

TABLES

Table 1 METEOROLOGICAL DATA IN PERLIS/KEDAH/P. PINANG

Station	Month	Mean Air Temperature (°C)	Relative Humidity (%)	Sunshine Hours (hrs.)	Open Water Evaporation (mm)	Rainfall (mm)
<u>Alor Star</u>						
	Jan.	26.2	74.0	8.40	151	49
	Feb.	27.1	71.2	8.58	152	54
	Mar.	27.6	73.6	8.53	177	101
	Apr.	27.9	78.6	8.42	175	175
	May	27.5	83.2	7.07	155	226
	June	27.2	83.9	5.98	145	175
	July	27.0	83.7	6.36	146	193
	Aug.	26.9	83.5	6.15	147	210
	Sep.	26.5	85.3	5.38	143	307
	Oct.	26.3	86.0	5.25	136	328
	Nov.	26.1	84.7	5.33	130	224
	Dec.	26.1	80.3	6.12	130	100
	Annual	26.9	80.7	6.80	1,787	2,142
<u>Bayan Lepas</u>						
	Jan.	26.8	73.9	8.13	158	63
	Feb.	27.3	74.7	8.16	154	83
	Mar.	27.6	77.2	7.91	176	126
	Apr.	27.7	81.7	7.53	168	167
	May	27.4	83.3	6.53	151	198
	June	27.2	82.7	6.31	147	195
	July	27.0	81.9	6.46	147	186
	Aug.	26.9	82.4	6.12	147	200
	Sep.	26.4	84.4	5.12	142	316
	Oct.	26.4	84.7	5.35	138	371
	Nov.	26.5	82.7	5.75	136	210
	Dec.	26.5	79.0	6.32	137	131
	Annual	27.0	80.7	6.64	1,801	2,246

Table 2 RIVER CHARACTERISTICS IN PERLIS/KEDAH/P. PINANG (1/3)

Basin No.	Item	Description
1	Perlis river	
	(A) River Morphology	Meandering in tidal reaches, but generally in a stable regime with nippah and mangrove banks. Erosion appearing in upper reach, but the extent not serious due to hard banks.
	(B) Estuary	No serious problem at present, but right banks and dune seems to be expanding. Future observation recommended.
	(C) Sediment	Yield rate not studied so far. No impending problem at present, except silting in partial area due to sediment caused by the failure of mining bunds in 1980.
	(D) Sea Water Intrusion	Up to 1 - 2 km upstream from Kangar Town. No adverse problem at present. Tidal control gates installed at almost all tributaries/channel outlets in the lower reaches.
3	Kedah river	
	(A) River Morphology	Meanders in tidal reaches up to Langgar, but in a stable regime. Erosion observed at localized places along Pdg. Terap river, but the extent is not severe. River is generally in a stable regime.
	(B) Estuary	Silting due to littoral drift is progressive. No serious problem at present, but big boats not navigable during low spring tide.
	(C) Sediment	No sediment problem observed in middle/lower part. No information as to silting in canals and channels in irrigation area.
	(D) Sea Water Intrusion	Up to tidal barrage at 2 km downstream from Alor Setar. No specific problem existing.

Table 3 RIVER CHARACTERISTICS IN PERLIS/KEDAH/P. PINANG (2/3)

Basin No.	Item	Description
5	Muda river	
	(A) River Morphology	Some meanders with localized erosion in lower/middle reaches, but no active meandering/erosion reported and observed. River course generally in stable regime.
	(B) Estuary*	Present river width at outlet is 2/3 to 1/2 as compared with 1 : 63,360 map (1970). This is due to development of right bank sand dune created by littoral drift. No major adverse problem, but difficulty in navigation.
	(C) Sediment	It is likely that basin is yielding sediment. Shoals of medium/coarse sands existing in reaches K. Kechil - Batu Pekaka (mainly observed on map, not visible during field visit due to high stage flow).
(D) Sea Water Intrusion	Tidal barrage near Kg. Nangka prevents tidal and saline intrusion. No adverse problem at present.	
6	Perai/Kulim river	
	(A) River Morphology	Meanders existing in tidal swamp area, but the banks generally in a stable condition.
	(B) Estuary	Marine mud intruding in river mouth, but no present difficulty reported. Sediment after completion of barrage to be observed.
	(C) Sediment*	No sand bars and shoals. Mud deposit observed in lower reaches, but not causing major problem at present. Estimated yield rate at barrage site: 130,000 m ³ /y.
(D) Sea Water Intrusion	Presently up to 1 km downstream from Kg. Mak Sulong. Up to barrage site after its completion.	

Remarks; *: Major problems requiring some improving measures

Table 4 RIVER CHARACTERISTICS IN PERLIS/KEDAH/P. PINANG (3/3)

Basin No.	Item	Description
7	Pinang river	
	(A) River Morphology	No noteworthy meanders. Erosion observed on banks, but mostly of minor extent and local nature. In view of dense housings adjacent to river banks, revetment work may be needed for protection.
	(B) Estuary*	Marine mud silting in river mouth (above mean sea level) and along coastal line. Navigation of small boat (only up to Jelutong road) difficult during low tide.
	(C) Sediment	Sediment yield from housing development sites. Although quantity is not much, it may cause bed aggravation due to limited sediment carrying capacity.
	(D) Sea Water Intrusion	No problem reported at present.
8	Kerian river	
	(A) River Morphology	Meanders in tidal reaches and sluggish course in middle reaches. Bank erosion observed at meanders in middle reaches may be contributing sediment yield.
	(B) Estuary	No noteworthy problems reported. Marine mud depositing on both banks of river mouth, but no difficulty in navigation.
	(C) Sediment	Sand shoals observed at meanders in upper and middle reaches. High yield of sediment due to land development and logging. Ijok diversion headwork silted.
	(D) Sea Water Intrusion	Up to tidal gate at Parit Bantar. No problem existing at present (no water intakes in reach downstream from barrage).

Remarks; *: Major problems requiring some improving measures

Table 5 FLOODED AREA BY RECORDED MAXIMUM FLOOD
IN PERLIS/KEDAH/P. PINANG

State	Basin No.	River Basin	Year	Flood Area (km ²)	Population 1980 (10 ³)	Estimated Damage at 1980 Condition (M\$10 ⁶)
Perlis	1	Perlis	1976	49	28	6.2
Kedah	3	Kedah	1975	16	15	1.9
	4	Merbok	-	-	-	-
	5	Muda	1973	99	47	7.4
	8	Kerian	-	23	1	0.2
		Sub-total		138	63	9.5
P. Pinang	5	Muda	1973	8	6	1.0
		Tembus	1971	50	21	3.8
	6	Perai	1971	15	8	0.9
		Juru	-	6	-	-
	7	Pinang	1980	1	10	1.6
		Sub-total		80	45	7.3

Table 6

LIST OF EXISTING AND PLANNED DAMS
IN KEDAH/PERLIS/PULAU PINANG

State	Name	River	Purpose/ Year of Com- mission	Organi zation	Catch- ment Area (kg ²)	Active Storage Capacity (10 ⁶ m ³)	Net Supply Capacity (10 ⁶ m ³ /y)
<u>Existing</u>							
Kedah							
	Pedu Dam		IR	MADA	171	864	(780)
	Kedah Barrage		TB	DID	-	-	-
	Muda Dam		IR	MADA	984	123	-
	Muda Barrage		TB, WS	PWA	4,200	-	-
P. Pinang							
	Ayer Hitam Dam	P. Pinang	WS, HY	PWA	25	2	-
<u>Under Construction</u>							
P. Pinang							
	Perai Barrage	Perai	TB	DID	-	-	-

Remarks; WS: Domestic and industrial water supply
 FM: Flood mitigation
 TB: Tidal barrage
 HY: Hydropower
 (): Assumed capacity

Table 7 HISTORICAL AND PROJECTED POPULATION OF DISTRICT BY CITY/TOWN AND RURAL AREA IN KEDAH/PERLIS

Unit: 10³

District	City/Rural	Historical	Projected			Average Annual Growth (%)
		1980	1985	1990	2000	1980-2000
<u>Perlis</u>						
1. Perlis	I. Kangar	14	16	19	26	3.1
	Rural	143	159	172	171	0.9
	District Total	157	175	191	197	1.0
<u>Kedah</u>						
2. Pulau Langkawi	Rural	31	34	36	38	1.0
3. Kulang Pasu	101. Jitra	15	21	27	41	5.2
	Rural	125	127	128	129	0.2
	District Total	140	148	155	170	1.0
4. Padang Terap	Rural	45	52	57	61	1.5
5. Kota Setar	2. Alor Setar	76	79	85	100	1.4
	Rural	228	253	269	290	1.2
	District Total	304	332	354	390	1.3
6. Pendang	Rural	82	86	89	91	0.5
7. Yan	102. Guar Chempedak	9	10	11	15	2.6
	103. Yan	6	7	9	13	3.9
	Rural	49	50	50	50	0.1
	District Total	64	67	70	78	1.0
8. Sik	Rural	47	50	51	53	0.6
9. Kuala Muda	3. Sg. Petani	49	55	62	79	2.4
	104. Tikan Batu	4	7	9	14	6.5
	Rural	156	169	179	186	0.9
	District Total	209	231	250	279	1.5
10. Baling	Rural	115	118	119	120	0.2
11. Kulim	4. Kulim	29	34	40	54	3.2
	Rural	73	73	73	73	1.0
	District Total	102	107	113	127	1.1
12. Bandar Bharu	Rural	34	34	34	34	1.0
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Total	Urban Total	202	229	262	342	2.7
	Rural Total	1,128	1,205	1,257	1,296	0.7
	State Total	1,330	1,434	1,519	1,638	1.0

Table 8 HISTORICAL AND PROJECTED POPULATION OF DISTRICT BY CITY/TOWN AND RURAL AREA IN PULAU PINANG

Unit: 103

District	City/Rural	Historical	Projected			Average Annual Growth (%)
		1980	1985	1990	2000	1980-2000
<u>Pulau Pinang</u>						
13. Seberang Perai Utara	5. Butterworth	82	92	103	121	2.0
	109. Kg. PMTG Kuching	11	13	16	20	3.0
	Rural	120	130	133	128	0.3
	District Total	213	235	252	269	1.2
14. Seberang Perai Tengah	6. Bk. Mertajam	30	31	33	38	1.2
	110. Perai	10	12	13	15	2.0
	Rural	133	161	176	157	0.9
	District Total	173	204	222	210	1.0
15. Selatan	Rural	78	84	86	83	0.3
16. Timur Laut	8. Georgetown	267	258	262	294	0.5
	105. Air Itam	39	47	54	65	2.6
	106. Tg. Tokong	15	17	18	21	1.7
	107. Gelugor	14	17	20	25	2.9
	108. Tg. Bunga	12	13	14	17	1.8
	Rural	76	97	106	94	1.1
District Total	423	449	474	516	1.0	
17. Barat Daya	Rural	83	94	99	93	0.6
Total	Urban Total	480	500	533	616	1.3
	Rural Total	490	566	600	555	0.6
	State Total	970	1,066	1,133	1,171	1.0

Table 9. HISTORICAL AND PROJECTED GROSS VALUE OF
MANUFACTURING OUTPUT BY COMMODITY GROUP
IN PERLIS/KEDAH/P. PINANG

Unit: M\$10⁶

Item	Year			
	1980	1985	1990	2000
<u>Perlis/Kedah</u>				
Food	231	497	836	2,072
Textile	0	0	0	1
Wood	64	90	122	235
Paper	0	0	0	0
Publishing	1	2	7	63
Chemical	3	11	57	414
Rubber	90	222	483	2,300
Non-metal	5	14	31	170
Basic metal	0	1	4	31
Machinery	10	33	90	700
Others	0	0	0	1
Total	404	870	1,630	5,987
<u>P. Pinang</u>				
Food	529	608	644	394
Textile	429	544	640	548
Wood	46	34	29	14
Paper	29	56	58	58
Publishing	94	179	336	758
Chemical	130	211	751	1,322
Rubber	121	158	217	255
Non-metal	19	28	39	54
Basic metal	265	453	755	1,554
Machinery	933	1,643	2,854	5,602
Others	0	0	1	1
Total	2,595	3,914	6,324	10,560

Remarks; In factor cost at 1970 prices

Table 10 BASIN AREA AND ASSUMED RIVER MAINTENANCE FLOW
IN KEDAH/PERLIS/PULAU PINANG

Basin No.	Basin	Total Catchment Area (km ²)	Effective Catchment Area (km ²)	Balance Point (km)	River Maintenance Flow (m ³ /s)
1	Perlis	790	550	12	2.3
2	P. Langkawi	475	350	island	2.3
3	Kedah	3,695	2,510	15	14.3
4	Merbok & Others	520	340	12	2.1
5	Muda	4,300	4,200	10	28.0
6	Perai & Others	895	600	13	4.5
7	P. Pinang	300	220	island	1.6
8	Kerian	1,420	1,360	7	10.2

Remarks; The location of balance point is the river length in km measured upstream from the estuary.

Table 11 ESTIMATED AND PROJECTED SERVICE FACTOR AND PER CAPITA DAILY USE OF DOMESTIC WATER IN PERLIS/KEDAH/P.PINANG

City/Rural	Service Factor (%)				Per Capita Daily Use (lpcd)			
	Estimated		Projected		Estimated		Projected	
	1980	1985	1990	2000	1980	1985	1990	2000
<u>PERLIS</u>								
1. <u>Urban Area</u>								
1 Kangar	80	85	90	100	160	175	190	220
2. <u>Rural Area</u>								
PWD Area	75	75	75	75	75	100	125	175
MOH Area	5	13	18	25	40	48	55	70
3. <u>Non-Pipe-Served Area</u>	-	-	-	-	40	40	40	40
<u>KEDAH</u>								
1. <u>Urban Area</u>								
2 Alor Setar	80	85	90	100	160	175	190	230
3 Sg. Petani	80	85	90	100	160	175	190	220
4 Kulim	80	85	90	100	160	175	190	220
101 Jitra	80	85	90	100	160	175	190	220
102 Guar Chempedak	41	85	90	100	115	153	190	220
103 Yan	41	85	95	100	115	148	180	220
104 Tikan Batu	41	85	95	100	115	148	180	220
2. <u>Rural Area</u>								
PWD Rural	28	54	61	64	75	100	125	175
MOH Rural	16	31	34	36	40	48	55	70
3. <u>Non-Pipe-Served Area</u>	-	-	-	-	40	40	40	40
<u>P. PINANG</u>								
1. <u>Urban Area</u>								
5 Butterworth	80	85	100	100	160	180	200	230
6 Bk. Mertajam	80	85	90	100	160	175	190	220
8 Georgetown	100	100	100	100	170	185	200	230
105 Air Itam	80	85	90	100	160	175	190	220
106 Tg. Tokong	80	85	90	100	160	175	190	220
107 Gelugor	80	85	90	100	160	175	190	220
108 Tg. Bunga	80	85	90	100	160	175	190	220
109 Kg. PMTG Kuching	80	85	90	100	160	175	190	220
110 Perai	80	85	90	100	160	175	190	220
2. <u>Rural Area</u>								
PWD Rural	78	84	89	95	75	100	125	175
MOH Rural	1	2	3	5	40	48	55	70
3. <u>Non-Pipe-Served Area</u>	-	-	-	-	40	40	40	40

Note; Service factors of PWD and MOH rural areas are computed by the served population of each rural area divided by the total rural population.

Table 12 NET UNIT MANUFACTURING WATER USE
PER GROSS VALUE OF MANUFACTURING
OUTPUT BY COMMODITY GROUP

Unit: m³/d/M\$10⁶/y

Commodity Group	Assumed ^{/1}	Estimated ^{/2}	Projected	
	1975	1980	1985 ^{/2}	1990 & 2000
1. Food	77.0	75.0	73.0	71.0
2. Textile	79.0	77.0	75.0	73.0
3. Wood Product	12.0	12.3	12.7	13.0
4. Paper Product	581.0	560.7	540.3	520.0
5. Publishing	10.0	10.0	10.0	10.0
6. Chemicals	140.0	136.7	133.3	130.0
7. Rubber Manufacturing	126.0	105.7	85.3	65.0
8. Non-metal	88.0	86.7	69.3	68.0
9. Basic Metal	53.0	51.7	50.3	49.0
10. Machinery	16.0	17.3	18.7	20.0
11. Miscellaneous	48.0	48.3	48.7	49.0

Remarks; /1: Assumed from data in Japan in 1970

/2: Obtained by interpolation

Note; The values indicated are net manufacturing water use (excluding the water used cyclically) per M\$10⁶ of the gross value of manufacturing output at 1970 price.

Table 13 ESTIMATED AND PROJECTED D&I WATER DEMAND
BY BASIN IN PERLIS/KEDAH/P. PINANG (1/2)

Unit: 10⁶ m³/y

Basin No.	City/Rural	Estimated				Projected						
		1980 D&I	1985 D	1985 I	1985 Total	1990 D	1990 I	1990 Total	2000 D	2000 I	2000 Total	
<u>Perlis</u>												
1	1 Kangar	2.2	1.2	1.3	2.5	1.6	5.4	7.0	2.7	22.0	24.7	
	Rural	4.8	6.3	0.4	6.7	8.3	0.3	8.6	12.2	0.3	12.5	
State Total for Perlis		7.0	7.5	1.7	9.2	9.9	5.7	15.6	14.9	22.3	37.2	
<u>Kedah</u>												
2	Rural	0.9	1.2	0.2	1.4	1.6	0.2	1.8	2.5	0.2	2.7	
3	2 Alor Setar	8.9	5.8	10.3	16.1	7.2	17.1	24.3	11.0	69.6	80.6	
	101 Jitra	1.1	1.6	0.3	1.9	2.2	0.6	2.8	4.3	2.2	6.5	
	102 Guar Chempedak	0.7	0.7	1.0	1.7	0.9	1.7	2.6	0.6	7.2	7.8	
	103 Yan	0.5	0.3	0.9	1.2	0.5	1.5	2.0	1.4	6.0	7.4	
	City Total	11.2	8.4	12.5	20.9	10.8	20.9	31.7	16.3	85.0	101.3	
	Rural	13.1	20.9	1.9	22.8	27.5	1.7	29.2	40.9	1.7	42.6	
	Basin Total	24.3	29.3	14.4	43.7	38.3	22.6	60.9	57.2	86.7	143.9	
4	3 Kulang Pasu	5.6	4.1	6.5	10.6	5.2	10.7	15.9	8.3	43.8	52.1	
	Rural	3.1	3.1	1.6	4.7	4.4	1.7	6.1	6.4	2.3	8.7	
	Basin Total	8.7	7.2	8.1	15.3	9.6	12.4	22.0	14.7	46.1	60.8	
5	104 Tikan Batu	0.3	0.3	0.7	1.0	0.5	1.4	1.9	1.5	6.7	8.2	
	Rural	11.9	11.5	5.3	16.8	15.3	5.0	20.3	22.6	5.7	28.3	
	Basin Total	12.2	11.8	6.0	17.8	15.8	6.4	22.2	24.1	12.4	36.5	
6	4 Kulim	2.2	2.5	0.8	3.3	3.4	1.3	4.7	5.7	5.5	11.2	
	5 Butterworth	20.7	6.9	24.3	31.2	9.9	39.4	49.3	13.4	61.7	75.1	
	6 Bk. Mertajan	7.8	2.3	9.2	11.5	2.8	14.9	17.7	4.0	23.3	27.3	
	109 Kg. Pmtg. Kuching	1.9	0.9	2.2	3.1	1.3	4.0	5.3	2.1	6.9	9.0	
	110 Perai	13.1	0.9	19.7	20.6	1.1	31.9	33.0	1.6	50.0	51.6	
	City Total	45.7	13.5	56.2	69.7	18.5	91.5	110.0	26.8	147.4	174.2	
	Rural	26.3	15.8	15.6	31.4	21.4	15.1	36.5	29.2	14.7	43.9	
	Basin Total	72.0	29.3	71.8	101.1	39.9	106.6	146.5	56.0	162.1	218.1	
8	Rural	1.8	0.4	0.8	1.2	2.3	1.1	3.4	3.2	1.8	5.0	
Sub-total		119.9	79.2	101.3	180.5	107.5	149.3	256.8	157.7	309.3	467.0	
(State Total for Kedah)		(48.5)	(52.2)	(29.3)	(81.5)	(69.8)	(42.8)	(112.6)	(106.6)	(153.2)	(259.8)	
<u>P. Pinang</u>												
5	104 Tikan Batu	0.3	0.3	0.7	1.0	0.5	1.4	1.9	1.5	6.7	8.2	
	Rural	11.9	11.5	5.3	16.8	15.3	5.0	20.3	22.6	5.7	28.3	
	Basin Total	12.2	11.8	6.0	17.8	15.8	6.4	22.2	24.1	12.4	36.5	
6	4 Kulim	2.2	2.5	0.8	3.3	3.4	1.3	4.7	5.7	5.5	11.2	
	5 Butterworth	20.7	6.9	24.3	31.2	9.9	39.4	49.3	13.4	61.7	75.1	
	6 Bk. Mertajan	7.8	2.3	9.2	11.5	2.8	14.9	17.7	4.0	23.3	27.3	
	109 Kg. Pmtg. Kuching	1.9	0.9	2.2	3.1	1.3	4.0	5.3	2.1	6.9	9.0	
	110 Perai	13.1	0.9	19.7	20.6	1.1	31.9	33.0	1.6	50.0	51.6	
	City Total	45.7	13.5	56.2	69.7	18.5	91.5	110.0	26.8	147.4	174.2	
	Rural	26.3	15.8	15.6	31.4	21.4	15.1	36.5	29.2	14.7	43.9	
	Basin Total	72.0	29.3	71.8	101.1	39.9	106.6	146.5	56.0	162.1	218.1	

Remarks; Water demand: Total source demand
D: Domestic water demand
I: Industrial water demand

Table 14 ESTIMATED AND PROJECTED D&I WATER DEMAND
BY BASIN IN PERLIS/KEDAH/P. PINANG (2/2)

Unit: 10⁶ m³/y

Basin No.	City/Rural	Estimated				Projected					
		1980		1985		1990			2000		
		D&I	D	I	Total	D	I	Total	D	I	Total
7	8 Georgetoun	28.7	21.6	12.9	34.5	23.7	21.0	44.7	30.6	32.7	63.3
	105 Air Itam	6.7	3.5	7.7	11.2	4.5	13.9	18.4	6.9	22.6	29.5
	106 Tg. Tokong	2.6	1.2	2.8	4.0	1.5	4.5	6.0	2.2	7.4	9.6
	107 Gelugor	1.4	1.2	0.7	1.9	1.6	1.2	2.8	2.6	1.8	4.4
	108 Tg. Bunga	1.9	0.9	2.2	3.1	1.1	3.6	4.7	1.8	6.0	7.8
	City Total	41.3	28.4	26.3	54.7	32.4	44.2	76.6	44.1	70.5	114.6
	Rural	11.9	8.1	6.6	14.7	11.4	6.5	17.9	15.1	5.8	20.9
	Basin Total	53.2	36.5	32.9	69.4	43.8	50.7	94.5	59.2	76.3	135.5
8	Rural	1.8	0.4	0.8	1.2	2.3	1.1	3.4	3.2	1.8	5.0
9	10 Taiping	26.3	18.2	27.7	45.9	23.7	41.7	65.4	34.6	91.9	126.5
	112 Bagan Serat	2.5	0.7	3.9	4.6	0.9	6.1	7.0	1.4	13.4	14.8
	City Total	28.8	18.9	31.6	50.5	24.6	47.8	72.4	36.0	105.3	141.3
	Rural	16.0	15.8	5.3	21.1	20.7	14.4	35.1	34.4	30.4	64.8
	Basin Total	44.8	34.7	36.9	71.6	45.3	62.2	107.5	70.4	135.7	206.1
	Sub-total	184.0	112.7	148.4	261.1	147.1	227.0	374.1	212.9	388.3	601.2
	(State Total for P. Pinang)	(124.1)	(63.8)	(104.7)	(168.5)	(80.7)	(155.7)	(236.4)	(110.3)	(232.5)	(342.8)
	Total	310.9	199.5	251.4	450.9	264.5	382.0	646.5	385.5	719.9	1105.4
	(States Total for Perlis/ Kedah/P. Pinang)	(179.6)	(123.5)	(135.7)	(259.2)	(160.4)	(204.2)	(364.6)	(231.8)	(408.0)	(639.8)

Remarks; Water demand: Total source demand
D: Domestic water demand
I: Industrial water demand

Table 15 ESTIMATED AREA OF IRRIGATED PADDY FIELD
IN PERLIS/KEDAH/P. PINANG

Unit: ha

No.	Basin Name	Scheme	1980		1990		2000	
			Main Season	Off Season	Main Season	Off Season	Main Season	Off Season
<u>Perlis</u>								
1.	Perlis	Minor	6,815	-	11,708	2,266	13,355	2,428
<u>Kedah</u>								
2.	P. Langkawi	Minor	2,692	319	3,120	319	3,120	319
3.	Kedah	Major	95,860	91,580	95,860	91,580	95,860	91,580
		Minor	1,083	473	7,166	1,820	13,000	3,426
4.	Merbok+	Minor	2,074	399	2,624	825	2,624	825
5.	Muda	Minor	7,058	4,978	13,894	5,007	15,000	8,500
6.	Perai	Minor	443	443	443	443	443	443
8.	Kerian	Minor	215	210	656	651	1,021	651
Total for Kedah			109,425	98,402	123,763	100,645	131,068	105,744
<u>P. Pinang</u>								
5.	Muda	Minor	8,612	8,612	8,612	8,612	8,612	8,612
6.	Perai	Minor	5,450	5,235	5,908	5,235	5,908	5,235
7.	Pinang	Minor	1,189	566	1,189	821	1,189	870
9.	Kurau	Major ^{/1}	1,504	204	1,504	204	1,504	204
Total for P. Pinang			16,755	14,617	17,213	14,872	17,213	14,921
Total for the region			132,995	113,019	152,684	117,783	161,636	123,093

Remarks; /1: Portion of the Krian Irrigation Project of 23,490 ha

Note; + marked after the name of Basin shows the inclusion of other Basin than the stated Basin.

Table 16 ESTIMATED IRRIGATION WATER DEMAND FOR PADDY IN PERLIS/KEDAH/P. PINANG

Unit: 10⁶ m³/y

Basin		Scheme	1980	1990	2000
No.	Name				
<u>Perlis</u>					
1.	Perlis	Minor	94	189	213
<u>Kedah</u>					
2.	P. Langkawi	Minor	44	45	45
3.	Kedah	Major	1,911	1,764	1,764
		Minor	25	114	208
4.	Merbok+	Minor	37	48	48
5.	Muda	Minor	205	273	352
6.	Perai	Minor	15	14	14
8.	Kerian	Minor	7	19	24
Total for Kedah			2,244	2,277	2,455
<u>P. Pinang</u>					
5.	Muda	Minor	293	266	266
6.	Perai	Minor	168	152	152
7.	Pinang	Minor	28	30	31
9.	Kurau	Minor	18	17	17
Total for P. Pinang			507	465	466
Total for the region			2,845	2,931	3,134

Table 17 RIVER UTILIZATION RATIO BY BASIN IN KEDAH/
PERLIS/PULAU PINANG FOR 1990 and 2000

Unit: $10^6 \text{ m}^3/\text{y}$

No.	Basin Name	Surface* Runoff (1)	1990			2000				
			Source Demand		Ratio	Source Demand		Ratio		
			D&I	Irri.	Total (2) (X)	(2)/(1)	D&I	Irri.	Total (2) (%)	
1.	Perlis	465	16	189	205	44	37	213	250	54
2.	Pulau Langkawi	455	2	45	47	10	3	45	48	11
3.	Kedah	2,837	52	1,878	1,930	68	132	1,972	2,104	74
4.	Merbok	426	22	48	70	16	61	48	109	26
5.	Muda	5,569	23	539	562	10	36	618	654	12
6.	Perai	893	147	166	313	35	218	166	384	43
7.	Plau Pinang	311	95	30	125	40	136	31	167	54
8.	Kerian	2,037	3	54	57	3	5	61	66	3

Remarks; *: Surface runoff in effective area

Table 18 ANNUAL DEFICIT BY BASIN IN KEDAH/PERLIS/
PULAU PINANG FOR 1990 AND 2000

Unit: 10^6 m³/y

Basin No.	Drought Level									
	1/N		2/N		3/N		4/N		5/N	
	Deficit	Year	Deficit	Year	Deficit	Year	Deficit	Year	Deficit	Year
<u>1990</u>										
1	63.3	1968	52.4	1963	44.5	1979	33.3	1965	33.2	1967
2	14.7	1968	12.4	1963	8.8	1979	7.4	1962	6.3	1967
3	963.4	1963	902.7	1968	863.1	1968	761.1	1965	649.3	1979
4	13.9	1968	11.9	1963	8.0	1979	7.8	1962	7.5	1965
5	221.5	1963	193.1	1968	147.8	1965	113.9	1979	106.6	1962
6	100.9	1963	85.1	1968	63.9	1965	55.7	1964	45.3	1962
7	56.8	1963	50.7	1968	37.2	1979	36.9	1965	31.8	1962
8	10.4	1965	7.1	1968	6.6	1963	6.0	1979	5.1	1962
<u>2000</u>										
1	86.7	1968	70.4	1963	58.7	1979	49.7	1967	48.7	1965
2	14.9	1968	12.6	1963	8.9	1979	7.5	1962	6.4	1967
3	1,144.0	1963	1,080.0	1964	1,061.8	1968	903.6	1965	822.5	1979
4	12.5	1963	17.9	1968	10.9	1979	10.6	1965	9.7	1962
5	280.4	1963	242.6	1968	188.7	1965	138.0	1979	133.2	1962
6	156.7	1963	136.6	1968	99.4	1965	91.3	1964	89.7	1979
7	81.8	1963	78.6	1968	61.4	1979	57.6	1965	53.5	1964
8	10.8	1965	8.1	1968	7.3	1963	6.4	1979	5.8	1962

Table 19 ASSUMED DEVELOPMENT OF LAND DISPOSAL
IN PALM OIL MILLS AND RUBBER FACTORIES
IN PERLIS/KEDAH/P. PINANG

	Unit: %		
	1980	1990	2000
Palm oil mills	25	50	75
Rubber factories	0	10	20

Table 20 DISCHARGE RATIO, RUNOFF RATIO, INFILTRATION
RATIO AND BOD CONCENTRATION OF EFFLUENT
ASSUMED UNDER PRESENT PURIFICATION LEVEL
IN PERLIS/KEDAH/P. PINANG

Pollution Source	Year	Discharge Ratio	BOD Concentration (mg/lit)	Runoff Ratio	Infiltration Ratio
Domestic					
Urban sewerage	1999 & 2000	0.9	30	1.0	0.2
Urban non-sewerage	1990	0.9	160	0.6	0
	2000	0.9	140	0.6	0
Rural	1990 & 2000	0.8	200	0.1	0
Manufacture					
Urban sewerage	1990 & 2000	1.0	30	1.0	0.2
Urban non-sewerage	1990	1.0	155	0.6	0
	2000	1.0	120	0.1	0
Rural					
Palm Oil Mill					
With P.S./1	1990	0.55	50	0.6	0
	2000	0.3	50	0.6	0
Without P.S.	1990	0.55	22,000	0.6	0
	2000	0.3	22,000	0.6	0
Land disposal	1990	0.1	50	0.6	0
	2000	0.1	50	0.6	0
Rubber Factories					
With P.S.	1990	0.9	50	0.6	0
	2000	0.8	50	0.6	0
Without P.S.	1990	0.9	2,320	0.6	0
	2000	0.8	2,320	0.6	0
Land disposal	1990	0.1	50	0.6	0
	2000	0.1	50	0.6	0
Animal Husbandry	1990 & 2000	1.0	200 ²	0.1	0

Remarks; /1: Purification System
/2: g/d/head

Table 21 PROPOSED FLOOD FORECASTING AND WARNING SYSTEM IN PERLIS/KEDAH/P. PINANG

Basin No.	River Basin	People Rel'ved by F/F (10 ³)	Construction Cost (M\$106)	Construction Period
PERLIS				
1	Perlis	9.0	0.9	5MP
KEDAH				
5	Muda	10.2	1.2	5MP
P. PINANG				
7	Pinang	5.5	0.8	5MP

Table 22 WATER SOURCE DEVELOPMENT PLANS FOR ALTERNATIVE B1
IN KEDAH/PERLIS/PULAU PINANG

(1) DAM

Location		Facilities	Purpose	Catchment Area (km ²)	Active Storage Capacity (10 ⁶ m ³)	Net Supply Capacity (10 ⁶ m ³ /y)	Construction Cost (M\$106)	Construction Period
State**	Basin No.							
Perlis	1	Arau dam	IR	50	37	36	25	1983 - 1987
Perlis	1	Timah-Tasoh dam	WS, IR, FM	150	6	20	14	1989 - 1993
Kedah	2	Aver Tawar dam	IR	11	8	10	219	1985 - 1989
Kedah	2	Ulu Melaka dam	IR	7	3	6	15	1985 - 1989
Kedah	2	Nylor dam	IR	4	0.5	2	8	1985 - 1989
Kedah	3	Ahning dam	WS, IR	120	116	100	70	1983 - 1987
Kedah	3	Badak-Temin dam	IR	114	137	95	34	1983 - 1987
Kedah	3	Sari dam	IR	61	73	51	31	1986 - 1990
Kedah	3	Durian dam	IR	75	88	63	35	1989 - 1994
Kedah	4	4-A dam	WS, IR	16	15	21	17	1985 - 1989
Kedah	5	Naok-Reman dams	WS, IR	-	-	350	123	1983 - 1987
Perak	10	Rui dam	WS, IR	215	313	163	796	1983 - 1987
Kedah	5	Beris dam	WS, IR	115	21	75	25	1983 - 1987
Kedah	5	Tawar-Muda dam	WS, IR	135	21	75	37	1985 - 1989
Kedah	5	Legong dam	WS, IR	44	44	45	32	1985 - 1989
Kedah	5	Weng dam	WS, IR	37	37	38	27	1985 - 1989
Kedah	5	Charock Teber dam	WS, IR	38	38	39	27	1985 - 1989
Kedah	5	Chiak dam	WS, IR	23	23	24	17	1986 - 1990
P. Pinang	6	Mengkuang Phase I & II	WS	4	24	24	55	1981 - 1985
Kedah/Perak	8	Kerian dam	WS, IR	112	208	134	1,356***	1985 - 1989
Kedah/Perak	8	Sira dam	WS, IR	29	32	47	178***	1985 - 1989
Kedah/Perak	9	9-A(2) dam	WS, IR	-	-	15	18***	1990 - 1994

U/C (Phase I)

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m ³ /s)	Construction Cost (M\$106)	Construction Period
1	Pumping from the Muda Irrigation canal	Kedah Perlis 3 to 1	3.1	*	1983 - 1987
3	Jeniang diversion (barrage & canal)	Kedah 5 to 3	21.1	included in Naok-Reman dams	1983 - 1987
10	Rui diversion (tunnel)	Perak Kedah 10 to 5	10.5	(15)	1983 - 1987
6	Pipe line	Kedah P. Pinang 5 to 6	7.5	*	1985 - 1989
6	Pipe line	Kedah P. Pinang 5 to 6	1.3	*	1986 - 1990
6	Pipe line	Kedah P. Pinang 5 to 6	1.2	*	1991 - 1995
7	Pipe line	Kedah P. Pinang 5 to 7	4.3	*	1985 - 1989
7	Pipe line	Kedah P. Pinang 5 to 7	1.1	*	1986 - 1990
7	Pipe line	Kedah P. Pinang 5 to 7	0.5	*	1992 - 1996

Remarks: IR = Irrigation; WS = Water Supply; FM = Flood Mitigation; U/C = Under Construction
* = Cost included in other distribution facilities
Construction cost = Financial cost at 1980 constant price
** = The state where the facilities are located
() = Included in dam cost
*** = Some part is for diversion to the Kurau river

Table 23 WATER SOURCE DEVELOPMENT PLANS FOR ALTERNATIVE B2
IN KEDAH/PERLIS/PULAU PINANG

(1) DAM

Location		Facilities	Purpose	Catchment Area (km ²)	Active Storage Capacity (10 ⁶ m ³)	Net Supply Capacity (10 ⁶ m ³ /y)	Construction Cost (M\$10 ⁶)	Construction Period
State**	Basin No.							
Perlis	1	Timah-Tasoh dam	WS, IR, FM	150	6	20	14	1986 - 1990
Kedah	2	Aver Tawar dam	IR	11	8	10	219	1985 - 1989
Kedah	2	Ulu Melaka dam	IR	7	3	6	15	1985 - 1989
Kedah	3	Ahning dam	WS, IR	120	27	73	51	1983 - 1987
Kedah	3	Badak-Temin dam	IR	114	137	95	34	1983 - 1987
Kedah	3	Sari dam	IR	61	73	51	31	1986 - 1990
Kedah	3	Durian dam	IR	75	88	63	35	1990 - 1994
Kedah	5	Naok-Reman dams	WS, IR	-	-	350	123	1983 - 1987
Perak	10	Rui dam	WS, IR	215	313	163	796	1983 - 1987
Kedah	5	Beris dam	WS, IR	115	21	75	25	1985 - 1989
Kedah	5	Tawar-Muda dam	WS, IR	135	21	75	37	1985 - 1989
Kedah	5	Legong dam	WS, IR	44	44	45	32	1986 - 1990
P. Pinang	6	Mengkuang Phase I & II	WS	4	24	24	55	U/C (Phase I) 1981 - 1985
Kedah/Perak	8	Kerian dam	WS, IR	112	92	120	970***	1985 - 1989

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m ³ /s)	Construction Cost (M\$10 ⁶)	Construction Period
1	Pumping from the Muda Irrigation canal	Kedah Perlis 3 to 1	4.1	*	1983 - 1987
3	Jeniang diversion (barrage canal)	Kedah 5 to 3	17.3	included in Naok-Reman dams	1983 - 1987
4	Naok diversion (canal)	Kedah 5 to 3	1.4	*	1985 - 1989
10	Rui diversion (tunnel)	Perak Kedah 10 to 5	10.5	(15)	1983 - 1987
6	Pipe line	Kedah P. Pinang 5 to 6	5.5	*	1985 - 1989
6	Pipe line	Kedah P. Pinang 5 to 6	1.3	*	1986 - 1990
6	Pipe line	Kedah P. Pinang 5 to 6	0.6	*	1991 - 1995
7	Pipe line	Kedah P. Pinang 5 to 7	3.4	*	1985 - 1989
7	Pipe line	Kedah P. Pinang 5 to 7	0.9	*	1986 - 1990
7	Pipe line	Kedah P. Pinang 5 to 7	0.9	*	1990 - 1994

Remarks; IR = Irrigation; WS = Water Supply; FM = Flood Mitigation; U/C = Under Construction
 * = Cost included in other distribution facilities
 Construction cost = Financial cost at 1980 constant price
 ** = The state where the facilities are located
 () = Included in dam cost
 *** = Some part is for diversion to the Kurau river

Table 24. WATER SOURCE DEVELOPMENT PLANS FOR ALTERNATIVE B3
IN KEDAH/PERLIS/PULAU PINANG

(1) DAM

State**	Location Basin No.	Facilities	Purpose	Catch- ment Area (km ²)	Active Storage Capacity (10 ⁶ m ³)	Net Supply Capacity (10 ⁶ m ³ /y)	Construc- tion Cost (M\$10 ⁶)	Construc- tion Period
Perlis	1	Timah-Tasoh dam	WS, IR, FM	150	6	20	14	1985 - 1989
Kedah	2	Ulu Melaka dam	IR	7	2	5	12	1985 - 1989
Kedah	2	Aver Tawar dam	IR	11	2	6	131	1985 - 1989
Kedah	3	Ahning dam	WS, IR	120	27	73	51	1983 - 1987
Kedah	3	Badak-Temin dam	IR	114	19	59	21	1983 - 1987
Kedah	3	Sari dam	IR	61	14	38	23	1987 - 1991
Kedah	3	Durian dam	IR	75	17	45	25	1991 - 1995
Kedah	5	Naok-Reman dams	WS, IR	-	-	350	123	1983 - 1987
Kedah	5	Beris dam	WS, IR	115	12	35	15	1986 - 1990 U/C (Phase I)
P. Pinang	6	Mengkuang Phase I & II	WS	4	24	24	55	1981 - 1985
Kedah/Perak	8	Kerian dam	WS, IR	112	9	40	54***	1985 - 1989

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m ³ /s)	Construc- tion Cost (M\$10 ⁶)	Construc- tion Period
1	Pumping from the Muda Irrigation canal	Kedah Perlis 3 to 1	2.6	*	1983 - 1987
3	Jenjang diversion (barrage canal)	Kedah 5 to 3	5.0	included in Naok-Reman dams	1983 - 1987
4	Naok diversion (canal)	Kedah 5 to 4	0.8	*	1985 - 1989
6	Pipe line	Kedah P. Pinang 5 to 6	2.3	*	1985 - 1989
6	Pipe line	Kedah P. Pinang 5 to 6	1.3	*	1986 - 1990
7	Pipe line	Kedah P. Pinang 5 to 7	1.2	*	1985 - 1989

Remarks; IR = Irrigation; WS = Water Supply; FM = Flood Mitigation; U/C = Under Construction
* = Cost included in other distribution facilities
Construction cost = Financial cost at 1980 constant price
** = The state where the facilities are located
*** = Some part is for diversion to the Kurau river

Table 25 OUTLINE OF FLOOD MITIGATION PROGRAM BY ALTERNATIVE
IN PERLIS/KEDAH/P. PINANG

Basin No.	Basin Name	R.I. (km)	Dam (nos)	F.W. (km)	Pold. (nos)	N.S. (10 ³)	P.P. (10 ³)	F.A. (10 ³ ha)	C.C. (M\$10 ⁶)
<u>PERLIS</u>									
<u>ALTERNATIVE F1</u>									
1	Perlis	46	1	-	-	-	31	5	26
<u>ALTERNATIVE F2</u>									
1	Perlis	34	1	-	-	-	25	4	22
<u>ALTERNATIVE F3</u>									
1	Perlis	46	1	-	-	-	31	5	26
<u>KEDAH</u>									
<u>ALTERNATIVE F1</u>									
3	Kedah	31	-	-	-	-	16	1	32
5	Muda	121	-	-	-	-	50	10	108
	Total	152	-	-	-	-	66	11	140
<u>ALTERNATIVE F2</u>									
5	Muda	59	-	-	-	-	29	6	41
<u>ALTERNATIVE F3</u>									
3	Kedah	16	-	-	-	4	12	1	10
5	Muda	59	-	-	-	-	29	6	41
	Total	75	-	-	-	4	41	7	51
<u>P. PINANG</u>									
<u>ALTERNATIVE F1</u>									
5	Muda	19	-	-	-	-	28	6	19
6	Perai	4	-	-	-	-	3	0	4
7	Pinang	2	-	-	-	-	11	0	30
	Total	25	-	-	-	-	42	6	53
<u>ALTERNATIVE F2</u>									
5	Muda	17	-	-	-	-	25	6	19
6	Perai	4	-	-	-	-	3	0	4
7	Pinang	2	-	-	-	-	11	0	30
	Total	23	-	-	-	-	39	6	53
<u>ALTERNATIVE F3</u>									
5	Muda	17	-	-	-	-	25	6	19
6	Perai	4	-	-	-	-	3	0	4
7	Pinang	2	-	-	-	-	11	0	30
	Total	23	-	-	-	-	39	6	53

Remarks; R.I. : River improvement, P.P.: Population protected (the year 2000)
F.W. : Floodway, F.A.: Flood area relieved
Pold.: Polder, C.C.: Construction cost
N.S. : Non-structural measure, in person

Table 26

RECOMMENDED WATER SUPPLY DEVELOPMENT PLAN
FOR CITIES/TOWNS IN PERLIS/KEDAH/P. PINANG

Basin No.	Code No.	City/Town	1985			1990			2000		
			TC	SF	SP	TC	SF	SP	TC	SF	SP
1	1	Kangar	5.5	85	13.6	12.9	90	17.1	41.4	100	26.0
		Perlis State	5.5	85	13.6	12.9	90	17.1	41.4	100	26.0
3	2	Alor Setar	32.6	85	67.2	47.1	90	76.5	138.1	100	100.0
	101	Jitra	5.2	85	17.9	7.7	90	24.3	16.2	100	41.0
	102	Guar Chempedak	3.6	85	8.5	5.5	90	9.9	12.6	100	15.0
	103	Yen	2.5	85	6.0	3.8	90	8.1	13.2	100	13.0
4	3	Sg. Petani	21.6	85	46.8	31.8	90	55.8	91.0	100	79.0
5	104	Tikan Batu	2.2	85	6.0	3.6	90	8.1	16.2	100	14.0
6	4	Kulim	8.5	85	28.9	12.1	90	36.0	25.8	100	54.0
		Kedah State	76.2	85	181.3	111.6	90	218.7	313.1	100	316.0
6	5	Butterworth	56.7	85	78.2	89.3	100	103.0	133.5	100	121.0
	6	Bk. Mertajam	20.5	85	26.4	30.7	90	29.7	47.3	100	38.0
	109	Kg. PMTG Kuching	6.0	85	11.1	9.9	90	14.4	16.9	100	20.0
	110	Perai	32.6	85	10.2	51.5	90	11.7	80.2	100	15.0
7	8	Georgetown	84.7	100	258.0	103.0	100	262.0	141.7	100	294.0
	105	Air Itam	21.9	85	40.0	34.2	90	48.6	54.9	100	65.0
	106	Tg. Tokong	7.9	85	14.5	11.5	90	16.2	17.8	100	21.0
	107	Gelugor	4.9	85	14.5	6.6	90	18.0	10.5	100	25.0
	108	Tg. Bunga	6.0	85	11.1	8.8	90	12.6	14.5	100	17.0
		P. Pinang State	241.2	93	464.0	345.5	97	516.2	517.3	100	616.0
		Total	322.9	90	658.9	470.0	95	752.0	871.8	100	958.0

Remarks; TC: Treatment capacity required in the corresponding year
in $10^3 \text{ m}^3/\text{d}$

SF: Service factor in %

SP: Served population in 10^3

Table 27 RECOMMENDED TREATED WATER SUPPLY DEVELOPMENT PLAN FOR RURAL AREA IN PERLIS/KEDAH/P. PINANG

Basin No.	Basin Name	1985			1990			2000		
		TC	SF	SP	TC	SF	SP	TC	SF	SP
1	Perlis	17.8	75.0	116.2	22.9	75.1	123.1	33.2	75.0	128.3
	Sub-total	17.8	-	116.2	22.9	-	123.1	33.2	-	128.3
	Perlis State	18.0	75.0	116.2	22.9	75.1	123.1	33.2	75.0	128.3
2	P. Langkawi	3.0	54.1	18.4	4.2	60.8	21.9	6.6	64.5	24.5
3	Kedah	47.6	54.0	309.1	68.7	60.8	365.4	104.9	64.4	402.5
4	Merbock	7.2	54.0	48.4	10.8	60.8	57.7	16.3	64.4	63.5
5	Muda	34.1	57.7	185.8	45.2	64.3	211.9	63.9	67.9	227.3
6	Perai	78.1	81.0	303.9	96.1	86.7	340.2	115.1	92.1	338.7
8	Kerian	4.5	58.8	38.4	6.6	65.4	31.6	10.2	68.4	32.2
	Sub-total	174.5	-	894.0	231.6	-	1,028.7	317.0	-	1,088.7
	Kedah State	89.5	54.0	567.1	126.6	60.8	664.6	191.4	64.4	727.1
5	Muda	34.1	57.7	185.8	45.2	64.3	211.9	63.9	67.9	227.3
6	Perai	78.1	81.0	303.9	96.1	86.7	340.2	115.1	92.1	338.7
7	P. Pinang	38.0	84.0	160.4	48.5	89.4	183.3	57.9	95.2	178.0
8	Kerian	4.5	58.8	28.4	6.6	65.4	31.6	10.2	68.4	32.2
9	Kurau	48.5	70.1	281.4	84.1	76.3	307.4	159.4	78.7	371.4
	Sub-total	203.2	-	959.9	280.5	-	1,074.4	406.5	-	1,147.6
	P. Pinang State	121.8	84.0	477.2	148.0	89.4	536.6	179.3	95.2	529.3
Total		395.5	-	1,452.0	535.0	-	1,642.5	756.7	-	1,766.4
Perlis/Kedah/P. Pinang		229.3	65.5	1,160.5	297.5	71.3	1,324.3	403.9	74.6	1,384.7

Remarks; TC: Treatment capacity required in the corresponding year in $10^3 \text{ m}^3/\text{d}$
 SF: Service factor in %
 SP: Served population in 10^3 persons

Table 28 RECOMMENDED UNTREATED WATER SUPPLY DEVELOPMENT
PLAN FOR RURAL AREA IN PERLIS/KEDAH/P. PINANG

Unit: 10⁶ m³/y

Basin No.	Basin Name	1985			1990			2000		
		SD	SF	SP	SD	SF	SP	SD	SF	SP
1	Perlis	0.4	12.5	19.4	0.7	17.9	29.4	1.4	25.0	42.8
	Sub-total	0.4	-	19.4	0.7	-	29.4	1.4	-	42.8
	Perlis State	0.4	12.5	19.4	0.7	17.9	29.4	1.4	25.0	42.8
2	P. Langkawi	0.2	30.6	10.4	0.3	34.2	12.3	0.4	35.5	13.5
3	Kedah	4.8	30.7	175.4	5.2	34.2	205.5	7.1	35.6	222.5
4	Merbock	0.6	30.7	27.5	0.8	34.1	32.4	1.1	35.6	35.1
5	Muda	1.7	27.1	87.4	2.4	30.4	100.2	3.5	32.1	107.3
6	Perai	0.3	4.4	16.6	0.6	5.6	21.9	0.8	7.9	29.1
8	Kerian	0.3	27.1	13.1	0.4	30.2	14.6	0.5	31.6	14.9
	Sub-total	7.9	-	330.4	9.7	-	386.9	13.4	-	422.4
	Kedah State	6.4	30.7	322.4	9.3	34.2	373.7	12.8	35.6	401.9
5	Muda	1.7	27.1	87.4	2.4	30.4	100.2	3.5	32.1	107.3
6	Perai	0.3	4.4	16.6	0.6	5.6	21.9	0.8	7.9	29.1
7	P. Pinang	0.0	1.5	2.9	0.2	2.6	5.3	0.2	4.8	9.0
8	Kerian	0.3	27.1	13.1	0.4	30.2	14.6	0.5	31.6	14.9
9	Kurau	1.6	18.9	76.1	2.1	20.7	83.2	3.2	21.2	100.5
	Sub-total	3.9	-	196.1	5.7	-	225.2	8.2	-	260.8
	P. Pinang State	0.1	1.5	8.5	0.5	2.6	15.4	0.7	4.8	26.7
Total		9.9	-	428.8	12.7	-	504.8	18.2	-	574.7
Perlis/Kedah/P. Pinang		6.9	19.8	350.3	10.5	22.6	418.5	14.9	25.4	471.4

Remarks; SD: Source demand in the rural area in the corresponding year in 10⁶ m³/y
SF: Service factor in the rural area in %
SP: Served population in the rural area in 10³ persons

Table 29 RECOMMENDED WATER SOURCE DEVELOPMENT PLAN
IN KEDAH/PERLIS/PULAU PINANG

(1) DAM

Location		Facilities	Purpose	Catchment Area (km ²)	Active Storage Capacity (10 ⁶ m ³)	Net Supply Capacity (10 ⁶ m ³ /y)	Construction Cost (M\$10 ⁶)	Construction Period
State**	Basin No.							
Perlis	1	Timah-Tasoh dam	WS, IR, FM	150	6	20	14	1983-1987
Kedah	2	Aver Tawar dam	IR	11	2	6	131	1985-1989
Kedah	2	Ulu Melaka dam	IR	7	2	5	12	1985-1989
Kedah	3	Ahning dam	WS, IR	120	27	73	51	1983-1987
Kedah	3	Badak-Temin dam	IR	114	19	59	21	1985-1989
Kedah	3	Sari dam	IR	61	14	38	23	1987-1991
Kedah	3	Durian dam	IR	75	17	45	25	1991-1995
Kedah	5	Naok-Reman dams	WS, IR	-	-	350	123	1983-1987
Perak	10	Rui dam	WS, IR	215	145	140	447	1985-1989
Kedah	5	Beris dam	WS, IR	115	15	55	19	1988-1992
P. Pinang	6	Mengkuang Phase I & II	WS	4	24	24	55	1981-1985
Kedah/Perak	8	Kerian dam	WS, IR	112	9	40	54***	1985-1989

U/C (Phase I)

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m ³ /s)	Construction Cost (M\$10 ⁶)	Construction Period
1	Pumping from the Muda Irrigation canal	Kedah Perlis 3 to 1	2.5	*	1983-1987
3	Jeniang diversion (barrage & canal)	Kedah 5 to 3	8.4	included in Naok-Reman dams	1983-1987
4	Naok diversion	Kedah 5 to 4	1.5	*	1985-1989
10	Rui diversion (tunnel)	Perak Kedah 10 to 5	8.9	(14)	1985-1989
6	Pipe line	Kedah P. Pinang 5 to 6	7.5	*	1985-1989
6	Pipe line	Kedah P. Pinang 5 to 6	1.3	*	1986-1990
6	Pipe line	Kedah P. Pinang 5 to 6	1.2	*	1991-1995
7	Pipe line	Kedah P. Pinang 5 to 7	2.3	*	1985-1989
7	Pipe line	Kedah P. Pinang 5 to 7	1.0	*	1986-1990
7	Pipe line	Kedah P. Pinang 5 to 7	0.8	*	1991-1995

Remarks; IR = Irrigation; WS = Water Supply; FM = Flood Mitigation, U/C = Under Construction
* = Cost included in other distribution facilities
Construction cost = Financial cost at 1980 constant price
** = The state where the facilities are located
() = Included in dam cost
*** = Includes the part of diversion to the Kurau river

Table 30 RECOMMENDED PLAN FOR IMPROVEMENT OF PURIFICATION SYSTEM IN PALM OIL MILLS AND RUBBER FACTORIES IN TREATMENT CAPACITY IN PERLIS/KEDAH/P. PINANG

Unit: m³/d

Basin		1981 - 1990			1991 - 2000		
No.	Name	Palm Oil	Rubber	Total	Palm Oil	Rubber	Total
4	Merbok	0	2,500	2,500	0	2,332	2,332
6	Perai	0	936	936	0	5,852	5,852
9	Kurau	0	0	0	0	520	520
Total		0	3,436	3,436	0	8,704	8,704

Table 31 RECOMMENDED PUBLIC SEWERAGE DEVELOPMENT PLAN FOR WATER POLLUTION ABATEMENT IN PERLIS/KEDAH/P. PINANG

Basin No.	City/Tosn No. Name	1990			2000		
		Treatment Capacity (10 ³ m ³ /d)	Service Factor (%)	Served Population (10 ³)	Treatment Capacity (10 ³ m ³ /d)	Service Factor (%)	Served Population (10 ³)
4	C3 Sg. Petani	31	80	50	128	100	79
6	C4 Kulim	7	65	26	27	100	54
Total		38	-	76	155	-	133

Table 32 ASSUMED PUBLIC SEWERAGE DEVELOPMENT
NOT AFFECTING RIVER WATER QUALITY
IN PERLIS/KEDAH/P. PINANG

Basin No.	City/Town No. Name	1990			2000		
		Treatment Capacity (10 ³ m ³ /d)	Service Factor (%)	Served Popu- lation (10 ³)	Treatment Capacity (10 ³ m ³ /d)	Service Factor (%)	Served Popu- lation (10 ³)
3	C2 Alor Setar	30	50	43	119	60	60
6	C5 Butterworth	42	35	36	148	80	97
6	C6 Bukit Mertajam	15	35	12	54	80	30
7	C8 Georgegown	79	70	183	128	80	235
Total		166	-	274	449	-	422

Remarks; There is a sewerage system in C8, served 174,000 people with treatment capacity of 46,000 m³/d in 1980.

Table 33 POLLUTION LOAD IN 2000 BY BASIN UNDER WITH-AND-WITHOUT IMPLEMENTATION IN PERLIS/KEDAH/P. PINANG

Basin No.	Basin Name	Without Project				Max. BOD in River (mg/lit)	With Project				Max. BOD in River (mg/lit)
		BOD Load into River (ton/d)			Total		BOD Load into River (ton/d)			Total	
		PR	UI	RA			PR	UI	RA		
1	Perlis	0	4	0	4	14	0	4	0	4	14
2		-----				Not studied	-----				
3	Kedah	1	13	1	15	11	1	8	1	10	7
4	Merbok	8	6	0	14	54	0	2	0	2	9
5	Muda	9	1	1	11	3	9	1	1	11	3
6	Perai	7	2	2	11	32	0	0	2	2	5
7		-----				Not studied	-----				
8	Kerian	5	0	0	5	3	5	0	0	5	3
9	Kurau	3	2	1	6	6	0	2	1	3	0
	Total	33	28	5	66	-	15	17	5	37	-

Remarks; PR: Palm oil mill and rubber factory effluent
 UI: Urban sewer and industrial effluent
 RA: Rural sewer and animal husbandry

Table 34 RECOMMENDED FLOOD MITIGATION PROGRAM
IN PERLIS/KEDAH/P. PINANG

Basin No.	Name of River	R.I. (km)	F.W. (km)	Dam (nos)	Pold. (nos)	N.S. (10 ³)	P.P. (10 ³)	F.A. (10 ³ ha)	C.C. (M\$10 ⁶)
<u>PERLIS</u>									
<u>By 1990</u>									
1	Perlis	34	-	1	-	-	25	4	22
<u>By 2000</u>									
1	Perlis	34	-	1	-	-	25	4	22
<u>KEDAH</u>									
<u>By 1990</u>									
3	Kedah	-	-	-	-	-	-	-	-
5	Muda	45	-	-	-	-	21	4	27
	Total	45	-	-	-	-	21	4	27
<u>By 2000</u>									
5	Muda	59	-	-	-	-	29	6	41
<u>P. PINANG</u>									
<u>By 1990</u>									
5	Muda	3	-	-	-	-	22	5	-
6	Perai	-	-	-	-	-	-	-	-
7	P. Pinang	1	-	-	-	-	6	-	15
	Total	4	-	-	-	-	28	5	15
<u>By 2000</u>									
5	Muda	17	-	-	-	-	25	6	19
6	Perai+	4	-	-	-	-	3	-	4
7	P. Pinang	2	-	-	-	-	11	-	30
	Total	23	-	-	-	-	39	6	53

Remarks; R.I. : River improvement, P.P.: Population protected (the year 2000)
F.W. : Floodway, F.A.: Flood area relieved
Pold.: Polder, C.C.: Construction cost in person
N.S. : Non-structural measure,

Table 35 ASSUMED UNIT CONSTRUCTION COST (1/2)

1. Compensation on Land (M\$10⁶/km²)

Irrigated paddy	2.5	Urban area class S	100
Rainfed paddy	1.5	Urban area class A	10
Tree crop field classes A & B	1.5	Urban area class B	5
Tree crop field class C	0.5	Village area class A	5
Forest class A	0.5	Village area class B	1
Forest class B	0.1		

S: very good access, A: good access
B: poor access, C: very poor access

2. Resettlement (M\$10³/household)

Urban	30	Rural	10
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3. Civilwork

Dam	M\$48-66 per m ³ of embankment volume
Canal	M\$50-94/m per m ³ /s of discharge capacity
Tunnel	M\$160-182/m per m ³ /s of discharge capacity
Pipeline	M\$990-1,980/m per m ³ /s of discharge capacity
Barrage/Weir	M\$1,320/m per m ³ /s of 100-y maximum capacity
Pumping station	M\$7,700-14,300 m ³ /s of discharge capacity

4. River Facilities

<u>Channel improvement (M\$10⁶/km)</u>		<u>Floodway (M\$10⁶/km)</u>	
200 m ³ /s	0.2 - 0.4	200 m ³ /s	0.2 - 0.5
500 m ³ /s	0.3 - 0.6	500 m ³ /s	0.4 - 0.9
1,000 m ³ /s	0.4 - 0.8	1,000 m ³ /s	0.5 - 1.2
10,000 m ³ /s	1.2 - 2.9	2,000 m ³ /s	0.7 - 1.8

Polder

Protection bund	M\$150-700 x 10 ³ /km
Drainage system	M\$540 x 10 ³ /km
Drainage pump	M\$150-380 x 10 ³ per m ³ /s

Remarks; Unit construction costs include the engineering and administration cost, but the physical contingency is not included.

Table 36 ASSUMED UNIT CONSTRUCTION COST (2/2)

5. D&I Water Supply System

Pipeline	M\$430/m per m ³ /s of discharge capacity
Treatment plant	M\$710 per m ³ /d of capacity
Distribution system	M\$1,300 per m ³ /d of capacity

6. Sewerage System M\$157 x 10⁶ per 100 x 10³ m³/d

7. D&I Pre-treatment System

Aerated lagoon	M\$38 x 10 ⁶ per 100 x 10 ³ m ³ /d
Rapid sandfilter bed	M\$112 x 10 ⁶ per 100 x 10 ³ m ³ /d

8. Power Facilities

Generating equipment

Rated head more than 140 m	M\$275-440 per kW
Rated head 20 - 80 mm	M\$550-880 per kW
Rated less than 30 m	M\$1,320-1,540 per kW

Transmission line M\$162-194 x 10³ per km

9. Irrigation Facilities

From rainfed paddy to irrigated paddy	M\$11,370 per ha
From new reclaimed land to irrigated paddy	M\$12,300 per ha
From irrigated single cropped paddy to double	M\$6,150 per ha
Tertiary development and rehabilitation	M\$5,470 per ha

Remarks; Unit construction costs include the engineering and administration cost, but the physical contingency is not included.

Table 37 ESTIMATED PUBLIC DEVELOPMENT EXPENDITURE FOR
RECOMMENDED PLAN IN PERLIS/KEDAH/P. PINANG

		4MP	5MP	6MP	7MP	Total
Source Development		229	662	35	0	926
Irrigation	Perlis	11	79	10	15	115
	Kedah	33	220	331	326	910
	P. Pinang	0	9	1	0	10
	Sub-total	44	308	342	341	1,035
Inland Fishery	Perlis	0	0	12	6	18
	Kedah	2	20	68	56	146
	P. Pinang	1	7	13	7	28
	Sub-total	3	27	93	69	192
Public Water Supply	Perlis	14	28	32	13	87
	Kedah	100	207	227	93	627
	P. Pinang	135	198	180	73	586
	Sub-total	249	433	439	179	1,300
Public Water Supply (Pretreatment facilities)	Perlis	0	0	0	0	0
	Kedah	7	9	6	2	24
	P. Pinang	7	9	5	2	23
	Sub-total	14	18	11	4	47
Public Sewerage (Effective for river water pollution abatement)	Perlis	0	0	0	0	0
	Kedah	35	63	64	26	188
	P. Pinang	0	0	0	0	0
	Sub-total	35	63	64	26	188
Public Sewerage (Others)	Perlis	0	0	0	0	0
	Kedah	32	50	47	19	148
	P. Pinang	74	116	111	45	346
	Sub-total	106	166	158	64	494
Flood Mitigation	Perlis	-	23	-	-	23
	Kedah	-	28	15	-	43
	P. Pinang	0	15	15	22	52
	Sub-total	0	66	30	22	118
Total		680	1,743	1,172	705	4,300

Table 38

ESTIMATED ANNUAL RECURRENT EXPENDITURE FOR
RECOMMENDED PLAN IN PERLIS/KEDAH/P. PINANG

		4MP	5MP	6MP	7MP	Total
Source Development		0	7	22	23	52
Irrigation	Perlis	0	1	7	8	16
	Kedah	0	2	18	43	63
	P. Pinang	0	0	1	1	2
	Sub-total	0	3	26	52	81
Inland Fishery	Perlis	0	0	1	1	2
	Kedah	0	1	5	11	17
	P. Pinang	0	0	1	2	3
	Sub-total	0	1	7	14	22
Public Water Supply	Perlis	0	3	5	8	16
	Kedah	0	18	40	59	117
	P. Pinang	0	22	41	56	119
	Sub-total	0	43	86	123	252
Public Water Supply (Pretreatment facilities)	Perlis	0	0	0	0	0
	Kedah	0	1	2	2	5
	P. Pinang	0	1	2	2	5
	Sub-total	0	2	4	4	10
Public Sewerage (Effective for river water pollution abatement)	Perlis	0	0	0	0	0
	Kedah	0	12	25	36	73
	P. Pinang	0	0	0	0	0
	Sub-total	0	12	25	36	73
Public Sewerage (Others)	Perlis	0	0	0	0	0
	Kedah	0	10	20	28	59
	P. Pinang	0	25	47	65	136
	Sub-total	0	35	67	93	195
Flood Mitigation	Perlis	0	-	11	11	22
	Kedah	0	-	14	21	35
	P. Pinang	0	-	8	16	24
	Sub-total	0	0	33	48	81
Total		0	103	270	393	766

Table 39 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED
PLAN FOR WATER DEMAND AND SUPPLY BALANCE
IN PERLIS/KEDAH/P. PINANG

Item	Amount
1. National Economic Development	
1.1 Economic Benefit	
Irrigation	(M\$10 ⁶) 62
D&I water supply	(M\$10 ⁶) 122
Fish culture	(M\$10 ⁶) 8
Reservoir recreation	(M\$10 ⁶) 6
Total	(M\$10 ⁶) 198
1.2 Economic Cost	
Irrigation	(M\$10 ⁶) 30
D&I water supply	(M\$10 ⁶) 116
Fish culture	(M\$10 ⁶) 8
Dams, barrages & diversion facilities	(M\$10 ⁶) 31
Total	(M\$10 ⁶) 185
1.3 EIRR	(%) 10
2. Environmental Quality	
2.1 Beneficial Effect	
Safe maintenance flow period (2000)	See Table
Surface area of lake created	(km ²) 58
2.2 Adverse Effect	
Possible reduction in kind of fish immediately downstream of dams and barrages	(nos. of site) 11
3. Social Well-being	
3.1 Beneficial Effect	
Number of farm households benefited by proposed irrigation in 2000	(10 ³) 75
Number of people served by proposed public water supply in 2000	(10 ³) 2,814
Safe supply period (2000)	See Table
3.2 Adverse Effect	
Number of people to be removed for construction of facilities	(10 ²) 5

Remarks; All effects by proposed hydropower project are not shown except irrigation, D&I water supply and lake recreation benefit.

Table 40 SAFE SUPPLY PERIOD AND SAFE RIVER MAINTENANCE
FLOW PERIOD IN 2000 WITH RECOMMENDED PLAN
IMPLEMENTED PERLIS/KEDAH/P. PINANG

Unit: days

Basin No.	Basin Name	Safe Supply Period		Safe Maintenance Flow Period	
		Plan Implemented	Natural Flow	Plan Implemented	Natural Flow
1	Perlis	305	195	284	174
2	P. Langkawi	351	285	316	265
3	Kedah	335	133	317	133
4	Merbok	365	275	365	200
5	Muda	346	225	279	195
6	Perai	365	170	365	169
7	Pulau Pinang	365	148	365	143

Remarks; Natural Flow: Natural flow only is depended upon, with
neither existing nor proposed facilities.

Table 41 BENEFICIAL AND ADVERSE EFFECTS OF
RECOMMENDED PLAN FOR WATER POLLUTION
ABATEMENT IN PERLIS/KEDAH/P. PINANG

Item	Amount
1. National Economic Development	
1.1 Economic Benefit	
Sewerage	(M\$10 ⁶) 15
Saving in pre-treatment for D&I water supply	(M\$10 ⁶) 20
Total	(M\$10 ⁶) 35
1.2 Economic Cost	
Sewerage	(M\$10 ⁶) 35
Private purification facilities /2	(M\$10 ⁶) 1
Pre-treatment for D&I water supply	(M\$10 ⁶) 2
Total	(M\$10 ⁶) 38
2. Environmental Quality	
2.1 Beneficial Effects	
Length of river stretch where BOD concentration is not more than 10 mg/lit in 2000 compared with without project condition (Study length = 314 km)	(km) 305/237 ^{/1}
Length of river stretch where BOD concentration is not more than 5 mg/lit in 2000 compared with without project condition (Study length = 314 km)	(km) 264/221 ^{/1}
2.2 Adverse Effect	
3. Social Well-Being	
3.1 Beneficial Effects	
Number of people served by proposed sewerage system in 2000	(10 ³) 555
3.2 Adverse Effect	

Remarks; /1: (Length of river stretch with Project)/
(Length of river stretch without Project)
and including the river stretch in the State of Perak.
/2: Including the rubber factories and palm oil mills
in such part of the State of Perak as located in
Basin 8 and 9.

Table 42 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED
PLAN FOR FLOOD MITIGATION IN PERLIS/KEDAH/P. PINANG

Item		Recommended Plan
1. National Economic Development		
1.1 Economic Benefit		
Damage reduction	(M\$10 ⁶)	5.6
1.2 Economic Cost		
Flood mitigation work	(M\$10 ⁶)	4.0
1.3 EIRR	(%)	10
2. Environmental Quality		
2.1 Beneficial Effect		
Length of improved stretch	(km)	116
2.2 Adverse Effect		-
3. Social Well-Being		
3.1 Beneficial Effect		
Number of protected people by proposed facilities in 2000	(10 ³)	93
Population served by proposed flood warning system in 2000	(10 ³)	25
Area relieved from flood hazards	(10 ³ ha)	16
3.2 Adverse Effect		
Number of people to be removed for construction of facilities	(10 ³)	5

Table 43 SUMMARY OF FUTURE ECONOMIC NET VALUE
OF WET PADDY BY TYPE OF SCHEME IN
PERLIS/KEDAH/P. PINANG

	Yield (ton/ha)	Unit Price (M\$/ton)	Gross Value (M\$/ha)	Produc- tion Cost (M\$/ha)	Net Value (M\$/ha)
(1) Major Irrigation Scheme (Muda)					
Double cropping	9.4	640	6,016	1,754	4,262
Single cropping	4.5	640	2,880	852	2,028
(2) Minor Irrigation Scheme					
- Perlis					
Double cropping	8.9	640	5,696	1,717	3,979
Single cropping	4.2	640	2,688	835	1,853
- Kedah					
Double cropping	7.9	640	5,056	1,553	3,503
Single cropping	3.7	640	2,368	738	1,630
- Pulau Pinang					
Double cropping	8.5	640	5,440	1,556	3,884
Single cropping	4.0	640	2,560	747	1,813
(3) Rainfed Scheme					
- Perlis					
Single cropping	2.6	640	1,664	810	854
- Kedah					
Single cropping	2.3	640	1,472	730	742
- Pulau Pinang					
Single cropping	2.5	640	1,600	733	867

Table 44 ESTIMATED AND PROJECTED SERVICE FACTOR AND PER CAPITA DAILY USE OF DOMESTIC WATER IN PERLIS/KEDAH/P.PINANG UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

City/Rural	Service Factor (%)				Per Capita Daily Use (lpcd)			
	Estimated 1980	1985	Projected 1990	2000	Estimated 1980	1985	Projected 1990	2000
<u>PERLIS</u>								
1. <u>Urban Area</u>								
1 Kangar	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
2. <u>Rural Area</u>								
PWD Rural	75.0	75.0	73.8	73.5	75.0	95.0	115.0	155.0
MOH Rural	5.5	12.5	17.7	24.5	40.0	45.0	55.0	65.0
3. <u>Non-Pipe-Served Area</u>								
	-	-	-	-	40.0	40.0	40.0	40.0
<u>KEDAH</u>								
1. <u>Urban Area</u>								
2 Alor Setar	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
3 Sg. Petani	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
4 Kulim	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
101 Jitra	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
102 Guar Chempedak	44.0	85.0	90.0	95.0	75.0	170.0	185.0	210.0
103 Yan	44.0	84.7	94.0	95.0	75.0	95.0	115.0	210.0
104 Tikan Batu	44.0	84.7	94.0	95.0	75.0	95.0	115.0	210.0
2. <u>Rural Area</u>								
PWD Rural	28.0	54.0	60.2	63.4	75.0	95.0	115.0	155.0
MOH Rural	16.0	30.7	33.8	35.1	40.0	45.0	55.0	65.0
3. <u>Non-Pipe-Served Area</u>								
	-	-	-	-	40.0	40.0	40.0	40.0
<u>P.PINANG</u>								
1. <u>Urban Area</u>								
5 Butterworth	80.0	85.0	90.0	100.0	160.0	170.0	185.0	220.0
6 Bk. Mertajam	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
8 Georgetown	100.0	100.0	100.0	100.0	170.0	180.0	195.0	220.0
105 Air Itam	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
106 Tg. Tokong	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
107 Gelugor	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
108 Tg. Bunga	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
109 Kg. PMTG Kuching	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
110 Perai	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
2. <u>Rural Area</u>								
PWD Rural	78.0	84.0	87.5	92.3	75.0	95.0	115.0	155.0
MOH Rural	0.6	1.5	2.5	4.7	40.0	45.0	55.0	65.0
3. <u>Non-Pipe-Served Area</u>								
	-	-	-	-	40.0	40.0	40.0	40.0

Table 45 ESTIMATED AND PROJECTED D&I WATER DEMAND
BY BASIN UNDER THE CONDITION OF LOWER
ECONOMIC GROWTH IN PERLIS/KEDAH/P. PINANG (1/2)

Unit: 10⁶ m³/y

Basin No.	City/Rural	Estimated				Projected					
		1980 D&I	1985		Total	1990			2000		
		D	I			D	I	Total	D	I	Total
1	1 Kangar	2.2	1.1	2.6	3.7	1.4	3.9	5.3	2.1	9.0	11.1
	Rural	4.8	6.0	0.4	6.4	7.7	0.3	8.0	11.3	0.2	11.5
	Sub-total	7.0	7.1	3.0	10.1	9.1	4.2	13.3	13.4	9.2	22.6
	Perlis	7.0	7.1	3.0	10.1	9.1	4.2	13.3	13.4	9.2	22.6
2	Rural	0.9	1.1	0.2	1.3	1.5	0.2	1.7	2.3	0.1	2.4
3	2 Alor Setar	8.9	5.6	9.8	15.4	6.5	12.3	18.8	8.1	28.4	36.5
	101 Jitra	1.1	1.6	0.3	1.9	2.1	0.4	2.5	3.3	0.9	4.2
	102 Guar Chempedak	0.7	0.7	1.0	1.7	0.9	1.3	2.2	1.1	2.8	3.9
	103 Yan	0.5	0.3	0.8	1.1	0.5	1.1	1.6	1.0	2.4	3.4
	City Total	11.2	8.2	11.9	20.1	10.0	15.1	25.1	13.5	34.5	48.0
	Rural	13.3	18.9	2.1	21.0	26.0	1.4	27.4	37.9	1.1	39.0
	Basin Total	24.5	27.1	14.0	41.1	36.0	16.5	52.5	51.4	35.6	87.0
	4	3 Kulang Pasu	5.6	3.8	6.0	9.8	4.8	7.8	12.6	6.4	17.8
	Rural	3.1	3.0	1.6	4.6	4.1	1.7	5.8	6.0	2.2	8.2
	Basin Total	8.7	6.8	7.6	14.4	8.9	9.5	18.4	12.4	20.0	32.4
5	104 Tikan Batu	0.3	0.3	0.6	0.9	0.4	0.9	1.3	1.1	2.6	3.7
	Rural	12.0	11.0	5.2	16.2	14.4	4.7	19.1	20.7	5.4	26.1
	Basin Total	12.3	11.3	5.8	17.1	14.8	5.6	20.4	21.8	8.0	29.8
6	4 Kulim	2.2	2.5	0.8	3.3	3.1	1.0	4.1	4.2	2.3	6.5
	5 Butterworth	20.7	6.5	22.9	29.4	8.0	32.3	40.3	10.7	47.5	58.2
	6 Bk. Mertajan	7.8	2.3	8.7	11.0	2.6	12.3	14.9	3.0	18.0	21.0
	109 Kg. Pmtg. Kuching	1.9	0.9	2.1	3.0	1.2	3.3	4.5	1.5	5.2	6.7
	110 Perai	13.1	0.8	18.5	19.3	1.0	26.3	27.3	1.2	38.7	39.9
	City Total	45.7	13.0	53.0	66.0	15.9	75.2	91.1	20.6	111.7	132.3
	Rural	26.3	15.0	15.3	30.3	20.2	14.8	35.0	29.4	16.2	45.6
	Basin Total	72.0	28.0	68.3	96.3	36.1	90.0	126.1	50.0	127.9	177.9
8	Rural	1.8	1.7	0.9	2.6	2.1	1.0	3.1	2.9	1.5	4.4
	Sub-total	120.2	76.0	96.8	172.8	99.4	122.8	222.2	140.8	193.1	333.9
	Kedah	48.5	49.5	28.4	77.9	65.2	32.7	97.9	93.3	67.0	160.3

Remarks; D: Domestic water demand
I: Industrial water demand
Total: Total source demand

Table 46 ESTIMATED AND PROJECTED D&I WATER DEMAND BY BASIN UNDER THE CONDITION OF LOWER ECONOMIC GROWTH IN PERLIS/KEDAH/P. PINANG (2/2)

Unit: 10⁶ m³/y

Basin No.	City/Rural	Estimated				Projected					
		1980	1985			1990			2000		
		D&I	D	I	Total	D	I	Total	D	I	Total
5	104 Tiban Batu	0.3	0.3	0.6	0.9	0.4	0.9	1.3	1.1	2.6	3.7
	Rural	12.0	11.0	5.2	16.2	14.4	4.7	19.1	20.7	5.4	26.1
	Basin Total	12.3	11.3	5.8	17.1	14.8	5.6	20.4	21.8	8.0	29.8
6	4 Kulim	2.2	2.5	0.8	3.3	3.1	1.0	4.1	4.2	2.3	6.5
	5 Butterworth	20.7	6.5	22.9	29.4	8.0	32.3	40.3	10.7	47.5	58.2
	6 Bk. Mertajan	7.8	2.3	8.7	11.0	2.6	12.3	14.9	3.0	18.0	21.0
	109 Kg. Pmtg. Kuching	1.9	0.9	2.1	3.0	1.2	3.3	4.5	1.5	5.2	6.7
	110 Perai	13.1	0.8	18.5	19.3	1.0	26.3	27.3	1.2	38.7	39.9
	City Total	45.7	13.0	53.0	66.0	15.9	75.2	91.1	20.6	111.7	132.3
	Rural	26.3	15.0	15.3	30.3	20.2	14.8	35.0	29.4	16.2	45.6
Basin Total	72.0	28.0	68.3	96.3	36.1	90.0	126.1	50.0	127.9	177.9	
7	8 Georgetown	28.7	20.7	12.1	32.8	21.9	17.3	39.2	24.2	25.3	49.5
	105 Air Itam	6.7	3.3	7.2	10.5	4.2	11.3	15.5	5.2	17.5	22.7
	106 Tg. Tokong	2.6	1.1	2.5	3.6	1.4	3.8	5.2	1.7	5.9	7.6
	107 Gelugor	1.4	1.2	0.7	1.9	1.5	1.1	2.6	2.0	1.5	3.5
	108 Tg. Bunga	1.9	0.9	2.7	3.6	1.1	3.2	4.3	1.3	4.6	5.9
	City Total	41.3	27.2	25.2	52.4	30.1	36.7	66.8	34.4	54.8	89.2
	Rural	11.9	7.8	6.5	14.3	11.1	6.4	17.5	16.3	6.5	22.8
	Basin Total	53.2	35.0	31.7	66.7	41.2	43.1	84.3	50.7	61.3	112.0
8	Rural	1.8	1.7	0.9	2.6	2.1	1.0	3.1	2.9	1.5	4.4
9	10 Taiping	26.3	17.5	21.5	39.0	21.8	31.8	53.6	27.4	58.3	85.7
	112 Bagon Serat	2.5	0.7	3.1	3.8	0.9	4.6	5.5	1.1	8.5	9.6
	City Total	28.8	18.2	24.6	42.8	22.7	36.4	59.1	28.5	66.8	95.3
	Rural	16.0	15.0	8.1	23.1	18.6	11.5	30.1	25.3	20.4	45.7
	Basin Total	44.8	33.2	32.7	65.9	41.3	47.9	89.2	53.8	87.2	141.0
	Sub-total	184.1	109.2	139.4	248.6	135.5	187.6	323.1	179.2	285.9	465.1
	P. Pinang	124.1	61.2	99.3	160.5	74.8	131.8	206.6	97.4	186.8	284.2
Total		225.2	151.3	164.2	315.5	191.0	218.0	409.0	258.7	350.8	609.5
Perlis/Kedah/P. Pinang		179.6	117.8	130.7	248.5	149.1	168.7	317.8	204.1	263.0	467.1

Remarks; D: Domestic water demand
I: Industrial water demand
Total: Total source demand

Table 47 : RECOMMENDED WATER SUPPLY DEVELOPMENT PLAN FOR
CITIES/TOWNS IN PERLIS/KEDAH/P. PINANG UNDER
THE CONDITION OF LOWER ECONOMIC GROWTH

Basin Code			1985			1990			2000		
No.	No.	City/Town	TC	SF	SP	TC	SF	SP	TC	SF	SP
1	1	Kangar	7.1	85	13.6	10.1	90	16.2	20.0	95	20.9
		Perlis State	7.1	85	13.6	10.1	90	16.2	20.0	95	20.9
3	2	Alor Setar	31.0	85	66.3	38.1	90	72.0	66.8	95	78.9
	101	Titra	5.2	85	17.9	6.8	90	23.4	11.5	95	32.3
	102	Guar Chempedak	3.6	85	8.5	4.9	90	9.9	7.7	95	11.4
	103	Yen	2.2	85	6.0	3.3	90	8.1	6.6	95	9.5
4	3	Sg. Petani	20.3	85	45.9	26.0	90	53.1	45.8	95	62.7
5	104	Tikan Batu	1.9	85	5.1	2.7	90	7.2	7.1	95	10.5
6	4	Kulim	8.5	85	28.9	10.7	90	34.2	16.2	95	41.8
		Kedah State	72.7	85	178.6	92.5	90	207.9	161.7	95	247.1
6	5	Butterworth	53.7	85	77.4	72.3	90	87.3	104.1	100	101.0
	6	Bk. Mertajam	20.0	85	26.4	26.3	90	27.9	36.2	95	29.5
	109	Kg. PMTG									
		Kuching	6.0	85	11.1	8.8	90	13.5	12.3	95	15.2
	110	Perai	30.4	85	9.4	42.7	90	10.8	62.2	95	12.4
7	8	Georgetown	80.8	100	255.0	92.3	100	248.0	111.2	100	243.0
	105	Air Itam	20.6	85	39.1	29.6	90	45.9	42.2	95	51.3
	106	Tg. Tokong	7.1	85	13.6	9.9	90	15.3	14.0	95	17.1
	107	Gelugor	4.9	85	14.5	6.3	90	17.1	8.5	95	20.0
	108	Tg. Bunga	6.0	85	11.1	8.2	90	12.6	11.0	95	13.3
		P. Pinang State	229.5	93	457.6	296.4	95	478.4	401.7	98	502.8
		Total	309.3	90	649.8	399.0	93	702.5	583.4	97	770.8

Remarks; TC: Treatment capacity required in the corresponding year
in $10^3 \text{ m}^3/\text{d}$

SF: Service factor in %

SP: Served population in 10^3

Table 48 RECOMMENDED TREATED WATER SUPPLY DEVELOPMENT PLAN
FOR RURAL AREA IN PERLIS/KEDAH/P. PINANG UNDER
THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	Basin Name	1985			1990			2000		
		TC	SF	SP	TC	SF	SP	TC	SF	SP
1	Perlis	16.9	75.0	117.0	21.1	73.8	122.6	30.4	73.5	133.0
	Sub-total	16.9	-	117.0	21.1	-	122.6	30.4	-	133.0
	Perlis State	16.9	75.0	117.0	21.1	73.8	122.6	30.4	73.5	133.0
2	P. Langkawi	2.7	54.1	18.4	3.9	60.3	22.3	6.0	63.5	25.4
3	Kedah	46.1	54.0	309.6	63.3	60.1	367.0	94.9	63.4	416.8
4	Merbock & Others	6.9	54.1	48.7	9.9	60.2	57.7	15.1	63.4	65.9
5	Muda	32.6	57.6	186.0	41.6	63.5	211.9	58.5	66.9	231.6
6	Parai & Others	75.4	81.0	305.6	91.0	85.0	346.2	118.8	89.9	381.9
8	Kerian	4.5	58.8	28.4	5.7	64.5	31.2	8.4	67.8	32.8
	Sub-total	168.2	-	896.7	215.4	-	1,036.3	301.7	-	1,154.4
	Kedah State	85.6	54.0	568.5	116.3	60.2	666.1	171.8	63.4	746.2
5	Muda	32.6	57.6	186.0	41.6	63.5	211.9	58.5	66.9	231.6
6	Parai & Others	75.4	81.0	305.6	91.0	85.0	346.2	118.8	89.9	381.9
7	P. Pinang	36.8	83.9	162.0	46.1	87.5	189.8	62.4	92.3	213.3
8	Kerian	4.5	58.8	28.4	5.7	64.5	31.2	8.4	67.8	32.8
9	Kurau	52.1	70.1	280.7	71.1	74.8	296.5	110.0	77.9	307.4
	Sub-total	201.4	-	962.7	255.5	-	1,075.6	358.1	-	1,167.0
	P. Pinang State	117.2	84.0	480.2	140.7	87.5	549.4	190.2	92.3	610.4
	Total	274.0	-	1,456.4	353.7	-	1,645.2	504.5	-	1,808.1
	Perlis/Kedah/P. Pinang	219.7	65.5	1,165.7	278.1	70.4	1,338.1	392.4	73.8	1,489.6

Remarks; TC: Treatment capacity required in the corresponding year in 10³ m³/d
SF: Service factor in %
SP: Served population in 10³ persons

Table 49

RECOMMENDED UNTREATED WATER SUPPLY DEVELOPMENT
 PLAN FOR RURAL AREA IN PERLIS/KEDAH/P. PINANG
 UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	Basin Name	1985			1990			2000		
		SD	SF	SP	SD	SF	SP	SD	SF	SP
1		0.4	12.5	19.5	0.7	17.7	29.3	1.3	24.5	44.3
	Sub-total	0.4	-	19.5	0.7	-	29.3	1.3	-	44.3
	Perlis State	0.4	12.5	19.5	0.7	17.7	29.3	1.3	24.5	44.3
2	P. Langkawi	0.2	30.6	10.4	0.3	33.8	12.5	0.4	35.0	14.0
3	Kedah	3.5	30.7	175.7	5.2	33.8	206.4	6.9	35.1	230.4
4	Merbock+	0.6	30.6	27.6	0.8	33.9	32.5	1.1	35.0	36.4
5	Muda	1.7	27.1	87.6	2.4	30.0	100.1	3.4	31.4	108.7
6	Perai+	0.3	4.4	16.6	0.6	5.4	21.9	0.9	7.3	31.0
8	Kerian	0.3	27.1	13.1	0.4	29.8	14.4	0.5	40.0	15.0
	Sub-total	6.6	-	331.0	9.7	-	387.8	13.2	-	435.5
	Kedah State	6.4	30.7	322.4	9.3	33.8	374.7	12.5	35.1	412.4
5	Muda	1.7	27.1	87.6	2.4	30.0	100.1	3.4	31.4	108.7
6	Perai+	0.3	4.4	16.6	0.6	5.4	21.9	0.9	7.3	31.0
7	P. Pinang	0	1.6	3.0	0.2	2.5	5.5	0.3	4.7	10.8
8	Kerian	0.3	27.1	13.1	0.4	29.8	14.4	0.5	40.0	15.0
9	Kuraut	1.6	19.0	76.0	1.9	20.2	80.3	2.5	21.1	83.2
	Sub-total	3.9	-	196.3	5.5	-	222.2	7.6	-	248.7
	P. Pinang State	0.4	1.5	8.8	0.5	2.5	15.8	0.9	4.7	30.7
	Total	8.6	-	429.5	12.5	-	502.9	17.3	-	573.8
	Perlis/Kedah/P. Pinang	7.2	19.7	350.7	10.5	22.1	419.8	14.7	24.2	487.4

Remarks; SD: Source demand in the rural area in the corresponding year in $10^6 \text{ m}^3/\text{y}$
 SF: Service factor in the rural area in %
 SP: Served population in the rural area in 10^3 persons

Table 50 RECOMMENDED WATER SOURCE DEVELOPMENT PLAN
IN PERLIS/KEDAH/P. PINANG UNDER THE
CONDITION OF LOWER ECONOMIC GROWTH

(1) DAM

State**	Location Basin No.	Facilities	Purpose	Catch- ment Area (km ²)	Active Storage Capacity (10 ⁶ m ³)	Net Supply Capacity (10 ⁶ m ³ /y)	Construc- tion Cost (M\$10 ⁶)	Construc- tion Period
Perlis	1	Timah-Tasoh dam	WS, IR, FM	150	6	20	14	1986 - 1990
Kedah	2	Ulu Melaka dam	IR	7	2	5	12	1985 - 1989
Kedah	2	Aver Tawar dam	IR	11	2	6	131	1985 - 1989
Kedah	3	Ahning dam	WS, IR	120	27	73	51	1983 - 1987
Kedah	3	Badak-Temin dam	IR	114	19	59	21	1983 - 1987
Kedah	3	Sari dam	IR	61	14	38	23	1989 - 1993
Kedah	5	Naok-Reman dams	WS, IR	-	-	350	123	1983 - 1987
Perak	10	Rui dam	WS, IR	215	145	140	447	1985 - 1989
Kedah/Perak	8	Kerian dam	WS, IR	112	7	22	30***	1985 - 1989

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m ³ /s)	Construc- tion Cost (M\$10 ⁶)	Construc- tion Period
1	Pumping from the Muda Irrigation canal	Kedah Perlis 3 to 1	2.5	*	1983 - 1987
3	Jeniang diversion (barrage & canal)	Kedah 5 to 3	8.6	Included in Naok-Reman dams	1983 - 1987
4	Naok diversion (canal)	Kedah 5 to 4	1.1	*	1985 - 1989
10	Rui diversion (tunnel)	Perak Kedah 10 to 5	8.9	(14)	1985 - 1989
6	Pipe line	Kedah P. Pinang 5 to 6	6.7	*	1985 - 1989
6	Pipe line	Kedah P. Pinang 5 to 6	1.3	*	1986 - 1990
6	Pipe line	Kedah P. Pinang 5 to 6	0.6	*	1991 - 1995
7	Pipe line	Kedah P. Pinang 5 to 7	1.9	*	1985 - 1989
7	Pipe line	Kedah P. Pinang 5 to 7	0.6	*	1986 - 1990
7	Pipe line	Kedah P. Pinang 5 to 7	0.6	*	1991 - 1995

Remarks; IR = Irrigation; WS = Water Supply; FM = Flood Mitigation; U/C = Under Construction
* = Cost included in other distribution facilities
Construction cost = Financial cost at 1980 constant price
** = The state where the facilities are located
*** = Some part is for diversion to the Kurau river

Table 51 RECOMMENDED PLAN FOR IMPROVEMENT OF PURIFICATION SYSTEM IN PALM OIL MILLS AND RUBBER FACTORIES IN PERLIS/KEDAH/P. PINANG UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Unit: m³/d

Basin No.	Basin Name	1981 - 1990			1991 - 2000		
		Palm Oil	Rubber	Total	Palm Oil	Rubber	Total
4	Merbok	0	2,500	2,500	0	2,332	2,332
6	Perai	0	936	936	0	5,852	5,852
9	Kurau	0	0	0	0	520	520
	Total	0	3,436	3,436	0	8,704	8,704

Table 52 RECOMMENDED PUBLIC SEWERAGE DEVELOPMENT PLAN FOR WATER POLLUTION ABATEMENT IN PERLIS/KEDAH/P. PINANG UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	City/Town		1990			2000		
	No.	Name	Treatment Capacity (10 ³ m ³ /d)	Service Factor (%)	Served Population (10 ³)	Treatment Capacity (10 ³ m ³ /d)	Service Factor (%)	Served Population (10 ³)
4	C3	Sg. Petani	18	60	35	59	100	66
6	C4	Kulim	4	40	15	15	100	44
		Total	22	-	50	74	-	110

Table 53 ASSUMED PUBLIC SEWERAGE DEVELOPMENT NOT AFFECTING RIVER WATER QUALITY IN PERLIS/KEDAH/P. PINANG UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	City/Town		1990			2000		
	No.	Name	Treatment Capacity (10 ³ m ³ /d)	Service Factor (%)	Served Population (10 ³)	Treatment Capacity (10 ³ m ³ /d)	Service Factor (%)	Served Population (10 ³)
3	C2	Alor Setar	16	35	28	56	60	50
6	C5	Butterworth	30	30	29	93	65	66
6	C6	Bukit Mertajam	11	30	9	34	65	20
7	C8	Georgetown	64	65	174	81	65	174
		Total	121	-	240	264	-	310

Remarks; There is a sewerage system in C8, served 174,000 people with a treatment capacity of 46,000 m³/d.

Table 54 RECOMMENDED FLOOD MITIGATION PROGRAM
IN PERLIS/KEDAH/P. PINANG UNDER THE
CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	Name of River	R.I. (km)	F.W. (km)	Dam (nos)	Pold. (nos)	N.S. (km ²)	P.P. (10 ³)	F.A. (10 ³ ha)	C.C. (M\$10 ⁶)
<u>PERLIS</u>									
<u>By 1990</u>									
1	Perlis	34	-	1	-	-	25	4	22
<u>By 2000</u>									
1	Perlis	34	-	1	-	-	25	4	22
<u>KEDAH</u>									
<u>By 1990</u>									
3	Kedah	-	-	-	-	-	-	-	-
5	Muda	45	-	-	-	-	21	4	27
	Total	45	-	-	-	-	21	4	27
<u>By 2000</u>									
5	Muda	59	-	-	-	-	29	6	41
<u>P. PINANG</u>									
<u>By 1990</u>									
5	Muda	3	-	-	-	-	22	5	-
6	Perai	-	-	-	-	-	-	-	-
7	P. Pinang	1	-	-	-	-	5	-	15
	Total	4	-	-	-	-	27	5	15
<u>By 2000</u>									
5	Muda	17	-	-	-	-	25	6	19
6	Perai	4	-	-	-	-	3	-	4
7	P. Pinang	2	-	-	-	-	10	-	30
	Total	23	-	-	-	-	38	6	53

Remarks; R.I. : River improvement, P.P.: Population protected (the year 2000)
F.W. : Floodway, F.A.: Flood area relieved
Pold.: Polder, C.C.: Construction cost
N.S. : Non-structural measure,

Table 55 ESTIMATED PUBLIC DEVELOPMENT EXPENDITURE FOR
RECOMMENDED PLAN IN PERLIS/KEDAH/P. PINANG
UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

		4MP	5MP	6MP	7MP	Total
Source Development		176	632	16	0	824
Irrigation	Perlis	11	79	10	15	115
	Kedah	33	220	331	326	910
	P. Pinang	0	9	1	0	10
	Sub-total	44	308	342	341	1,035
Inland Fishery	Perlis	0	0	6	12	18
	Kedah	2	20	62	44	128
	P. Pinang	0	0	0	0	0
	Sub-total	2	20	68	56	146
Public Water Supply	Perlis	14	22	20	9	65
	Kedah	79	137	133	55	404
	P. Pinang	100	147	134	54	435
	Sub-total	143	306	287	118	904
Public Water Supply (Pretreatment facilities)	Perlis	0	0	0	0	0
	Kedah	7	5	1	0	13
	P. Pinang	6	5	0	0	11
	Sub-total	13	10	1	0	24
Public Sewerage (Effective for river water pollution abatement)	Perlis	0	0	0	0	0
	Kedah	22	37	37	14	110
	P. Pinang	0	0	0	0	0
	Sub-total	22	37	37	14	110
Public Sewerage (Others)	Perlis	0	0	0	0	0
	Kedah	14	23	23	9	70
	P. Pinang	43	70	69	28	209
	Sub-total	57	93	92	37	279
Flood Mitigation	Perlis	-	23	-	-	23
	Kedah	-	28	15	-	43
	P. Pinang	0	15	15	22	52
	Sub-total	0	66	30	33	118
Total		507	1,472	873	588	3,440

Table 56

ESTIMATED ANNUAL RECURRENT EXPENDITURE FOR
RECOMMENDED PLAN IN PERLIS/KEDAH/P. PINANG
UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

		4MP	5MP	6MP	7MP	Total
Source Development		0	6	20	20	46
Irrigation	Perlis	0	1	7	8	16
	Kedah	0	2	18	43	63
	P. Pinang	0	0	1	1	2
	Sub-total	0	3	26	52	81
Inland Fishery	Perlis	0	0	0	1	1
	Kedah	0	1	4	10	15
	P. Pinang	0	1	4	11	16
	Sub-total	0	2	8	22	32
Public Water Supply	Perlis	0	2	4	6	12
	Kedah	0	14	27	38	79
	P. Pinang	0	16	30	42	88
	Sub-total	0	32	61	86	179
Public Water Supply (Pretreatment facilities)	Perlis	0	0	0	0	0
	Kedah	0	1	1	2	4
	P. Pinang	0	1	1	1	3
	Sub-total	0	2	2	3	7
Public Sewerage (Effective for river water pollution abatement)	Perlis	0	0	0	0	0
	Kedah	0	7	15	21	43
	P. Pinang	0	0	0	0	0
	Sub-total	0	7	15	21	43
Public Sewerage (Others)	Perlis	0	0	0	0	0
	Kedah	0	5	9	13	27
	P. Pinang	0	14	28	40	82
	Sub-total	0	19	37	53	109
Flood Mitigation	Perlis	-	-	11	11	22
	Kedah	-	-	14	21	35
	P. Pinang	-	-	8	16	24
	Sub-total	0	0	33	48	81
Total		0	71	202	305	578

Table 57 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED
 PLAN FOR WATER DEMAND AND SUPPLY BALANCE
 IN PERLIS/KEDAH/P. PINANG UNDER THE CONDITION
 OF LOWER ECONOMIC GROWTH

Item	Amount
1. National Economic Development	
1.1 Economic Benefit	
Irrigation	(M\$10 ⁶) 62
D&I water supply	(M\$10 ⁶) 83
Fish culture	(M\$10 ⁶) 6
Reservoir recreation	(M\$10 ⁶) 4
Total	(M\$10 ⁶) 155
1.2 Economic Cost	
Irrigation	(M\$10 ⁶) 30
D&I water supply	(M\$10 ⁶) 73
Fish culture	(M\$10 ⁶) 6
Dams, barrages & diversion facilities	(M\$10 ⁶) 27
Total	(M\$10 ⁶) 136
1.3 EIRR	(%) 11
2. Environmental Quality	
2.1 Beneficial Effect	
Safe maintenance flow period (2000)	See Table
Surface area of lake created	(km ²) 49
2.2 Adverse Effect	
Possible reduction in kind of fish immediately downstream of dams and barrages	(nos. of site) 7
3. Social Well-being	
3.1 Beneficial Effect	
Number of farm households benefited by proposed irrigation in 2000	(10 ³) 75
Number of people served by proposed public water supply in 2000	(10 ³) 2,747
Safe supply period (2000)	See Table
3.2 Adverse Effect	
Number of people to be removed for construction of facilities	(10 ²) 4

Remarks; All effects by proposed hydropower project are not shown except irrigation, D&I water supply and lake recreation benefit.

Table 58 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED PLAN FOR WATER POLLUTION ABATEMENT IN PERLIS/KEDAH/P. PINANG UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Item	Amount
1. National Economic Development	
1.1 Economic Benefit	
Sewerage	(M\$10 ⁶) 9
Saving in pre-treatment for D&I water supply	(M\$10 ⁶) 15
Total	(M\$10 ⁶) 24
1.2 Economic Cost	
Sewerage	(M\$10 ⁶) 20
Private purification facilities /2	(M\$10 ⁶) 1
Pre-treatment for D&I water supply	(M\$10 ⁶) 1
Total	(M\$10 ⁶) 22
2. Environmental Quality	
2.1 Beneficial Effects	
Length of river stretch where BOD concentration is not more than 10 mg/lit in 2000 compared with without project condition (Study length = 314 km)	(km) 314/272 ^{/1}
Length of river stretch where BOD concentration is not more than 5 mg/lit in 2000 compared with without project condition (Study length = 314 km)	(km) 293/242 ^{/1}
2.2 Adverse Effect	
-	
3. Social Well-Being	
3.1 Beneficial Effects	
Number of people served by proposed sewerage system in 2000	(10 ³) 404
3.2 Adverse Effect	
-	
Remarks; /1: (Length of river stretch with Project)/ (Length of river stretch without Project) and including the river stretch in the State of Perak.	
/2: Including the rubber factories and palm oil mills in such part of the State of Perak as located in Basin 8 and 9.	

Table 59 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED
 PLAN FOR FLOOD MITIGATION IN PERLIS/KEDAH/P. PINANG
 UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Item	Amount
1. National Economic Development	
1.1 Economic Benefit	
Damage reduction	(M\$10 ⁶) 3.9
1.2 Economic Cost	
Flood mitigation work	(M\$10 ⁶) 4.0
1.3 EIRR	(%) 8
2. Environmental Quality	
2.1 Beneficial Effect	
Length of improved stretch	(km) 116
2.2 Adverse Effect	-
3. Social Well-Being	
3.1 Beneficial Effect	
Number of protected people by proposed facilities in 2000	(10 ³) 92
Population served by proposed flood warning system in 2000	(10 ³) 24
Area relieved from flood hazards	(km ²) 16
3.2 Adverse Effect	
Number of people to be removed for construction of facilities	(10 ³) 6

FIGURES

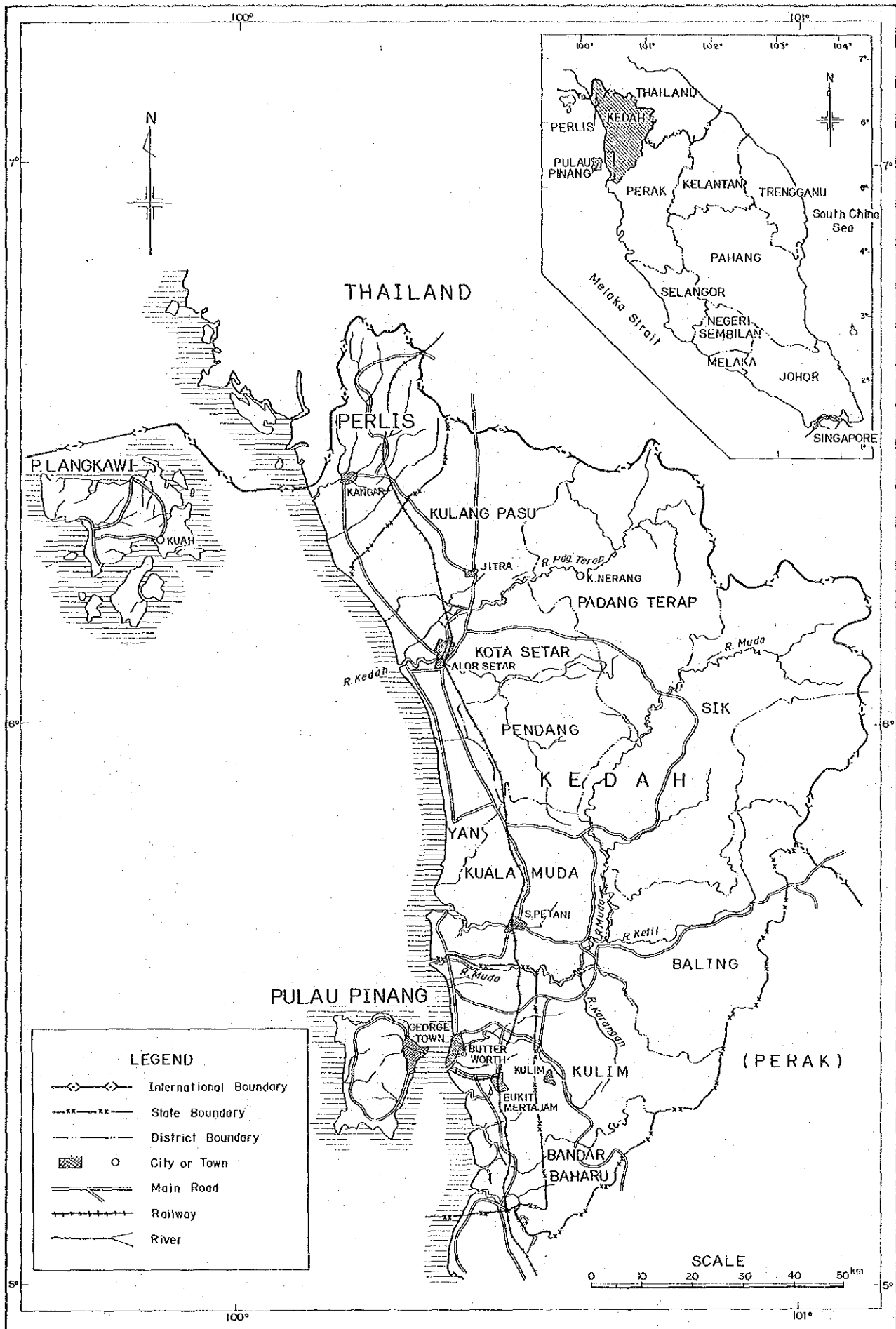


Fig.1 Map of the States of Perlis / Kedah / P.Pinang

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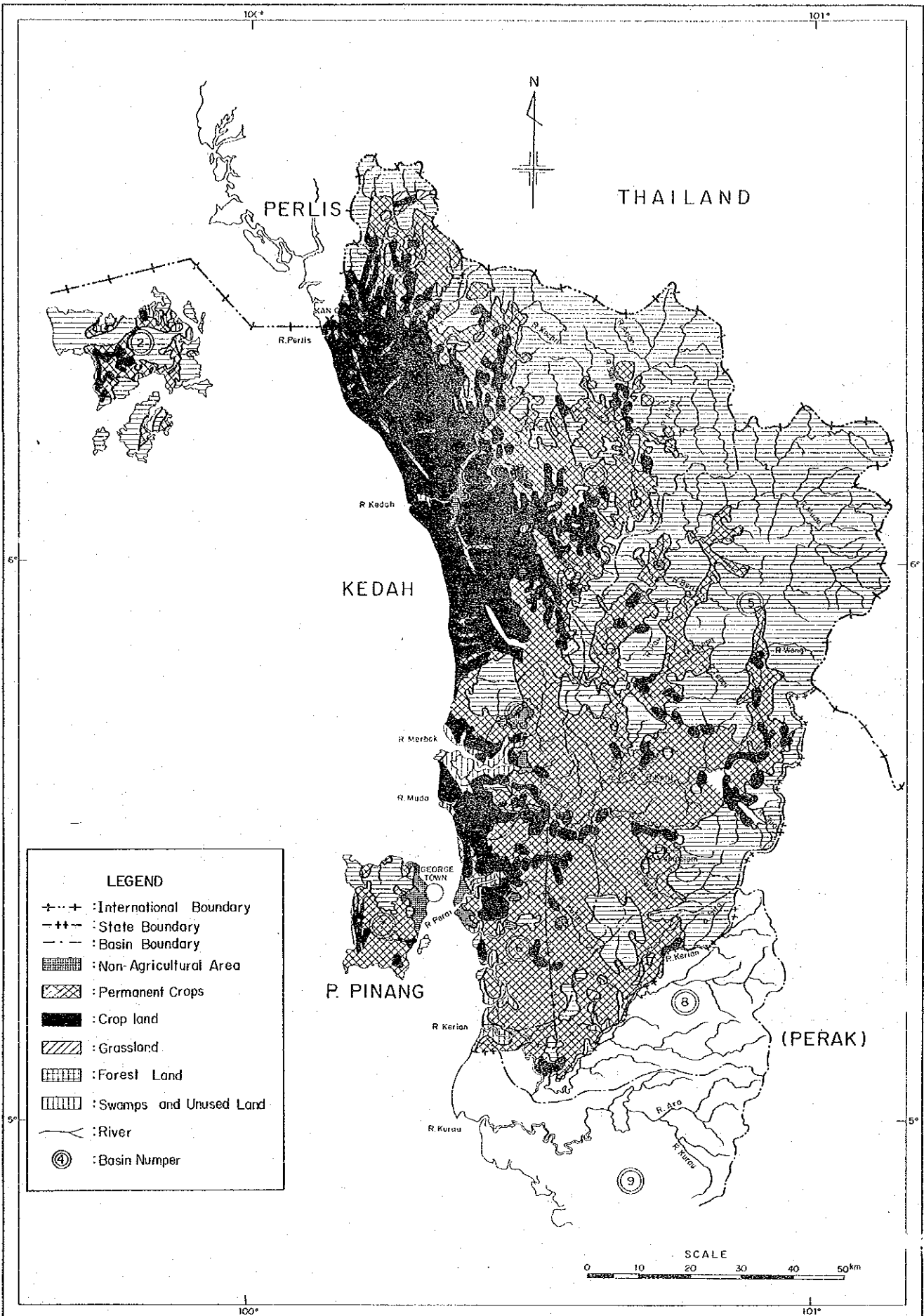


Fig. 2 Present Land Use

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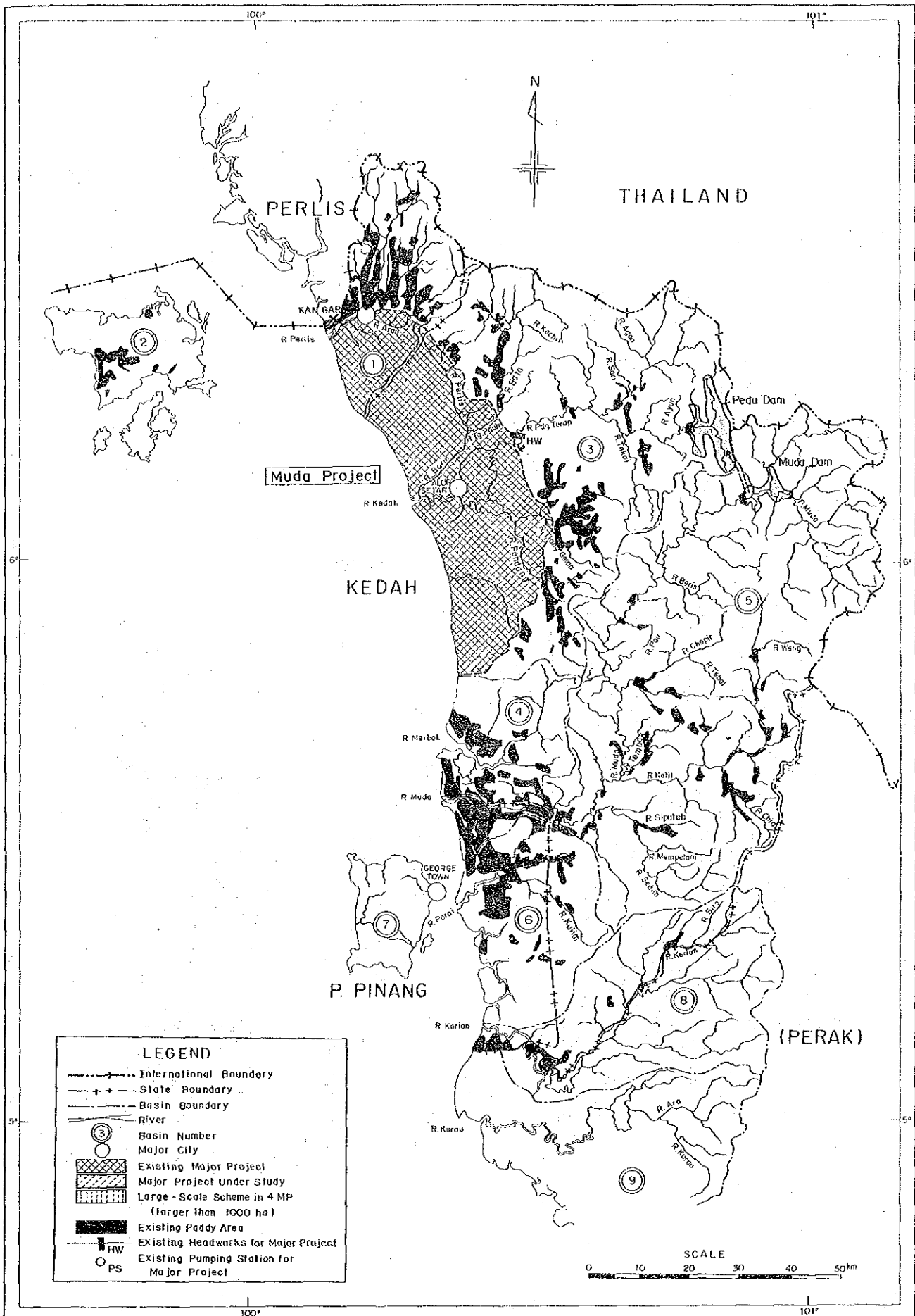


Fig. 3 Location of Paddy Field

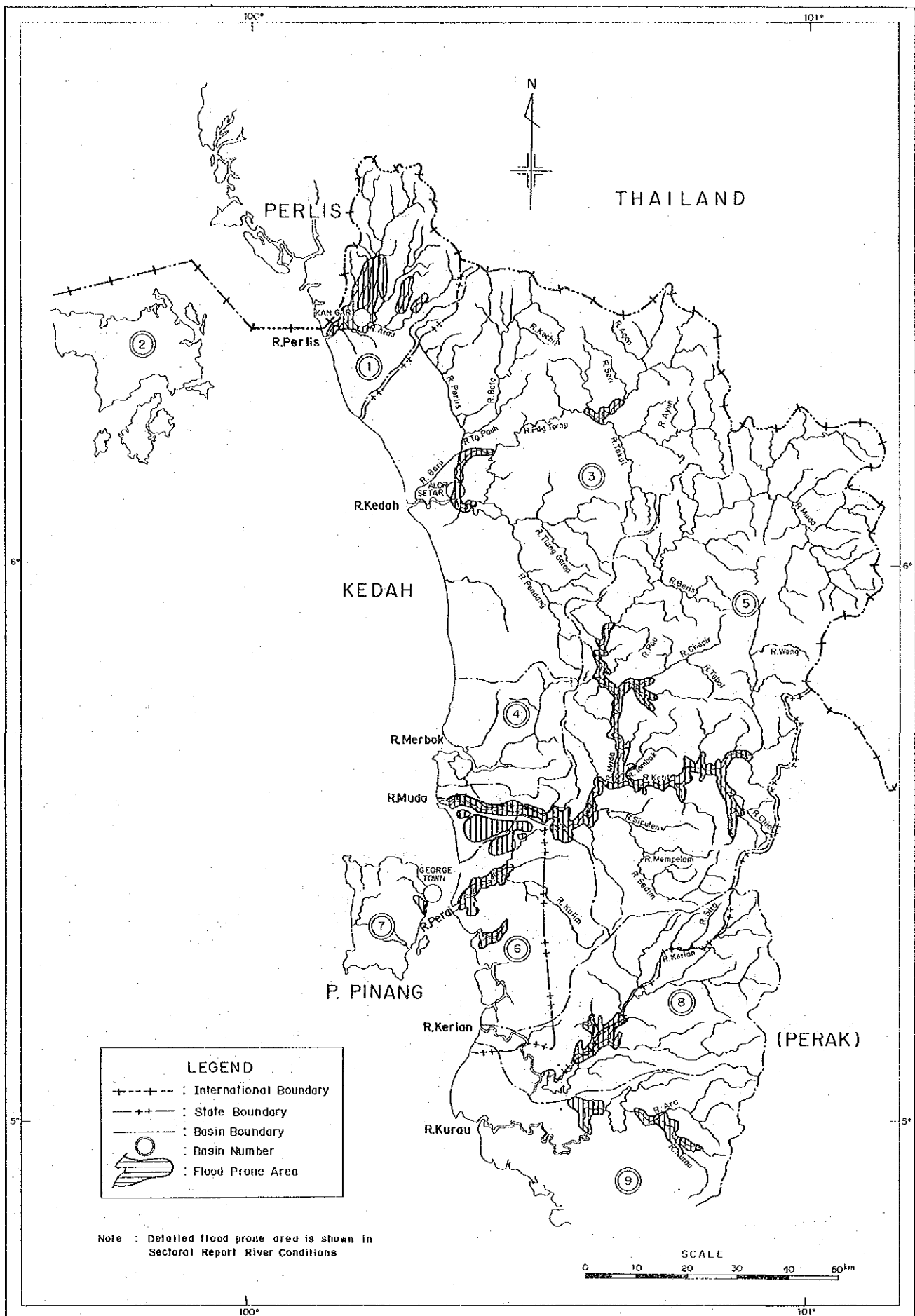


Fig.4 Flood Prone Area In Perlis, Kedah & P.Pinang

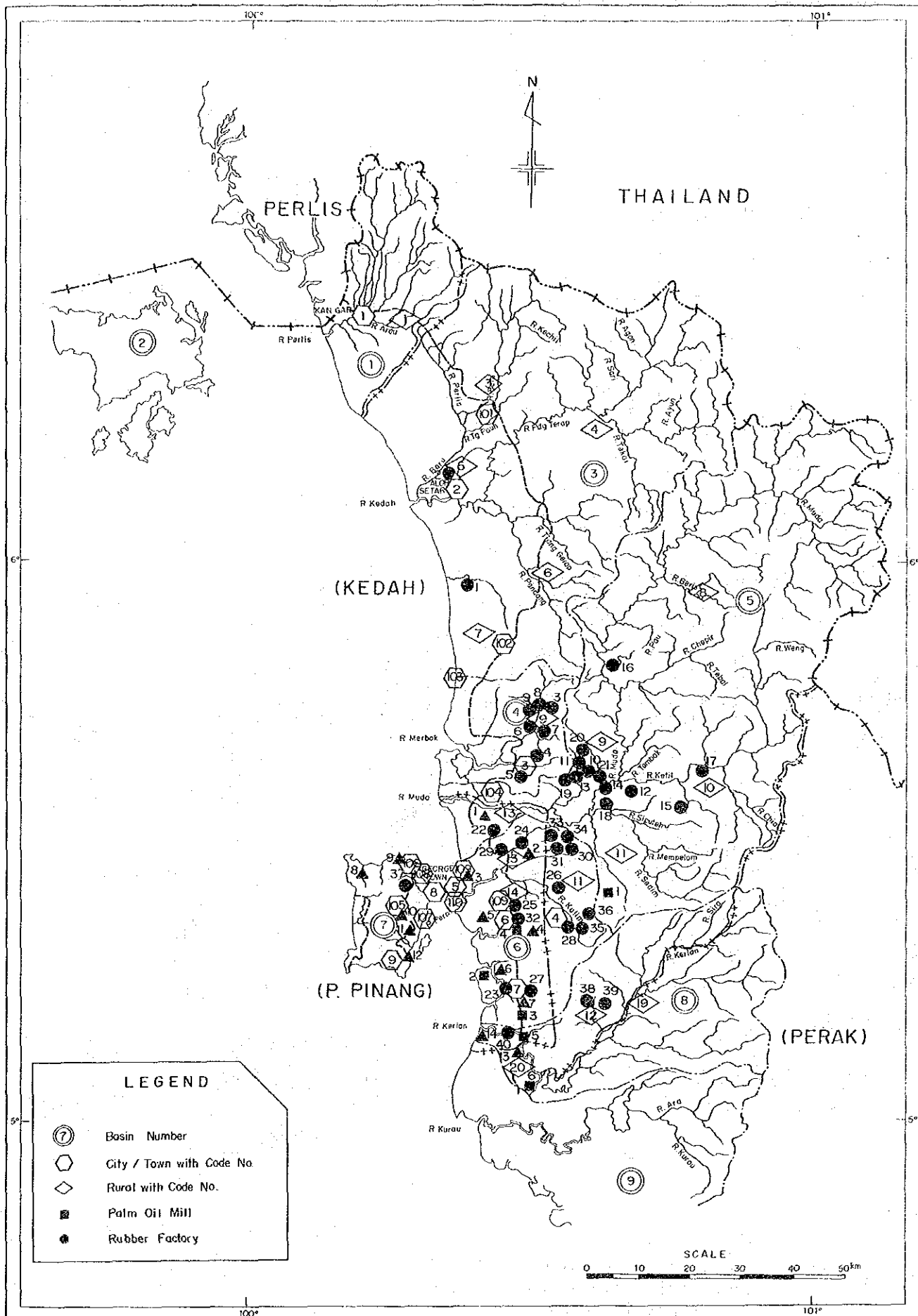


Fig. 5 Location of Demand Centers and Pollution Sources

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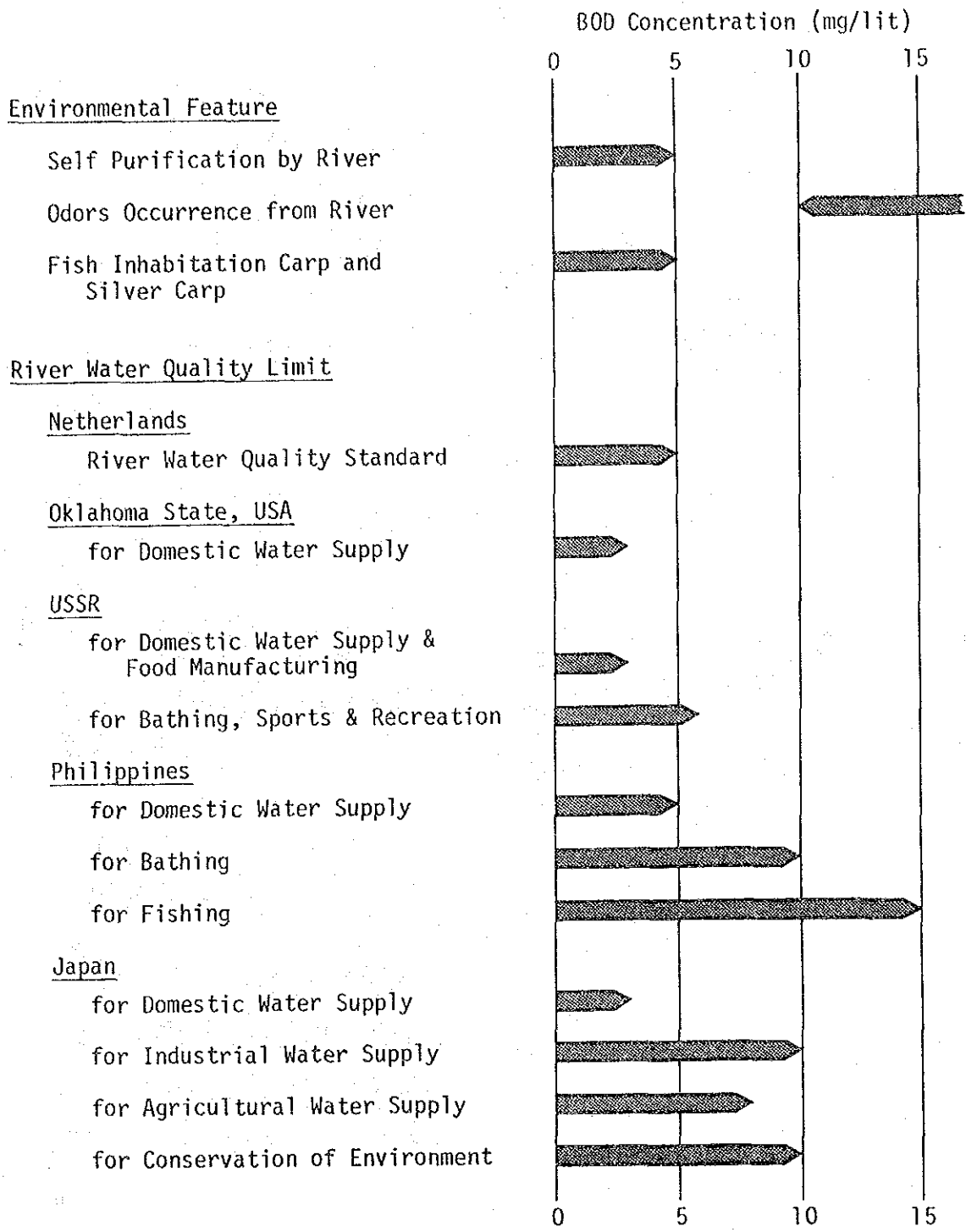


Fig. 6 Relationships between BOD Concentration and Environmental Feature and River Water Quality Limit

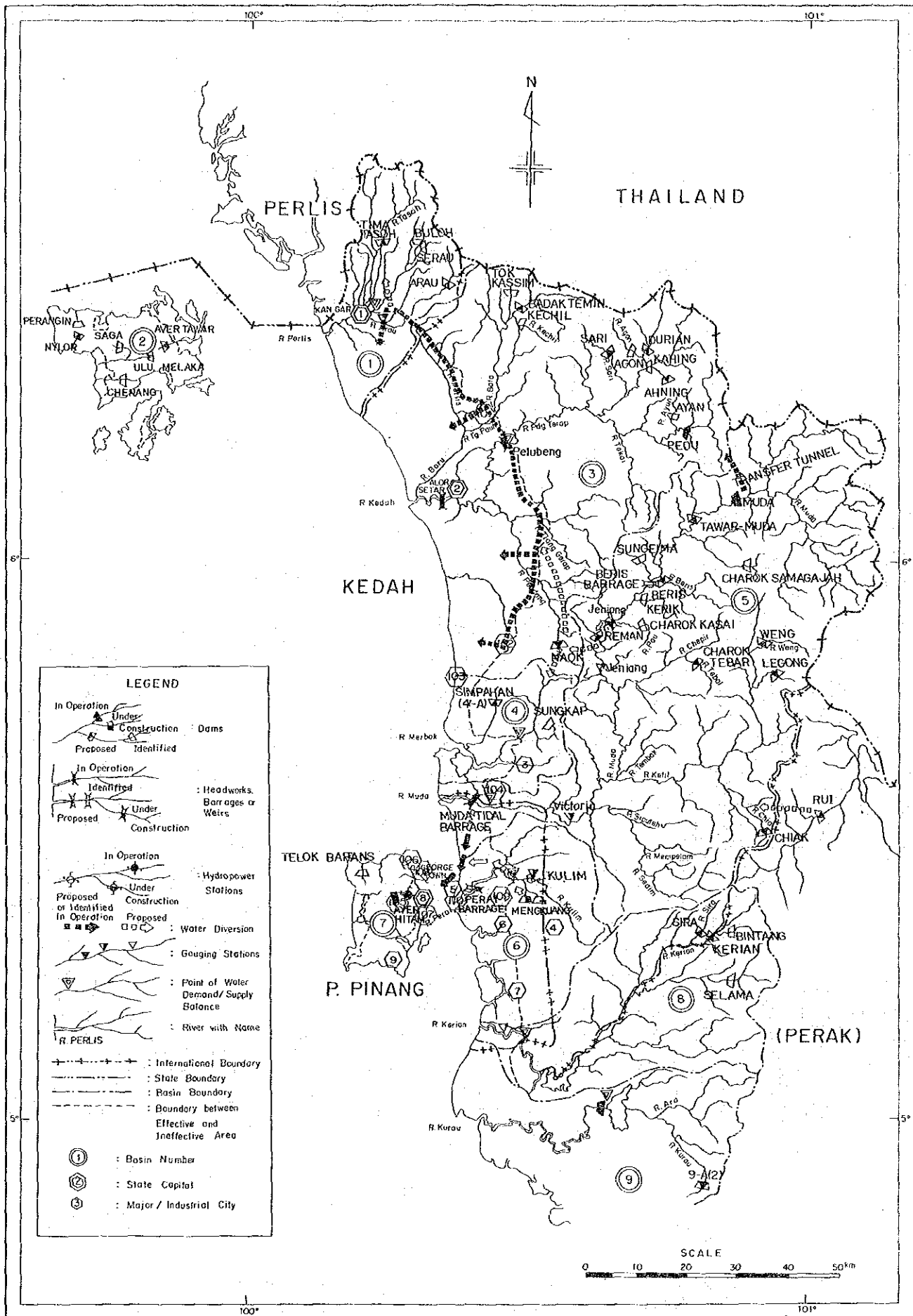


Fig. 7 Location of Potential and Proposed Water Source Facilities, Alternative B1

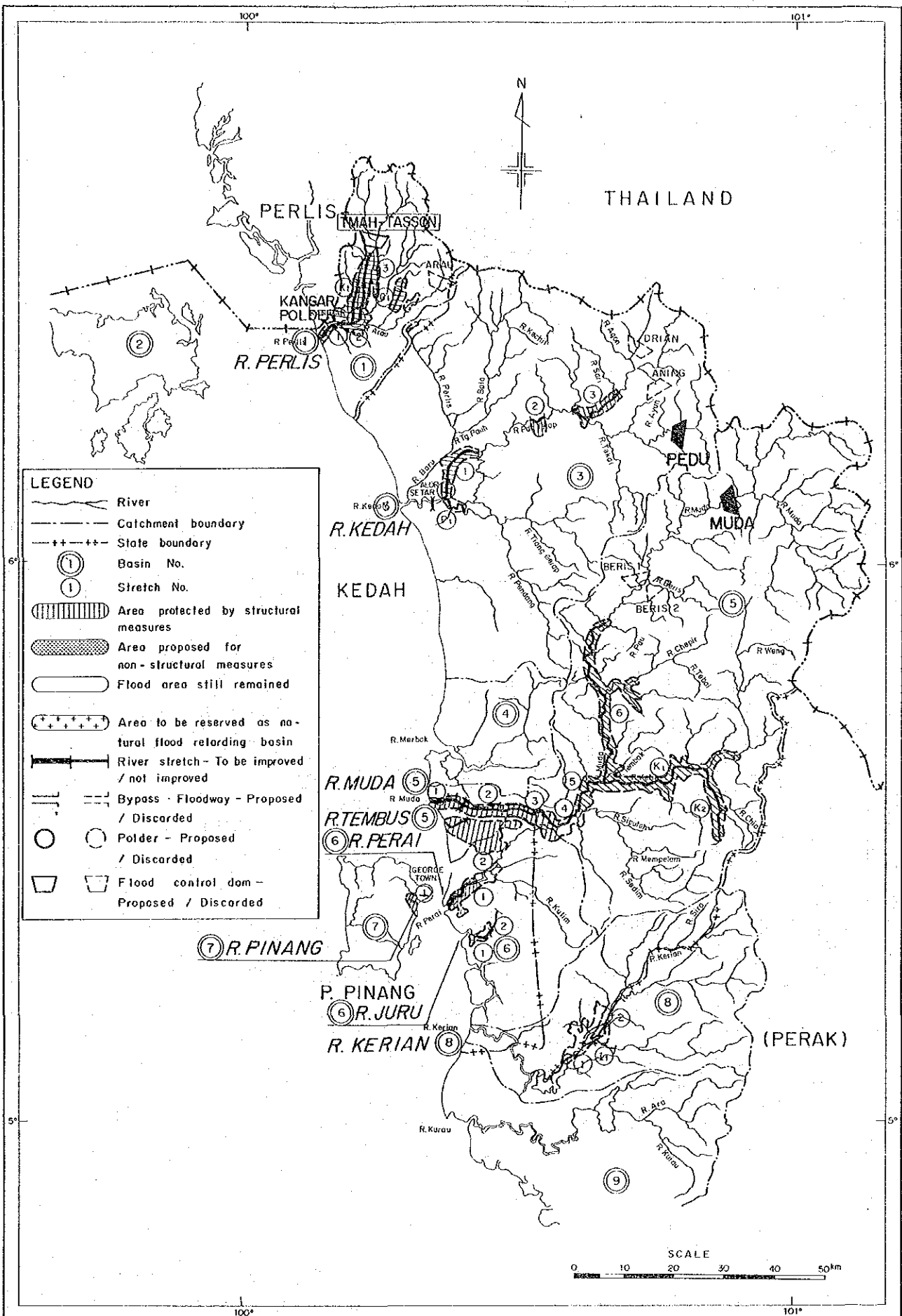


Fig. 8 Flood Mitigation Alternatives, Alternative F 1

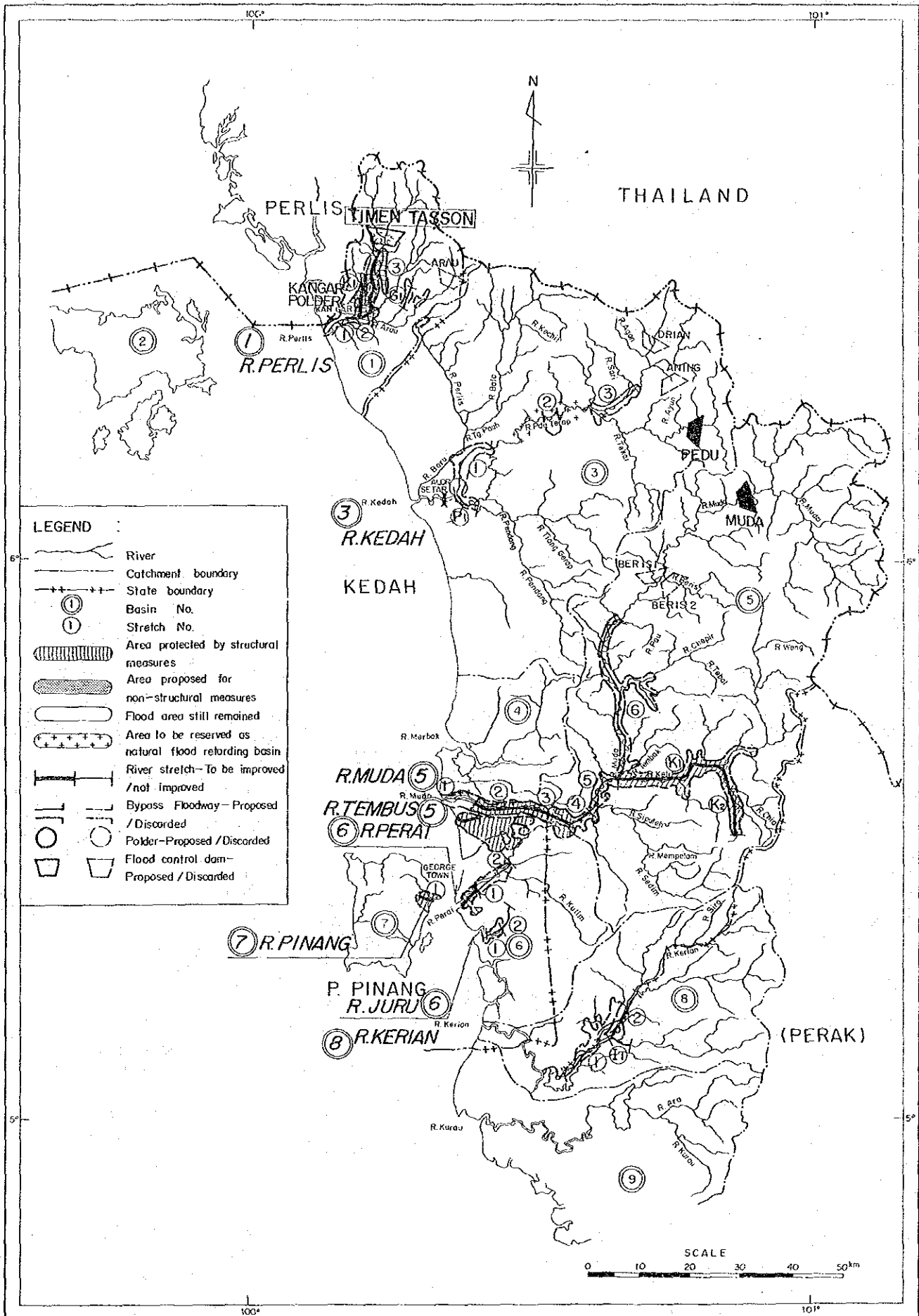


Fig. 9 Flood Mitigation Alternatives, Alternative F2

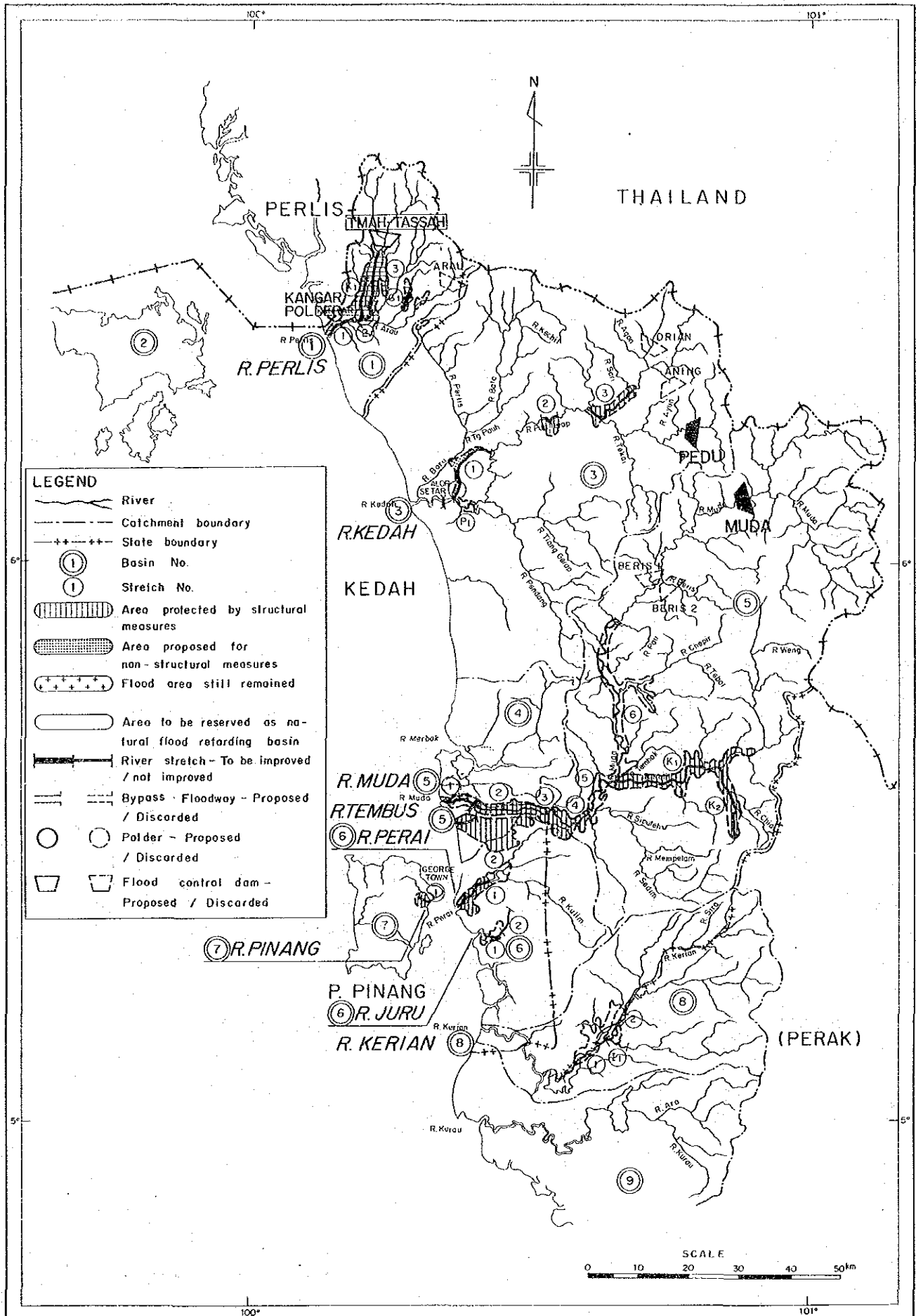


Fig.10. Flood Mitigation Alternatives, Alternative F3

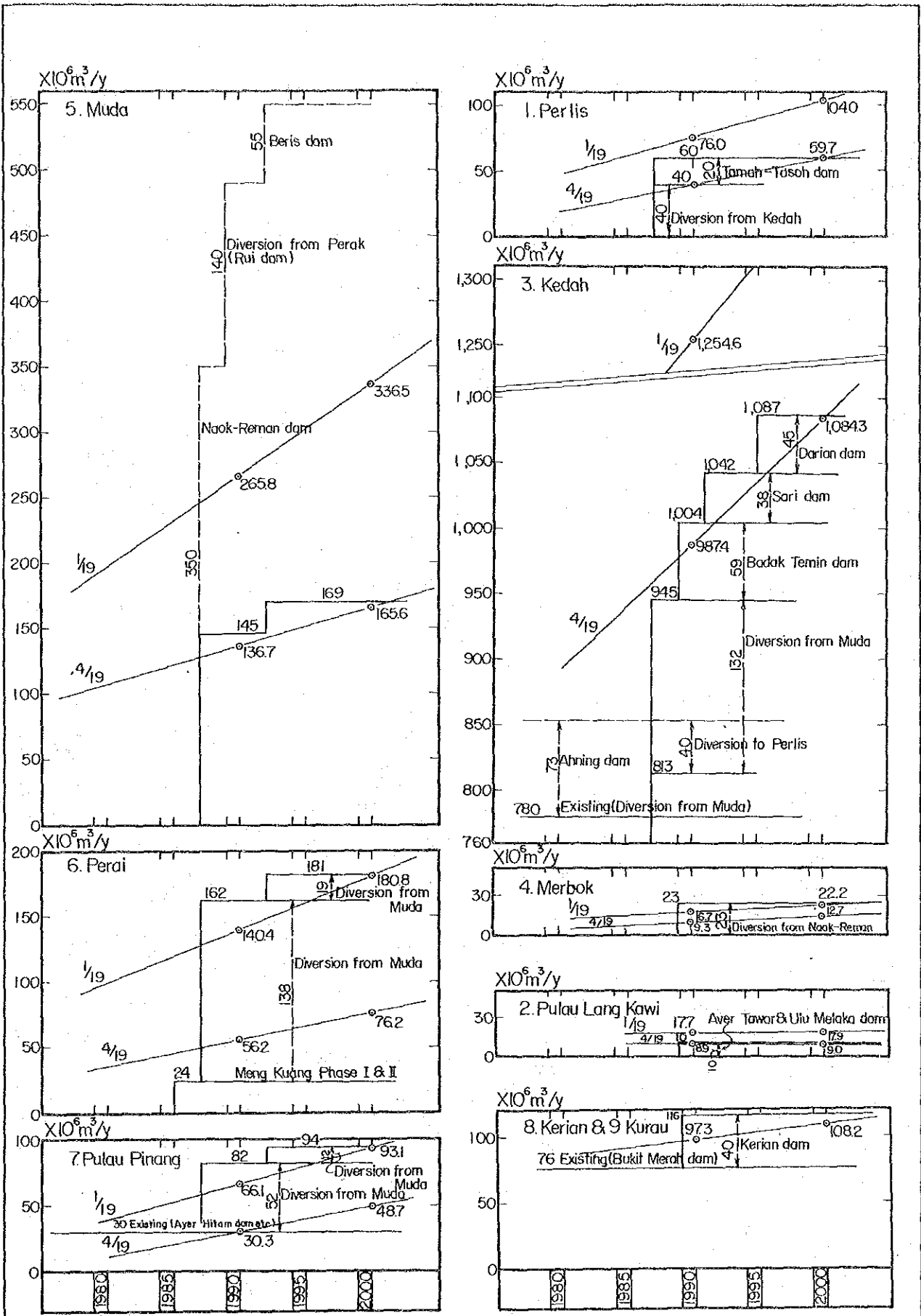


Fig. 11 Recommended Water Demand and Supply Balance Program
 For Perlis, Kedah and Pulau Pinang Region, Pulau
 Langkawi, and Kerian and Kurau River Basins

