		
(1) Sungai Mengkuang Dam Project, water supply, PWA	Acquisition is ongoing end 1980	i) Forest M$4,380/acre (M$10,800/ha) - ii) Town M$39,300/acre (M$97,000/ha)
(2) Sungai Perai Barrage Project, DID	Paid in 1979	i) Acquired land including state land = 99.811 acre, Average M$20,772/acre (M$51,307/ha) ii) Resettlement of squatters M$450,790 for 78 families iii) Expenditure by State & Section 8 of Land Code: M$1,151,942 for 335.05 acres; M$3,438/acre (M$8,492/ha)
KEDAH STATE		
DID General Information	1980	i) Rubber land: M$5,000/acre (M$12,400/ha) - M$6,000/acre (M$14,800/ha) ii) Paddy: Isolated M$4,000/acre (M$9,900/ha) - Close to the main roads M$10,000/acre (M$24,700/ha) iii) Paddy within MADA area M$8,000/acre (M$19,800/ha)
JOHOR STATE		
(1) Machap Dam, Flood Mitigation, DID	Application for land acquisition in 1976	Total area acquired 1,400 acre (5.67 km^2) M$6,430/acre (M$15,880/ha)
(2) DID General Information	1980	i) Oil palm: M$4,000 - 5,000/acre (M$9,880 - 12,400/ha) ii) Rubber : M$3,000 - 4,000/acre (M$7,410 - 9,880/ha) iii) Village area: M$15,000/acre (M$37,050/ha)

FIGURES

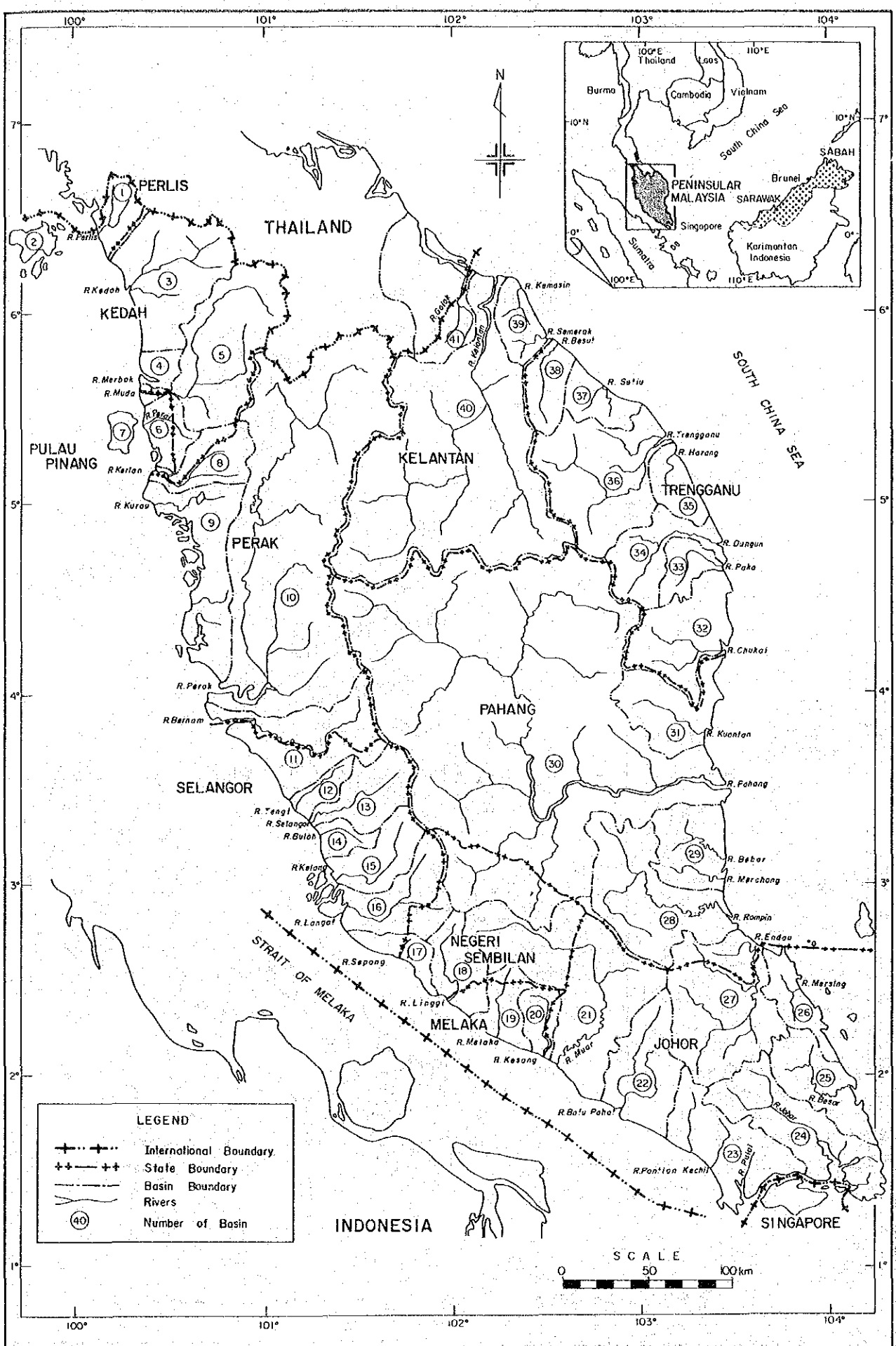

Fig. 1 Basin Division

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY MALAYSIA
JAPAN INTERNATIONAL COOPERATION AGENCY

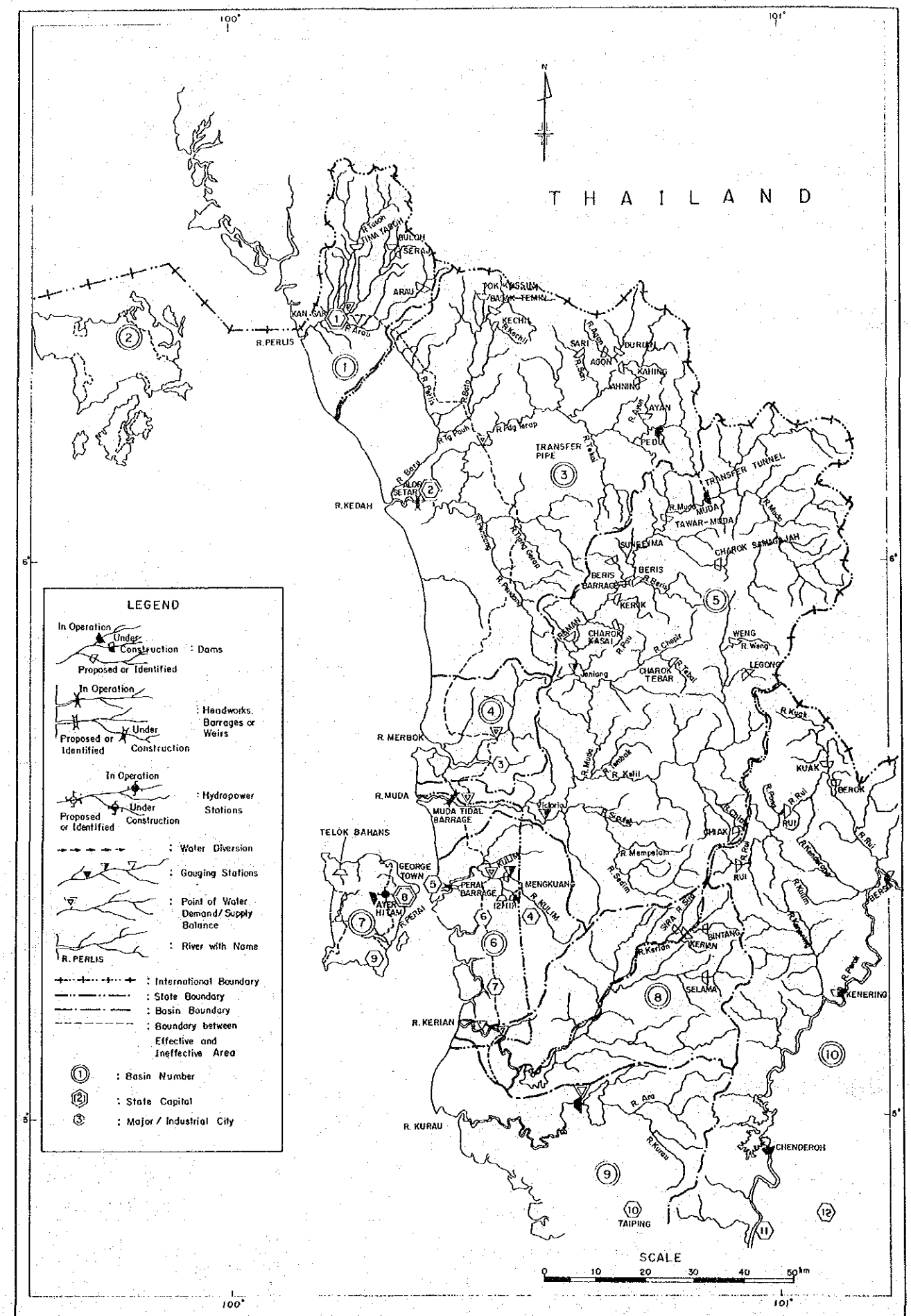

Fig. 2 Existing / Under Construction / Potential Dam Sites and Basins 1 – 7

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY MALAYSIA
JAPAN INTERNATIONAL COOPERATION AGENCY

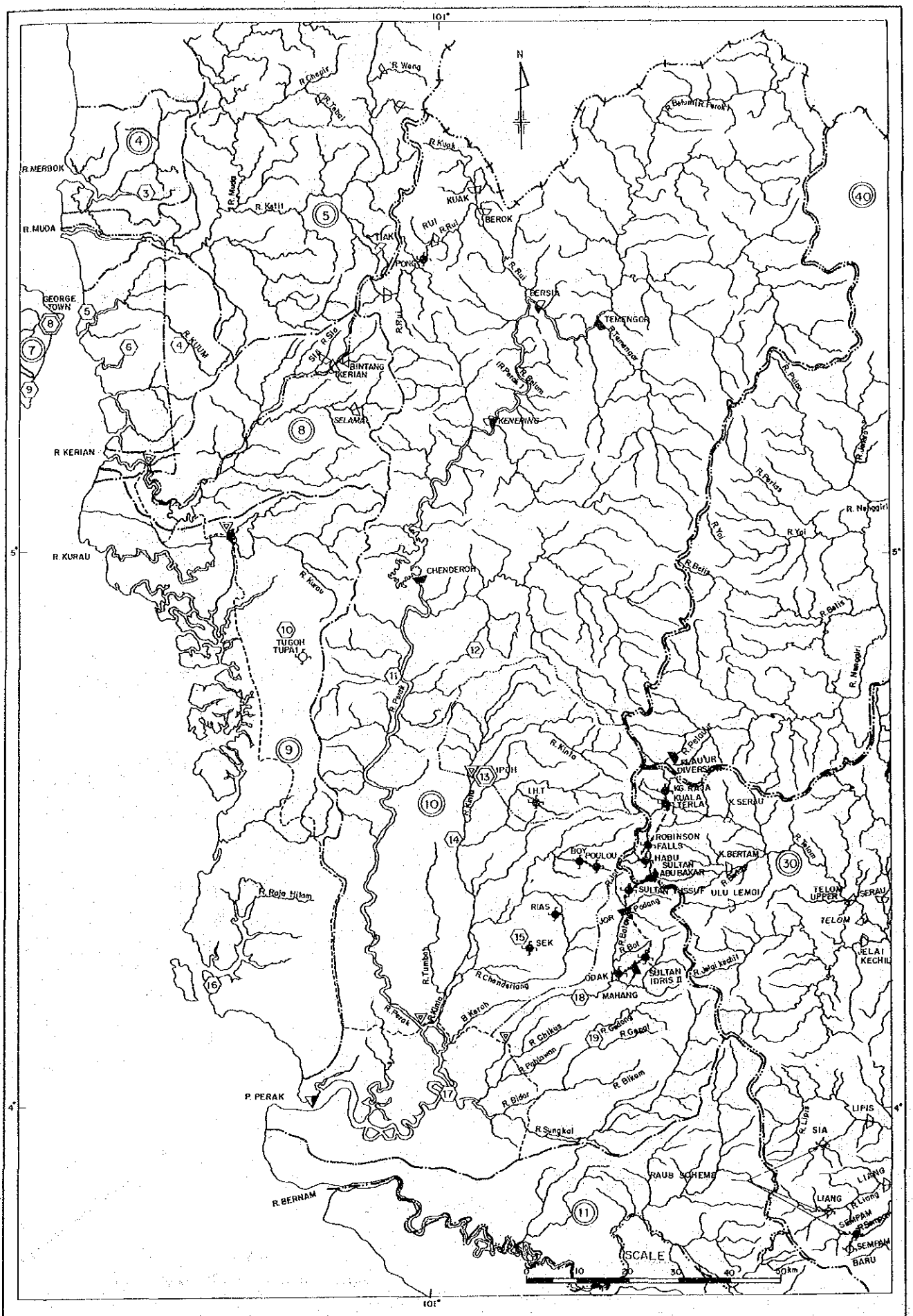

Fig 3 Existing/Under Construction/ Potential Dam Sites and Basins 8-10

GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY MALAYSIA

JAPAN INTERNATIONAL COOPERATION AGENCY

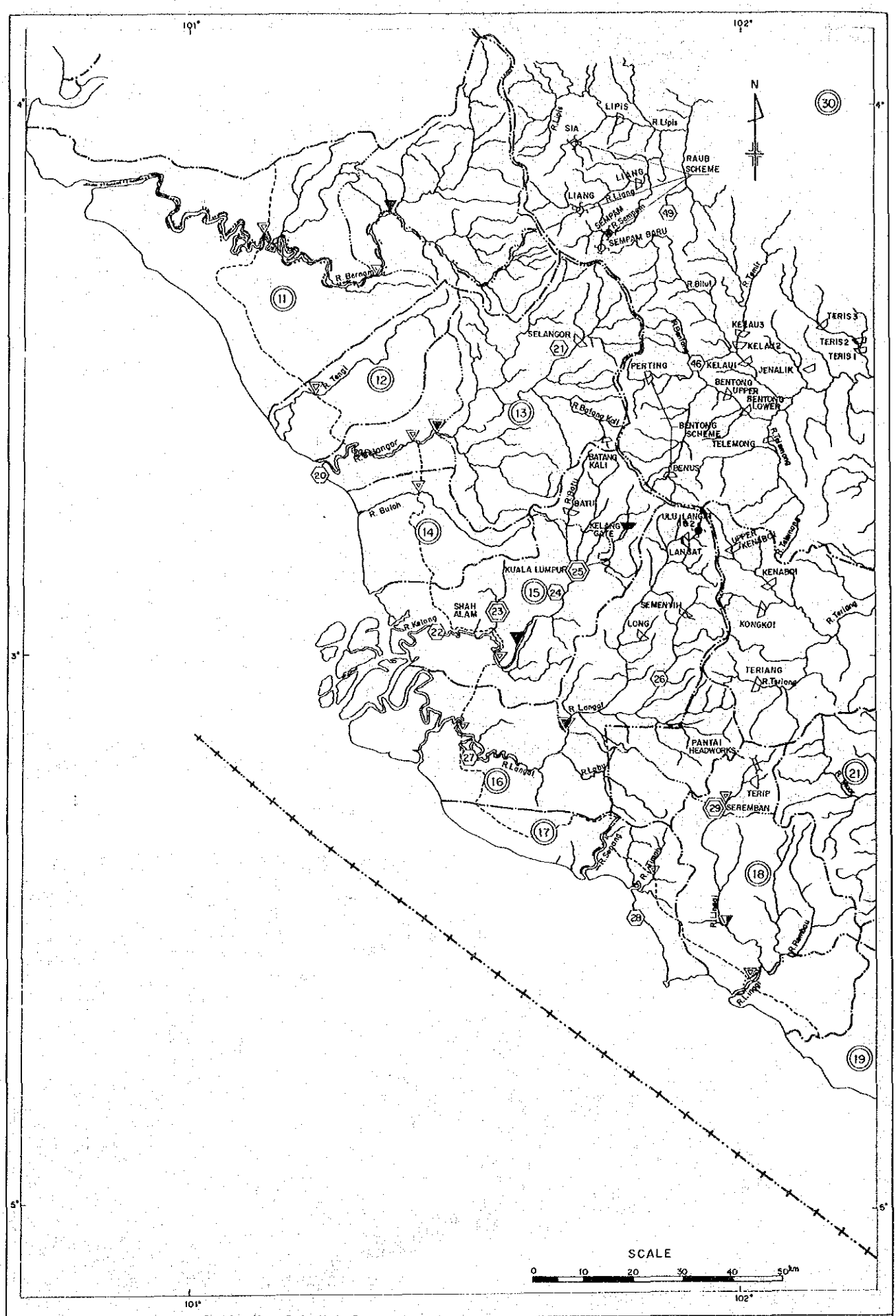

Fig. 4 Existing Under Construction Potential Dam Sites and Basins 11-18

GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY MALAYSIA

JAPAN INTERNATIONAL COOPERATION AGENCY

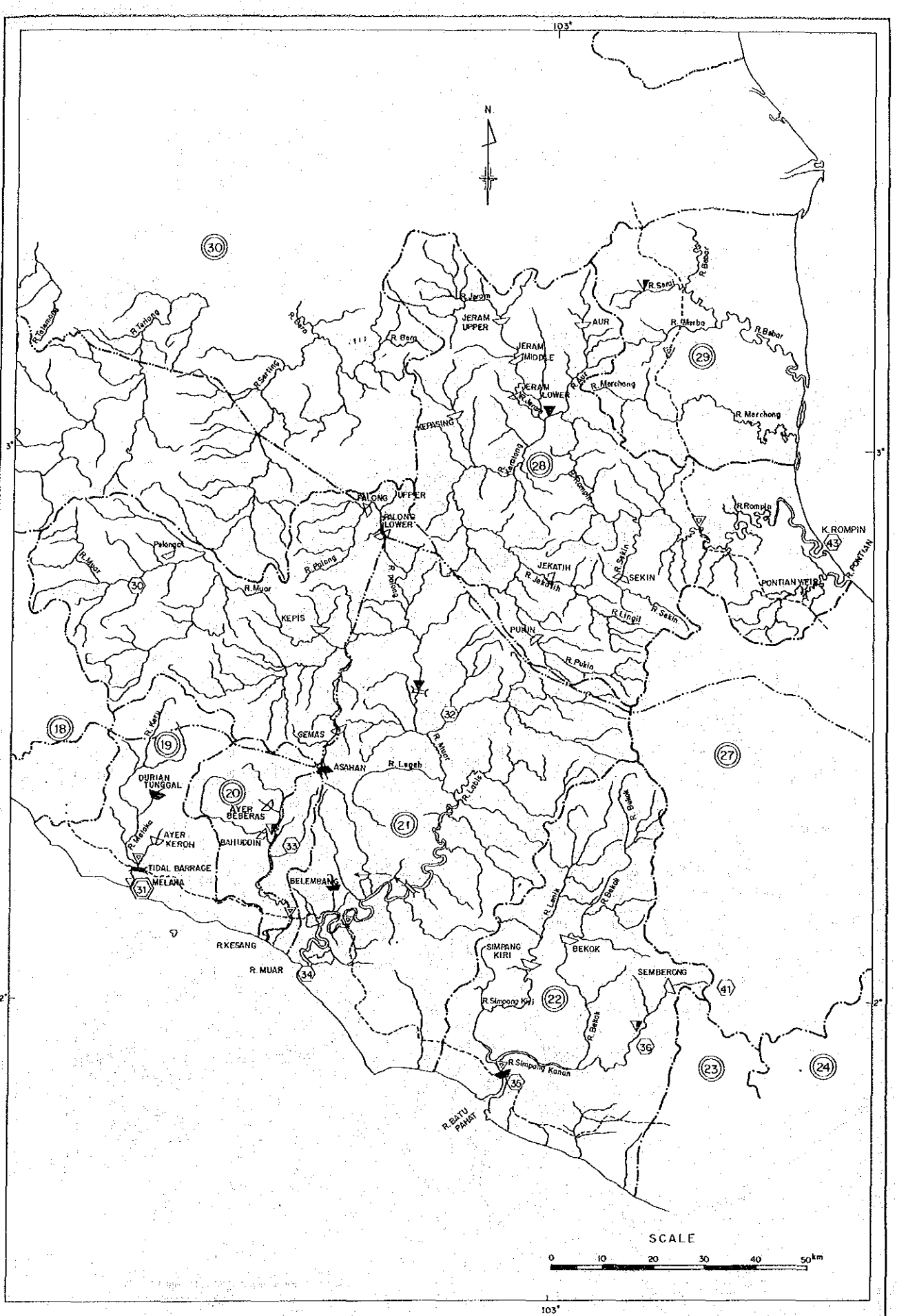

Fig 5 Existing / Under Construction / Potential Dam Sites and Basins 19-22, 28 and 29

GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY MALAYSIA

JAPAN INTERNATIONAL COOPERATION AGENCY

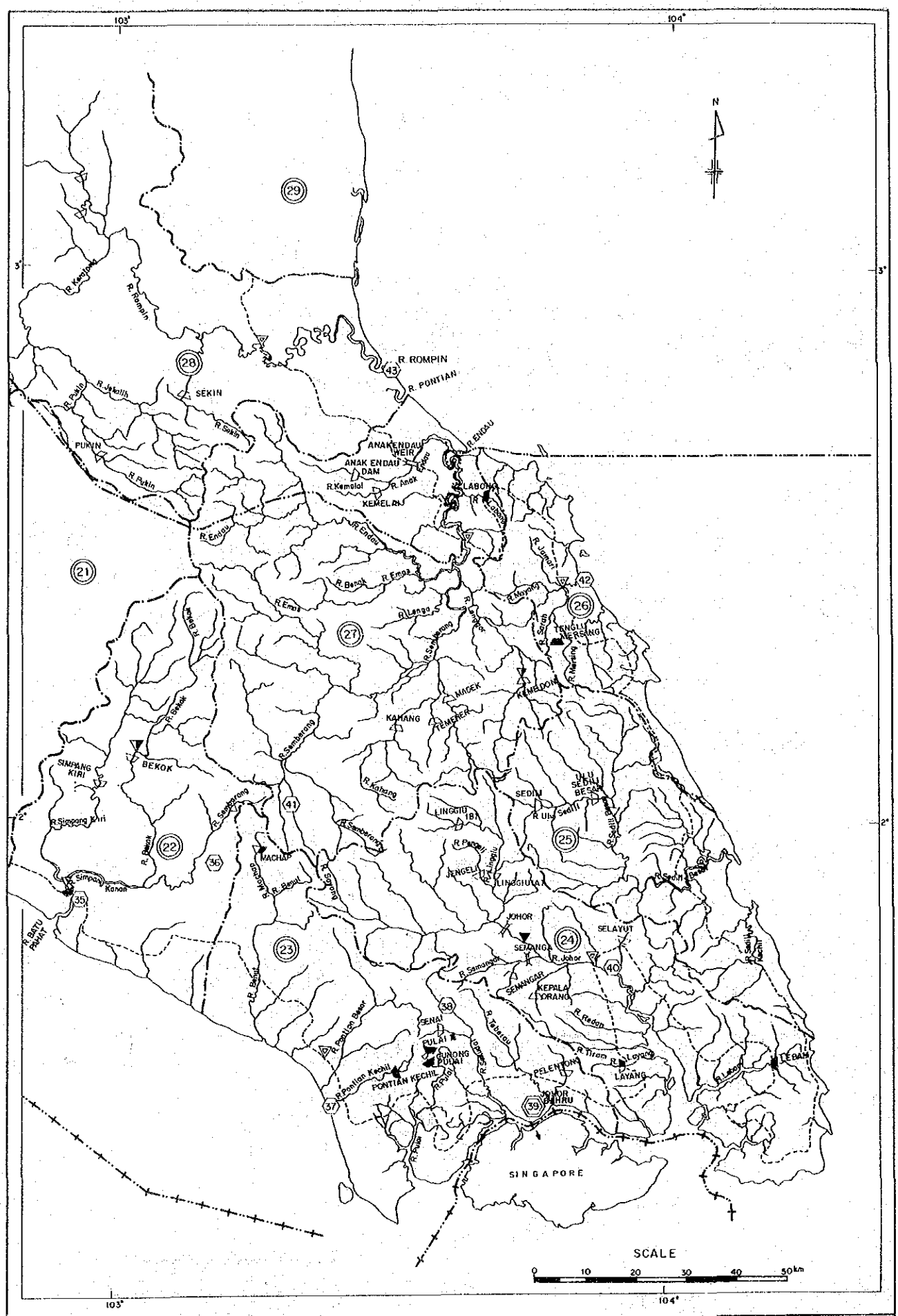

Fig. 6 Existing/Under Construction/Potential Dam Sites and Basins 23-27

GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY MALAYSIA

JAPAN INTERNATIONAL COOPERATION AGENCY

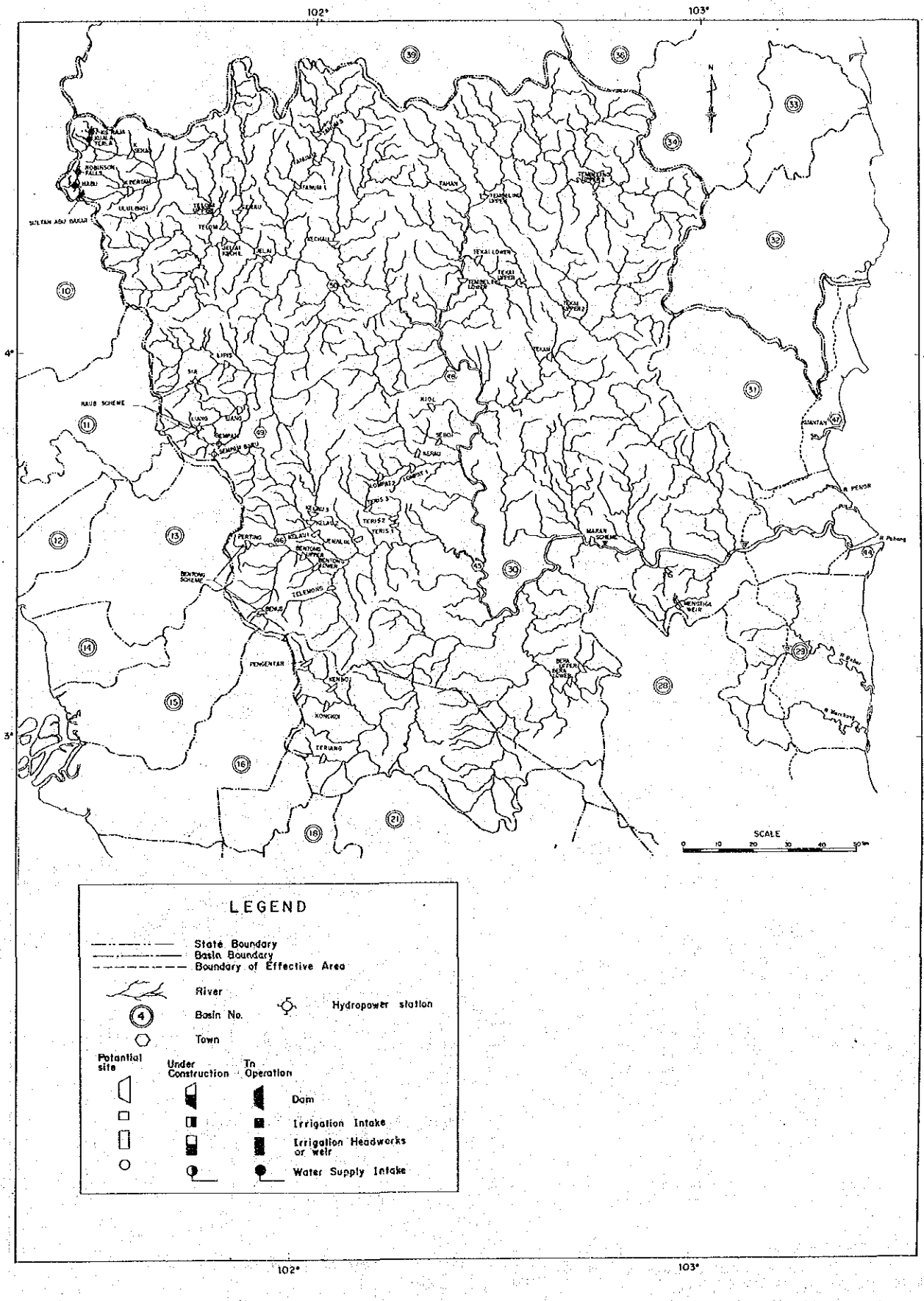

Fig. 7 Location of Potential and Proposed Water Source Facilities, Alternative B1

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY MALAYSIA
JAPAN INTERNATIONAL COOPERATION AGENCY

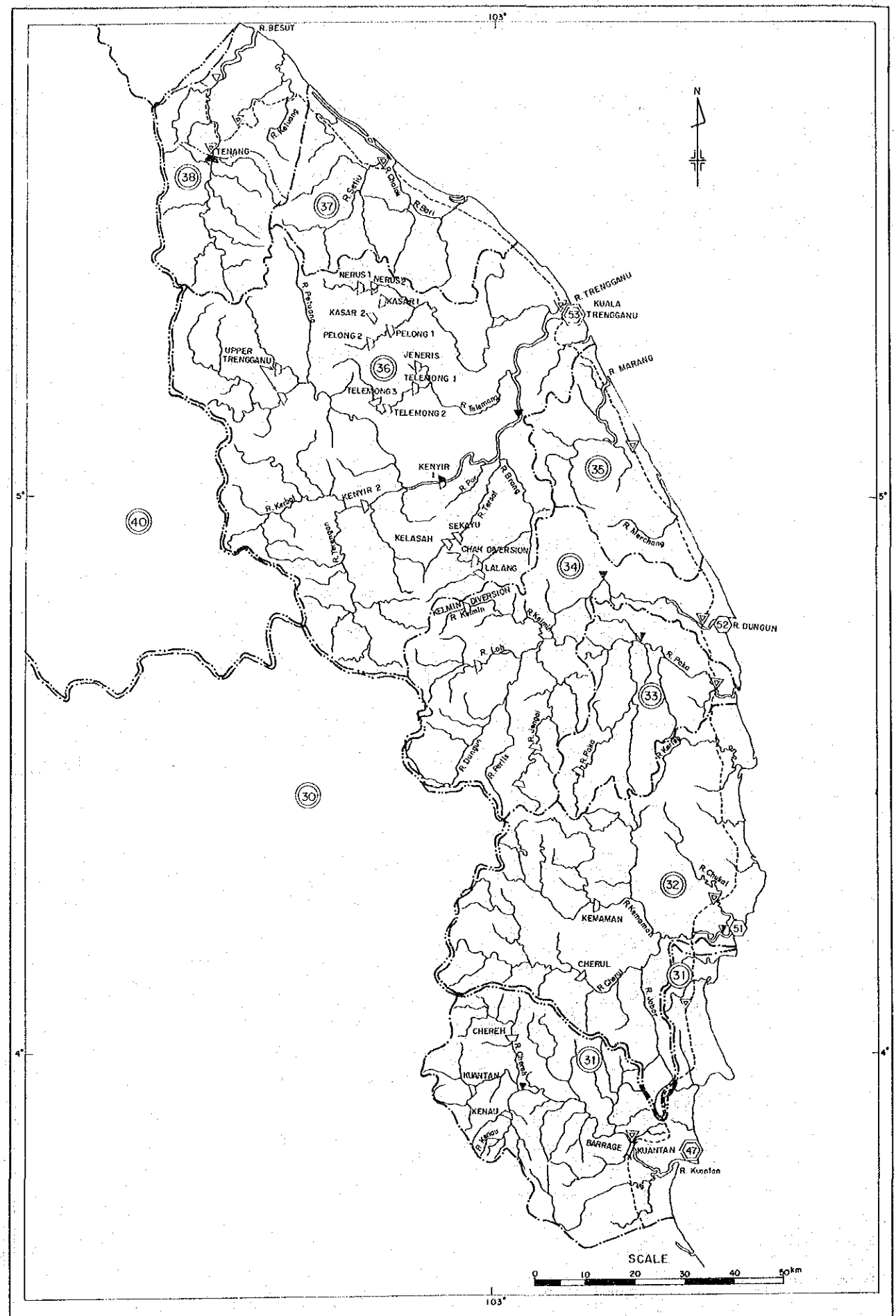

Fig. 8 Existing / Under Construction / Potential Dam Sites and Basins 31 – 38

GOVERNMENT OF MALAYSIA
NATIONAL WATER RESOURCES STUDY MALAYSIA
JAPAN INTERNATIONAL COOPERATION AGENCY

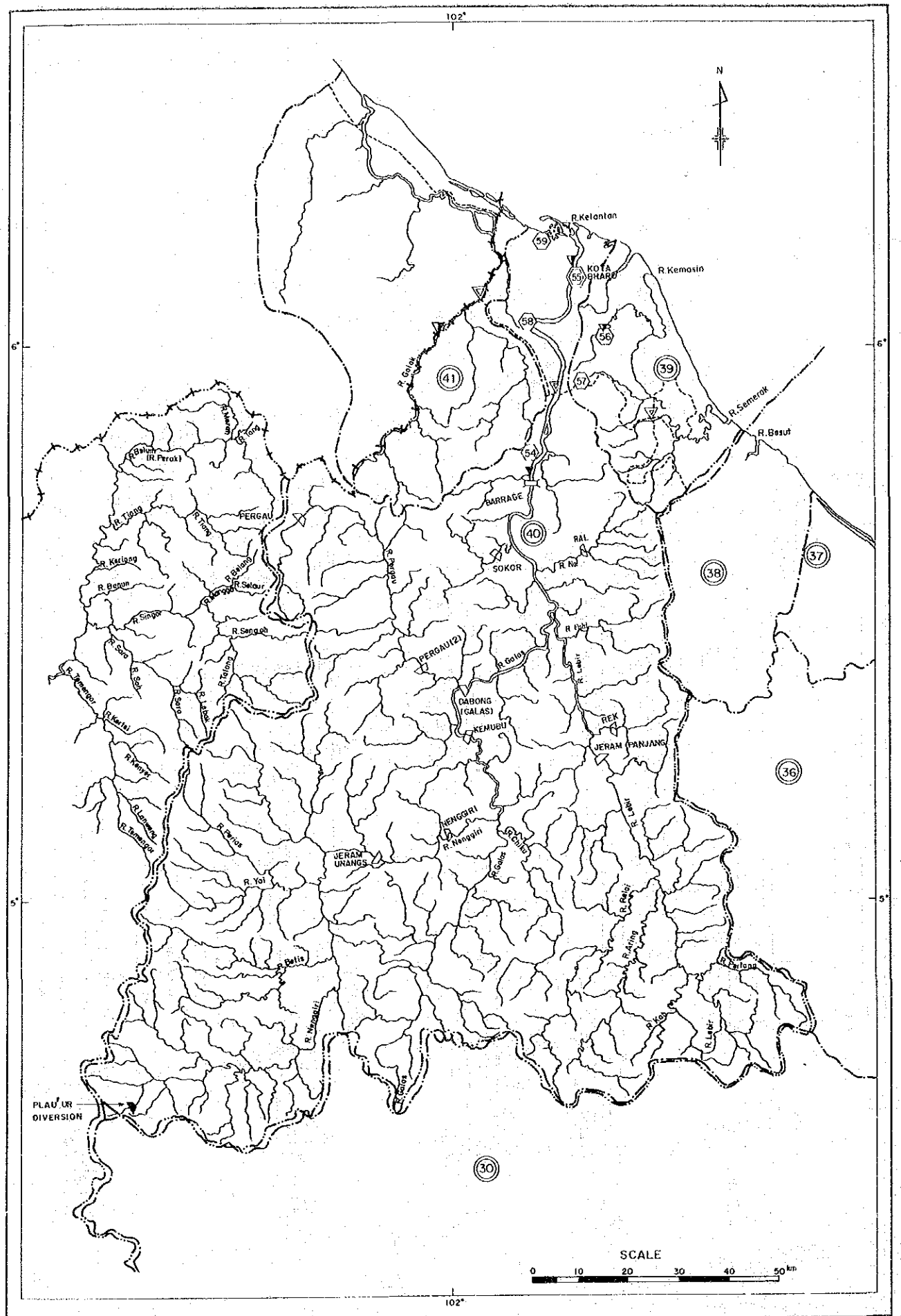

Fig. 9 Existing / Under Construction / Potential Dam Sites and Basins 39 – 41

GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY MALAYSIA

JAPAN INTERNATIONAL COOPERATION AGENCY

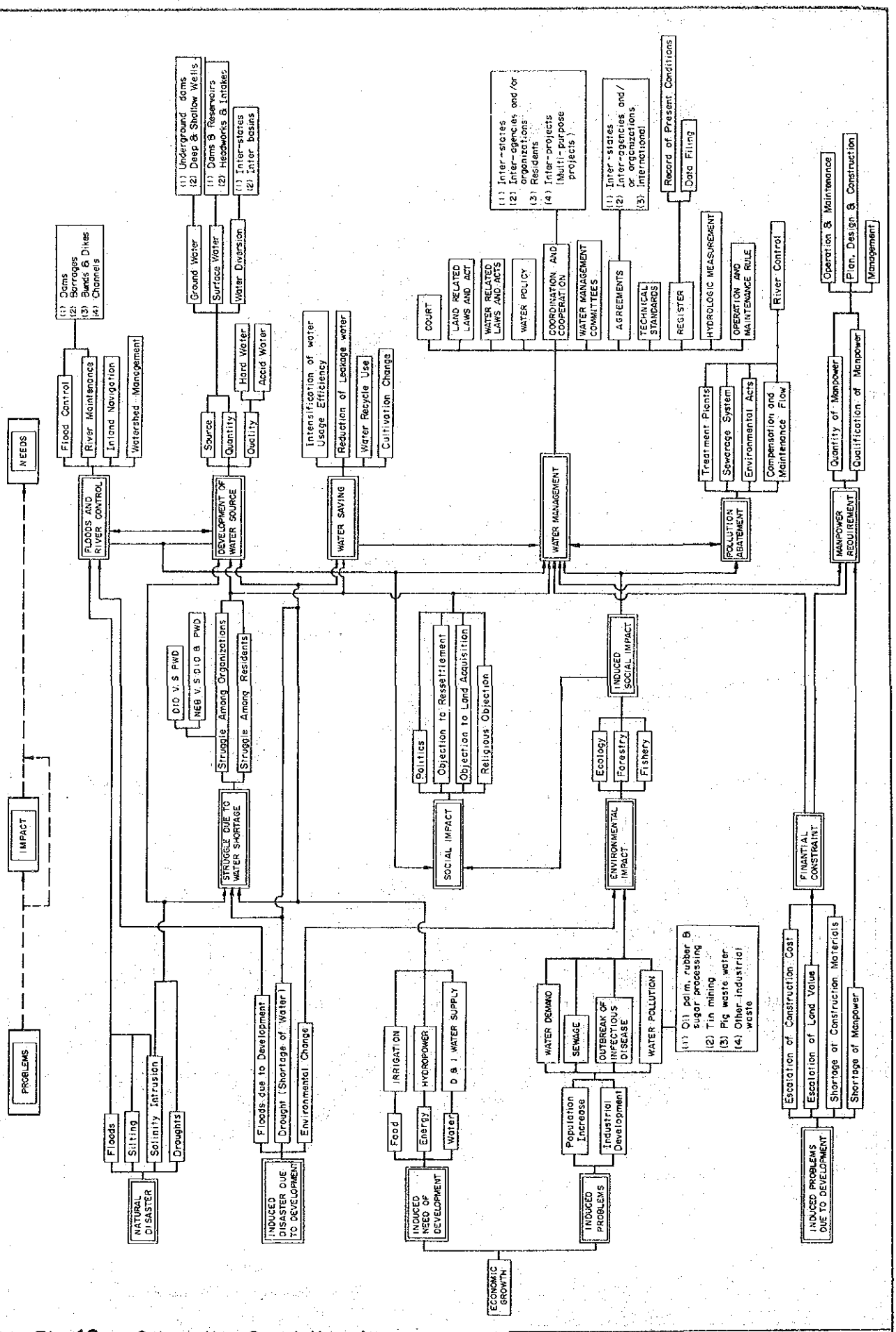

Fig. 10 Schematic Correlation Among Problems & Needs in water Resources Deveropment.

GOVERNMENT OF MALAYSIA

NATIONAL WATER RESOURCES STUDY MALAYSIA

JAPAN INTERNATIONAL COOPERATION AGENCY

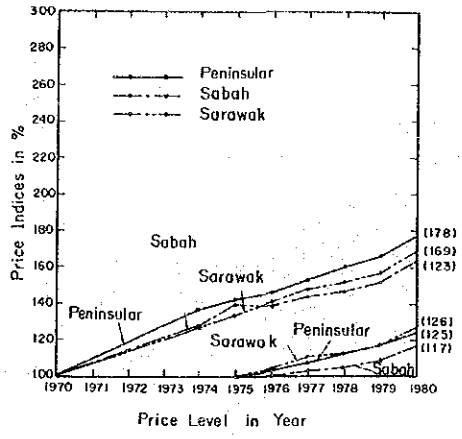

Fig. 11 Consumer Price Indices of Malaysia

source : Economic Report 1980~81, Ministry of Finance

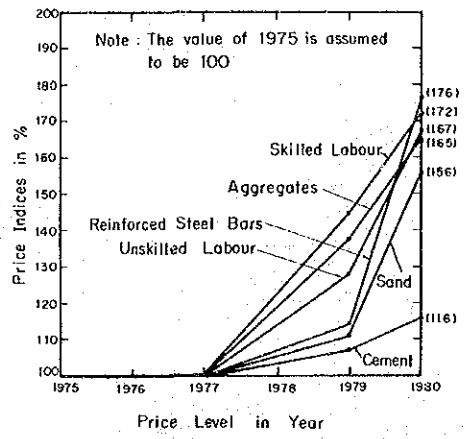

Fig. 12 Price Indices of Labour and Construction Materials

PART 2

SABAH AND SARAWAK

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The objective of the secor of Water Resources Engineering is to clarify the present conditions of the major water resources facilities which include dams and reservoirs, headworks, barrages and weirs, to review the ongoing or proposed short-term and long-term water resources development and use plans, and finally to establish the long-term water resources development and use alternative plans for the target years 1990 and 2000.

This report presents only the results of the field survey done in Sabah and Sarawak from August 19, 1981 to December 25, 1981. The methodology and results of the water source and hydropower development plans are presented in the Sectoral Report Vol. 16; WATER SOURCE AND HYDROPOWER DEVELOPMENT PLANNING.

Chapter 2 presents first the definition of the theoretical region for water resources development (i.e. Basin). Chapter 3 compiles the survey results of the present conditions of dams, reservoirs and hydropower stations and potential dam sites. Chapter 4 compiles the results of interview survey with regard to the present and anticipated problems and needs in water resources development and use. Chapter 5 presents the survey results of construction materials.

2. BASIN DIVISION

BASIN

The States of Sabah and Sarawak were divided into 47 divisions of "Basins" for the purpose of engineering study. Sabah was divided into 26 Basins and Sarawak was divided into 21 Basins. The Basin number, the name of Basin, the catchment area of each Basin are shown in Table 1. These Basins are shown in Fig. 1. The administrative divisions of the two States are shown in Fig. 2.

The Basin boundaries were delineated and the catchment area was measured on the map of 1/500,000 scale based on the following criteria:

(1) The Basin boundary is washershed,

(2) Each Basin is a river system or a group of river systems,

(3) If an international boundary crosses a river basin, it is adopted as a Basin boundary.

In most cases, the Basin boundary coincides with the administrative boundary of Residency, Division and or District.

EFFECTIVE AREA OF BASIN

An area of a Basin of which surface water can be practically used for the purpose of domestic and industrial water supply and irrigation schemes is defined as 'Effective Area' in this study. That is, the Basin catchment was divided into effective and ineffective areas. The border between effective and ineffective area is denoted as a broken line (--------) in Figs. 3 to 13. It is assumed that no intrusion of sea water was observed in the upstream of the border. This line was drawn based on the information from DID and PWD and study reports. The effective area is shown in Table 1.

The assumed definition of the border line is more precisely as follows:

(1) The upstream catchment from the lowest end sites of dams, headworks, barrages or intakes for irrigation, water supply and/or hydropower be effective.

(2) The area of the large scale irrigation schemes of which the return flow cannot be used, for example the flow which is planned to be directly discharged to the sea, be ineffective.

(3) The area of the drainage schemes of which the return flow can not be used depending on the direction of drainage channels, the location of rivers and the topography be ineffective.

(4) The swamp area of which discharge cannot be used because of inadequacy of water quality and/or topographic conditions be ineffective.

(5) If the area is fallen outside the above mentioned four categories and is located within 5 km along the coastal line is fallen outside the above-mentioned four categories be ineffective.

3. PRESENT CONDITIONS OF USAGE OF WATER RESOURCES

3.1 Present Conditions of Usage of Water Resources

Present usage and future needs of water resources were surveyed from the beginning of October to the end of November, 1981. The study reports, papers and verbal information, which were obtained from PWD, DID, SEB, SESCO and related statutory bodies, consultants and contractors in Sabah and Sarawak, were arranged and examined. In the States of Sabah and Sarawak the usage or needs of water resources can be classified into the following major four categories:

(1) Domestic and industrial water supply (treated water)

  (a) Surface water (river water)

  (b) Groundwater

    - Dug well
    - Tube well (bore hole); shallow or deep

  (c) Rainfall storage

(2) Community water supply (non-treated water)

  (a) Gravity water (creek water)

  (b) Shallow well (dug well)

(3) Irrigation water (non-treated water)

  (a) Surface water (river water)

  (b) Groundwater

  (c) Pond

(4) Hydropower generation (potential energy of water)

  (a) Major hydropower (storage or run-of-river)

  (b) Mini hydropower

The domestic and industrial water supply has been done by PWD and Water Board and treated or semi-treated water is supplied by organized pipeline systems. The Shell Corporation exceptionally supplies treated water to the employees and the residents in Miri urban area. The community water supply has been done for the residents in remoted rural area under the guidance by MOH. The survey results of the present water sources of the domestic and industrial water supply are listed in Tables 2 - 4 for the major 13 towns in Sabah and Table 5 for the major 7 towns in Sarawak. The sites of the present intakes and the route of trank

mains are schematically shown in Figs. 3 to 7 for Sabah and Figs. 8 to 13 for Sarawak.

Shortage of domestic and industrial water supply was experienced several times in the past in several towns in both Sabah and Sarawak. The conditions of shortage, however, have been improved by the extension works or it will be solved by the ongoing short-term development programs within several years. The shortage was mainly caused by shortage of supply capacity of existing water supply facilities. Surface water resources is abandant in Sabah and Sarawak except Sandakan and Labuan in Sabah and the remoted coastal area in Sarawak. In Sandakan and Labuan not only the capacity of supply facilities but also the yield capacity of both surface and underground water source is going to be short. Water shortage in the coastal rural area is very serious and the area is called as Drough Prone Area. Drastic measures are necessary to be executed for the area.

No groundwater has been used in the existing PWD water supply system in Sarawak. In Sabah groundwater has been developed well. Shallow wells are in operation in Semporna and Kota Belud. Deep bore hole wells are in operation in Labuan, Sandakan and Kuala Penyu.

The major irrigation scheme is under the control of DID. There are 20 major sites of intakes and headworks of irrigation schemes in Sabah and 8 sites in Sarawak. The only one inter-state water usage is observed at the boundary between Sabah and Sarawak. In the Merapok irrigation area, an irrigation intake is located in the Mengalong river in Basin 26 in Sabah and water is pumped and diverted to the irrigation area in Basin 27 in Sarawak.

No hydropower generation has been operated both in Sabah and Sarawak at the end of November, 1981, but the Tenom Pangi hydropower generation project in Sabah and the Batang Ai hydropower generation project in Sarawak are just under construction. The date of commission of the Tenom Pangi project is scheduled to be 1984 and that of the Batan Ai is scheduled to be 1985. The major features of the two projects are shown in Tables 6 and 7 respectively.

As for storage dams, no dams are operated both in Sabah and Sarawak. There is only one rain storage earthfill dam for water supply which was constructed about 10 years ago in Kudat in Sabah and there are two rain storage reservoirs at the Matang water supply scheme in Kuching in Sarawak. The Timbangan concrete dam which aims water supply to Semporna in Basin 218 and the Sepagaya concrete dam which aims water supply to Lahad Datu in Basin 219 are under construction in Sabah. The Sika earth dams which aims water supply to Bintulu in Basin 236 is under construction in Sarawak. The date of commission and the major features of these dams are shown in Tables 6 and 7. All the location of the above-mentioned water source facilities are shown in Figs. 3 to 7 for Sabah and Figs. 8 to 13 for Sarawak.

3.2 Future Conditions of Usage of Water Resources

The future conditions of water resources are also briefly reported in Tables 2 - 4 for the major 13 towns in Sabah and Table 5 for the major 7 towns in Sarawak. Water supply system of inter-basin (river) water usage are under planning stage, under design stage or under construction in the area, where high water demand was projected in the near future by PWD, such as Kota Kinabalu, Labuan, Sandakan, Semporna, Lahat Datu in Sabah. In Sarawak it is considered by PWD and Water Boards that surface water source is still abundant in the future except the rural area along the coast.

Immediate measures were required in Labuan and Sandakan. Three small storage dams (Bukit Kuda, Kerupang and Pagar) were under design stage for Labuan water supply and the feasibility study on the alternative surface water source for Sandakan water supply, which will be the Melian dam site or the Kinabatangan intake site, are ongoing. The major features of these sites are shown in Table 6.

As for hydropower generation, the three hydropower sites at the Sook river, the Papar river and the Kinabatangan river were identified as the sites having high priority in Sabah. The two hydropower sites of RAJA 284 (or Midi Pelagus) and Balu 037 are under feasibility study (Ref. SP 9) in Sarawak. The major features of these sites are shown in Tables 6 and 7.

In Sabah, ten mini-hydropower schemes of which installed capacity is less than 1,000 kW are under design stage and two schemes are under feasibility stage. The project name and installed capacity is shown in Table 8. The 10 selected mini-hydropower sites in Sarawak are listed in Table 9.

The location of these hydropower and mini-hydropower sites are shown in Figs. 3 to 13.

3.3 Mean Annual Rainfall and Runoff

The rainfall and surface runoff are shown in Table 10 by Basin (see detail in the Sectoral Report Meteorology and Hydrology). The balance of rainfall and runoff in Sabah and Sarawak is estimated by annual basis as follows:

	Catchment Area (km^2)	Rainfall (10^9 m^3/y)	Surface Runoff (10^9 m^3/y)
Sabah	72,850	194.05 (100%)	112.76 (58%)
Sarawak	124,449	477.35 (100%)	306.15 (64%)
Total	197,299	671.40 (100%)	418.91 (62%)

3.4 Potential Dam Sites and Hydropower Sites

Potential dam sites of 80 in Sabah and 30 in Sarawak were examined in the map of 1:50,000 scale. The 155 hydropower potential sites in Basins 29, 30 and 41, which were identified in the master plan of power system development prepared by SESCO (Ref. 9), are not included in the number. The catchment area of these sites is from 20 to 5,100 km^2. The location is shown in Figs. 3 to 13.

Though the potential hydropower has not been evaluated comprehensively yet in Sabah, SEB evaluated that of 12 Major Sites listed in Table 11. It was evaluated by SESCO and the German Agency for Technical Cooperation Ltd. in Sarawak in 1981 (Ref. 9).

In the master plan study a total of 155 dam sites with an installed capacity of more than 50 MW each and a combined capacity of roughly 80,000 MW (for a plant factor of 50%) were identified in Sarawak. Out of the 155 sites 51 mutually independent sites were assessed to be able to be constructed. Their combined installed capacity at a plant factor of 0.5 and annual generation were estimated to be 20,000 MW and 87,000 GWh, respectively. More than 90% of the generation is estimated to be firm. The best 11 sites were selected for detailed study and finally the Raja 284 (770 MW), Balu 037 (2,580 MW), Muro 040 (940 MW) and Bela 010 (260 MW) sites were proposed in the final report. The major features of the 4 sites are shown in Table 12. The Raja 284 (Midi Pelagus) site and the Balu 037 site were selected for the feasibility study as the most attractive sites.

4. PROBLEMS AND NEEDS

4.1 Problems and Needs in Sabah and Sarawak

The interview survey on the present and anticipated problems and needs with regard to water resources development was done at the state PWD, DID, SEB, SESCO and Water Board from the middle of October to the end of October, 1981.

The problems and needs in the State of Sabah and the State of Sarawak would be classified as a type of developing society because of their low population density and huge potential surface water resources, while Peninsular Malaysia would be classified as a type of urbanized society which reflected the influence of the rapid progress of the development from the middle of 1970's.

The interview was done for the items listed below. Figure 14 shows mutual correlation among the problems and needs in water resources development. The results are compiled separately for each State in Section 4.2.

(1) Water shortage and induced problems

  (a) Irrigation (DID) v.s. water supply (PWD)

  (b) Hydropower v.s. irrigation and water supply

  (c) Problems among residents

(2) Water management

  (a) Agreement (inter-states and inter-agencies)

  (b) Resister of water usage and water related facilities

  (c) Water management committees

  (d) Problems associated with multi-purpose development

  (e) Operation and maintenance

  (f) River maintenance flow

(3) Flood and river control

  (a) Flood

  (b) Silting

  (c) Salinity intrusion

(d) Drought

(e) Watershed management

(4) Quality of water resources

(a) Acid water

(b) Hard water

(5) Water pollution and environmental impact

(a) Oil palm, rubber and sugar processing

(b) Mining

(c) Pig waste water

(d) Sewage and sewerage systems

(e) Impacts on environment (ecology, fishery, forestry, irrigation and domestic water usages)

(f) Monitoring water quality

(6) Water resources development plans and needs

(a) Surface water

(b) Ground water

(c) Development plans and needs (irrigation, flood mitigation and river control, hydropower, and water supply)

(d) Demand projection

(7) Water saving measures

(a) Intensification of water usage efficiency

(b) Reduction of leakage water

(c) Water recycle use

(d) Cultivation change

(8) Problems associated with project implementation

(a) Land acquisition and resettlement

(b) Compensation cost (land value and resettlement cost)

(c) Society, politics, government

(d) Budgeting

(e) Water rate

(f) Construction cost and materials

(9) Manpower requirement

(a) Quantity of manpower

(b) Qualification of manpower

More details and further information are presented in respective Sectoral Reports. For example, the flood and river control is in RIVER CONDITIONS, water management in WATER MANAGEMENT, water pollution and environmental impact in WATER QUALITY and water supply in DOMESTIC AND INDUSTRIAL WATER SUPPLY.

4.2 Results of State Interview Survey

4.2.1 Outline of the interview survey

(1) Water shortage and induced problems

River runoff is large enough both in Sabah and Sarawak except in Sandakan, Labuan and the coastal rural area in Sarawak. Shortage of water supply was experienced but it was caused by insufficiency of supply capacity of facilities. For example, Kota Kinabalu, Sandakan, Labuan, Tawau, Lahad Datu, Semporna, Beaufort and Kota Beludu still have shortage problems but the condition is going to be improved by the extension programs. Water supply time or pressure is controlled daily in Sandakan, Labuan, Tawau, Beaufort and Kota Beludu. The condition of Labuan and Sandakan is recognized to be serious by the officials.

The shortage of drinking water is very serious in the coastal rural area and cholera breaks out in dry spell mostly every year. A piped water supply is considered to be physically and economically impossible by the officials and rainfall collection by roofing and groundwater development are going to be experimented as a drastic measures for this area.

Water shortage was also experienced in some irrigation schemes of double cropping in drought period in Sabah.

(2) Water management

The coordination of river water usage has been made between DID and PWD both in Sabah and Sarawak, but written agreements or documented rules were not made among departments or agencies. However, the single authorized body which is responsible for the comprehensive management of river water usage and watershed both in urban and rural area is recognized to be established by the officials in Sabah.

Problems of inter-state and international water usage were not experienced in the East Malaysia, through there is only one inter-state irrigation water usage in the state boundary between Sabah and Sarawak. Thus no coordination was made between the two states and among Malaysia, Indonesia and Brunei.

Problems with regard to multi-purpose large dam projects were not experienced because no large dams are in operation both in Sabah and Sarawak, though 2 hydropower projects are under construction.

PWD supplies fully treated or semi-treated water to the urban and rural towns by organized pipeline systems. The community water supply of untreated gravity water has been supplied to the residents in the remoted rural area under guidance by MOH. The rural water supply is sometimes conducted by the joint venture with PWD and MOH.

The shell corporation has own water supply system in Miri. It is completely independent on PWD and the ordinance.

(3) Flood and river control

Flood damage is generally not quite serious both in urban and rural area in Sabah and Sarawak except in the residential area in Kota Kinabalu, Beaufort and Tawau because large rivers does not across towns. Loss of life is very rare. Flood mapping, flood prone zoning and recording of flood damage have not been made yet. Town flood is generally caused by poor drainage systems.

In Sabah, the urban and town drainage is under the responsibility of PWD as a part of town planning while DID is responsible for the rural agricultural drainage. In Sarawak, DID executes the urban drainage project as a part of flood mitigation measures.

There is no flood forecasting systems both in Sabah and Sarawak, but the first pilot schemes will be started in the Kinabatangan river in Sabah and the Sadong river in Sarawak from 1982.

Silting causes no problem except at intake sites in Sabah. It is reported in the Sadong, Lupar, Baram and Miri rivers in Sarawak. Bank erosion is notable in the Rajang and Sadong rivers.

Tidal effect is not so serious in Sabah but is very serious in Sarawak. Salinity intrusion was experienced at only two intakes, Lahad Datu and Papar in dry spell in Sabah. In Sarawak it has been experienced in the drought from June to July at most PWD intakes, such as Sarikei, Balingian, Binatang, Daro, Matu Dalat, Igan, Kut, Muka, Tatau, Kuala Tatau, Awat Awat and Kuala Lawas.

(4) Quality of water resources

Quality of surface (river) water is usually good both in Sabah and Sarawak except in the peat swamp area in the Sarawak coastal line. The quality of creek water is quite satisfactory for the community water

supply in the mountain area in Sarawak. Water in the peat swamp contains sulfur. Iron contents of groundwater is high both in Sabah and Sarawak. Iron contents are treated by aeration in Sabah.

(5) Water pollution and environmental impact

Quality of river water has been monitored at water supply and irrigation intakes. The DOE monitoring for detecting water pollution just started from March, 1981 in Sarawak. It will start from November, 1981 in Sabah.

Saw mill dust was major pollutant in Sarawak and need of water conservation measures was recognized by the officials. Major environmental effect due to the copper mining in Lohan river in Sabah was reported to be silting. Effect on the water quality was reported to be not so serious.

Following sewerage systems were adopted in Sabah:

(a) outflow to the Sea (Sandakan, Tawau, part of Kota Kinabalu),

(b) oxidation system (considered effective),

(c) stabilization system (lagoon),

(d) package, and

(e) individual septic tank system.

Sewerage systems were studied or under study for Kota Kinabalu, Labuan, Tawau, Sandakan, Lahad Datu and other towns in Sabah. In Sarawak, no public sewerage system has been operated except in army camps and the central residential area in Bintulu, but it is under feasibility study or under construction for Kuching, Sibu, Bintulu and Miri.

(6) Water resources development plans and needs

The officers emphasized that the needs of water resources development was extremely different from that of Peninsular Malaysia because the natural and social conditions is different.

No high dams are in operation both in Sabah and Sarawak but construction of 5 small dams were proposed as water supply projects for 4 MP in Sabah. Two concrete dams of Sepagaya (Lahad Datu) and Timbangan Semporna) are under construction. Three earthfill dams were proposed for Labuan water supply.

The Sika fill dams and pumping stations are under construction in the new water supply scheme for Bintulu. The Tenom Pangi project (66 MW), the only hydropower dam in Sabah and the Batang Ai (92 MW), the only hydropower dam in Sarawak are under construction. (See major features in Table 6.)

It is considered by the officials to be rather difficult to serve piped water for all the citizens in Malaysia until 1990. The target year of 2000 may be more realistic. The treated water is not necessarily absolute requirement. Semi-treated or non-treated water may be acceptable depending on the site conditions.

Water supply implementation program was made until 1985 except Bintulu (to 1994) because of budget limitation while demand forecast was made until 1985, 1990 or 2000 depending on the site conditions.

The officials recognize that water source problems will be met in Labuan and Sandakan. For Labuan development of groundwater and construction of 3 small dams were proposed to be completed by around 1985 and the feasibility study of the new water source in the Padas river of which water was diverted to Labuan by a submarine pipeline system was made. For Sandakan two alternative surface water sources at the Melian river and the Kinabatangan river are under feasibility study.

The present intake of Kota Kinabalu water supply is in the Moyog river but a new intake was decided to construct in the Tuaran river under the phase 1 of the Stage 1 extension program. The development plan was made up to 2000 year but it was not approved by ADB.

In Sarawak, the study reports consisting water demand projection were prepared for only Kuching, Sibu, Bintulu and Miri. No reports were prepared for the other towns because no particular need arised. Water demand forecasting was done up to 1990. In other words, long term demand forecasting has not been done yet.

In Sabah groundwater has been well developed in Labuan, Sandakan, Kuala Penyu, Semporna and Kota Belud. The officials recognize that development cost of ground water (tube-well) is very expensive in Sarawak. Only two groundwater project is under construction (Kabong pilot scheme and Belawai scheme).

The rural water supply study, which will be financed by ADB, is under negotiation and will start next year.

Comprehensive future development plans of irrigation schemes including demand projection have not been done yet. The study is restricted to specific projects.

The Kinabatangan flood mitigation and hydropower dam project is under feasibility study and the feasibility studies on the sook and Papar hydropower sites will be made in Sabah. The feasibility study on the two huge hydropower sites (Pelagus and Balu 037) is under feasibility study in Sarawak. (See major features in Table 6.)

Mini-hydropower schemes, of which installed capacity is not larger than 1,000 MW, are under feasibility or design stage both in Sabah and Sarawak. (See major features in Tables 7 & 8.)

(7) Water saving measures

The unaccounted-for-water was reported to be 20 - 40% in Sabah and 15 - 30% in Sarawak. It includes leakage, inacculacy of water equipment, unmetered residents and usage for fire works, schools, hospitals and churches.

Intensification measures of water usage efficiency is going to be tried for irrigation schemes, but no concrete action has been done yet.

There is no experience and plans of water recycle use in Sabah and Sarawak.

(8) Problems associated with implementation

Project implementation is necessarily involved in large or small problems case by case. The major governmental problems are:

(a) funding and financing,

(b) resettlement,

(c) water right, and

(d) scattered demand centers.

The PWD finance is facing difficulties both in Sabah and Sarawak. The single water rate of M$2.0/1,000 gallons (4,550 m^3) has been fixed from 1961 in Sabah. In Sarawak it was set around 1969. There is no distinction between domestic use and industrial and commercial use in Sabah. In Sarawak the rate is divided into domestic and commercial use. The new water rate system is under study and it will be revised in the near future.

No water rate is charged for irrigation water use in Sabah.

Construction cost is high both in Sabah and Sarawak because of high price of construction materials and lack of skilled labours.

The public objection against the development for water supply is very rare both in Sabah and Sarawak because it results in the happiness of residents.

Land and resettlement problems were not reported from PWD both in Sabah and Sarawak though it usually takes long time to get mutual agreement. Land acquisition for inflastructures in irrigation projects, such as canals and roads was reported as one of the largest problems by Sabah DID. SEB and SESCO also reported that the land acquisition and resettlement would be a big problem because the natives have strong reluctance to part from their home land. The number of submerged residents was estimated to be about 10,000 in the Pelagus project and about 5,000 in the Balu project respectively.