

## ***TABLES***



Table 1 METEOROLOGICAL DATA IN N. SEMBILAN/MELAKA

Station	Month	Mean Air Temperature (°C)	Relative Humidity (%)	Sunshine Hours (hrs.)	Open Water Evaporation (mm)	Rainfall (mm)
<u>Melaka (El. 9 m)</u>						
	Jan.	26.0	79.0	6.79	147	76
	Feb.	26.6	77.0	6.96	144	87
	Mar.	26.7	80.3	6.95	162	154
	Apr.	26.9	84.2	7.12	157	197
	May	26.9	85.0	6.99	147	163
	June	26.6	85.9	6.17	137	195
	July	26.3	85.6	6.52	138	199
	Aug.	26.1	86.1	6.11	140	190
	Sep.	26.2	85.7	5.59	142	215
	Oct.	26.3	85.3	5.81	141	207
	Nov.	25.9	86.4	4.98	132	275
	Dec.	25.8	84.7	5.28	126	194
	Annual	26.3	83.8	6.27	1,713	2,152

Table 2 RIVER CHARACTERISTICS IN N. SEMBILAN/MELAKA (1/3)

Basin No.	Item	Description
16	Langat river	
	(A) River Morphology	Meanders in tidal reaches, sluggish river course in swampy land. Generally stable banks in upper/middle reaches. Banks in lower tidal reaches are loosening, possibly causing aggradation of riverbed.
	(B) Estuary	Silting at river mouth causes the difficulty of navigation and seems to aggravate flood levels. Sediment from upstream area rather than from sea.
	(C) Sediment*	Sediment problem existing. Yield from various land development and tin mines. River flow turbid in whole reach downstream from Cherus Town.
	(D) Sea Water Intrusion	No present problem (no water intake facility in lower reach). Tidal effect up to Kg. Sabohan Bagan (90 km).
18	Linggi river	
	(A) River Morphology	Although localized erosion observed in middle/upper reaches, river courses generally in a stable regime.
	(B) Estuary	No problem existing. 300 m river width, sufficient depth for navigation.
	(C) Sediment*	Progressive silting observed in reaches downstream of Seremban. Sediment mainly from tributaries (e.g. Temian R.) due to housing development.
	(D) Sea Water Intrusion	Tidal influence up to Linggi, Lubuk China towns. No adverse problem existing.

Remarks; \*: Major problems requiring some improving measures

Table 3 RIVER CHARACTERISTICS IN N. SEMBILAN/MELAKA (2/3)

Basin No.	Item	Description
19	Malaka river	
	(A) River Morphology	Only minor meanders, generally river regime seems stable. Bank erosion observed in upper/middle reaches, but mostly of less extent at localized places.
	(B) Estuary	No major problems reported, except that desilting work required to remove sediment transported from both river and sea.
	(C) Sediment	Approx. 70% of basin is cultivated land. River seems to have been silted, but present sediment yield seems moderate.
	(D) Sea Water Intrusion	Up to tidal barrage at 6 km upstream from river mouth. No present problem reported.
20	Kesang river	
	(A) River Morphology	Sluggish courses in lower reaches, but canalization completed up to Kg. Simpang Bekoh.
	(B) Estuary	No major problem reported.
	(C) Sediment	Presumably high yield of sediment, in view of mining activity, logging operation, recent land development and less forest cover, but observed S/S records show little yield. Detailed observation recommended.
	(D) Sea Water Intrusion	Up to tidal gate. No adverse problem at present.

Remarks; \*: Major problems requiring some improving measures

Table 4 RIVER CHARACTERISTICS IN N. SEMBILAN/MELAKA (3/3)

Basin No.	Item	Description
21	Muar river	
	(A) River Morphology	Meanders in lower tidal reaches, but stable at present. Only minor erosions at local places in upper reaches and in mangrove bank areas. River generally in a stable regime. Propagation of water plants active in lower reaches.
	(B) Estuary	No problem existing.
	(C) Sediment	Upstream area developed mostly for rubber plantation, but no noteworthy sediment problems.
	(D) Sea Water Intrusion*	Up to Kg. Kepong (110 km from river mouth). Sometimes, interruption of pumping.

Remarks; \*: Major problems requiring some improving measures

Table 5 FLOODED AREA BY RECORDED MAXIMUM FLOOD IN N. SEMBILAN/MELAKA

State	Basin No.	River Basin	Year	Flood Area (km <sup>2</sup> )	Population 1980 (10 <sup>3</sup> )	Estimated Damage at 1980 Condition (M\$10 <sup>6</sup> )
N. Sembilan	16	Langat	1971	12	6	1.0
	17	Sepang	1971	27	-	-
	18	Linggi	1971	84	36	5.5
	21	Muar	1971	81	43	9.4
	30	Pahang	1971	17	13	2.6
		Sub-total			221	98
Melaka	18	Linggi	1971	38	11	1.7
		Baharu	1971	20	14	1.7
	19	Melaka	1971	82	59	9.5
		Duyong	1971	16	2	0.3
	20	Kesang	1971	91	31	8.0
		Sub-total			247	117

Table 6. LIST OF EXISTING AND PLANNED DAMS  
IN N. SEMBILAN/MELAKA

State	Name	River	Purpose/ Year of Commission	Organi- zation	Catch- ment Area (km <sup>2</sup> )	Active Storage Capacity (10 <sup>6</sup> m <sup>3</sup> )	Net Supply Capacity (10 <sup>6</sup> m <sup>3</sup> /y)
<u>Existing</u>							
Melaka	Durian Tunggal dam	Melaka	WS	MWB	71	18	48
Melaka	Melaka barrage	Melaka	TB	MWB	690	-	-
Melaka	Ayer Keroh weir	Melaka	WS	MWB	-	-	0
Melaka/ Johor	Kesang barrage	Kesang	TB	DID	-	-	-
Melaka	Asahan dam	Kesang	WS	MWB	-	-	0
Johor	Belembang dam	Muar	WS	PWD	-	-	0
Johor	Gunong Ledang weir		-	PWD	-	-	0
Johor	Pengkalan Bukit weir		-	PWD	-	-	0

Remarks; WS: Domestic and industrial water supply  
TB: Tidal barrage

Table 7 HISTORICAL AND PROJECTED POPULATION OF DISTRICT BY CITY/TOWN AND RURAL AREA IN N. SEMBILAN/MELAKA

Unit: 10<sup>3</sup>

District	City/Rural	Historical 1980	1985	1995	2000	Average Annual Growth (%) 1980-2000
<u>Negri Sembilan</u>						
38. Port Dickson	28. Port Dickson	26	34	43	64	4.6
	Rural	65	64	65	70	0.4
	District Total	91	98	108	134	2.0
39. Seremban	29. Seremban	145	175	210	290	3.5
	Rural	76	72	74	104	1.6
	District Total	221	247	284	394	2.9
40. Jelebu	Rural	40	42	41	28	-1.8
41. Kuala Pilah	30. Kuala Pilah	13	13	14	16	1.0
	Rural	60	58	59	71	0.8
	District Total	73	71	73	87	0.9
42. Rembau	Rural	39	38	39	42	0.4
43. Tampin	119. Tampin	10	11	12	14	1.7
	Rural	52	56	53	33	-2.2
	District Total	62	67	65	47	-1.4
102. Jempol	118. Bahau	11	12	13	16	1.9
	Rural	63	72	66	8	-10.4
	District Total	74	84	79	24	-5.7
Total	Urban Total	205	245	292	400	3.4
	Rural Total	395	402	397	356	-0.5
	State Total	600	647	689	756	1.2
<u>Melaka</u>						
44. Utara	Rural	122	123	123	123	0.0
45. Melaka Tengah	31. Melaka	94	94	98	112	0.9
	120. Kelebang	9	10	11	13	1.9
	121. Bukit Baru	19	20	22	26	1.6
	Rural	144	166	175	167	0.7
	District Total	266	290	306	318	0.9
46. Selatan	Rural	94	96	97	97	0.2
Total	Urban Total	122	124	131	151	1.1
	Rural Total	360	385	395	387	0.4
	State Total	482	509	526	538	0.6



Table 8 HISTORICAL AND PROJECTED GROSS VALUE OF  
MANUFACTURING OUTPUT BY COMMODITY GROUP  
IN N. SEMBILAN/MELAKA

Unit: M\$10<sup>6</sup>

Item	Year			
	1980	1985	1990	2000
<u>N. Sembilan</u>				
Food	117	178	298	286
Textile	5	8	14	19
Wood	108	106	143	107
Paper	0	0	1	3
Publishing	4	9	27	96
Chemical	270	583	599	599
Rubber	93	163	354	652
Non-metal	20	38	87	185
Basic metal	5	11	30	97
Machinery	23	54	146	443
Others	143	352	686	1,777
Total	788	1,502	2,385	4,264
<u>Melaka</u>				
Food	88	130	153	155
Textile	0	0	0	0
Wood	23	22	21	17
Paper	0	0	0	0
Publishing	3	9	18	66
Chemical	21	44	183	541
Rubber	72	123	187	364
Non-metal	5	9	14	31
Basic metal	0	0	1	2
Machinery	85	194	368	1,174
Others	0	0	1	1
Total	297	531	946	2,351

Remarks; In factor cost at 1970 prices

Table 9 BASIN AREA AND ASSUMED RIVER MAINTENANCE FLOW  
IN N. SEMBILAN/MELAKA

Basin No.	Basin	Total Catchment Area (km <sup>2</sup> )	Effective Catchment Area (km <sup>2</sup> )	Balance Point (km)	River Maintenance Flow (m <sup>3</sup> /s)
17	Sepang	640	260	12	1.8
18	Linggi	1,420	1,310	3	0.6
19	Melaka	1,010	690	5	0.3
20	Kesang	705	675	4	0.4
21	Muar	6,595	6,170	20	6.2
30	Pahang	29,300	27,650	44	143.0

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

Table 10 ESTIMATED AND PROJECTED SERVICE FACTOR AND PER CAPITA DAILY USE OF DOMESTIC WATER IN N. SEMBLIAN/MELAKA

City/Rural	Service Factor (%)				Per Capita Daily Use (lpcd)			
	Estimated		Projected		Estimated		Projected	
	1980	1985	1990	2000	1980	1985	1990	2000
<u>N. SEMBILAN</u>								
1. <u>Urban Area</u>								
28 Port Dickson	80	85	90	100	160	175	190	220
29 Seremban	100	100	100	100	170	185	200	230
30 Kuala Pilah	80	85	90	100	160	175	190	220
118 Tampin	80	85	90	100	160	175	190	220
119 Bahau	80	85	90	100	160	175	190	220
2. <u>Rural Area</u>								
PWD Rural	66	74	79	81	75	100	125	175
MOH Rural	5	9	12	19	40	48	55	70
3. <u>Non-Pipe-Served Area</u>								
	-	-	-	-	40	40	40	40
<u>MELAKA</u>								
1. <u>Urban Area</u>								
31 Melaka	80	85	90	100	160	175	190	230
120 Kelebang	73	85	90	100	115	153	190	220
121 Bukit Baru	80	85	90	100	160	175	190	220
2. <u>Rural Area</u>								
PWD Rural	70	83	88	88	75	100	125	175
MOH Rural	3	6	9	12	40	48	55	70
3. <u>Non-Pipe-Served Area</u>								
	-	-	-	-	40	40	40	40

Table 11 NET UNIT MANUFACTURING WATER USE  
PER GROSS VALUE OF MANUFACTURING  
OUTPUT BY COMMODITY GROUP

Unit: m<sup>3</sup>/d/M\$10<sup>6</sup>/y

Commodity Group	Assumed <sup>/1</sup>	Estimated <sup>/2</sup>	Projected	
	1975	1980	1985 <sup>/2</sup>	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; <sup>/1</sup>: Assumed from data in Japan in 1970  
<sup>/2</sup>: Obtained by interpolation

Note; The values indicated are net manufacturing water use (excluding the water used cyclically) per M\$10<sup>6</sup> of the gross value of manufacturing output at 1970 price.

Table 12 ESTIMATED AND PROJECTED D&I WATER DEMAND  
BY BASIN IN N. SEMBILAN/MELAKA (1/2)

Unit: 10<sup>6</sup> m<sup>3</sup>/y

Basin No.	City/Rural	Estimated				Projected								
		1980				1985			1990			2000		
		D&I	D	I	Total	D	I	Total	D	I	Total			
16	26 Kajang Chua	6.6	2.7	7.1	9.8	3.6	7.3	10.9	6.1	8.4	14.5			
	115 Semenyih	2.1	0.8	2.1	2.9	1.0	1.8	2.8	1.5	1.8	3.3			
	City Total	8.7	3.5	9.2	12.7	4.6	9.1	13.7	7.6	10.2	17.8			
	Rural	28.6	14.1	14.4	28.5	19.7	10.7	30.4	24.7	8.1	32.8			
Basin Total		37.3	17.6	23.6	41.2	24.3	19.8	44.1	32.3	18.3	50.6			
17	28 Poru Dickson	24.5	2.5	46.5	49.0	3.6	61.5	65.1	6.8	96.9	103.7			
	Rural	5.9	2.6	3.1	5.7	3.7	2.4	6.1	5.3	1.9	7.2			
	Basin Total	30.4	5.1	49.6	54.7	7.3	63.9	71.2	12.1	98.8	110.9			
18	29 Selemban	15.9	15.5	8.3	23.8	20.2	10.9	31.1	32.0	17.2	49.2			
	Rural	8.0	7.3	3.1	10.4	9.2	2.9	12.1	14.9	3.2	18.1			
	Basin Total	23.9	22.8	11.4	34.2	29.4	13.8	43.2	46.9	20.4	67.3			
19	31 Melaka	12.1	7.0	10.2	17.2	8.2	18.2	26.4	12.4	45.0	57.4			
	119 Tampin	1.0	0.8	0.7	1.5	1.0	1.0	2.0	1.5	1.6	3.1			
	120 Kelebang	0.9	0.7	1.0	1.7	0.9	2.0	2.9	1.4	5.2	6.6			
	121 Bukit Baru	2.5	1.5	2.0	3.5	1.8	4.1	5.9	2.7	10.5	13.2			
	City Total	16.5	10.0	13.9	23.9	11.9	25.3	37.2	18.0	62.3	80.3			
	Rural	10.4	11.0	3.3	14.3	14.7	3.4	18.1	20.3	3.6	23.9			
	Basin Total	26.9	21.0	17.2	38.2	26.6	28.7	55.3	38.3	65.9	104.2			
21	30 Kuala Pilah	1.6	0.9	1.6	2.5	1.1	2.1	3.2	1.7	3.4	5.1			
	32 Segmat	4.2	3.6	3.6	7.2	5.4	4.9	10.3	11.5	8.7	20.2			
	34 Muar	9.6	5.3	10.0	15.3	6.4	13.6	20.0	9.5	24.0	33.5			
	122 Labis	2.2	0.9	3.0	3.9	1.1	3.9	5.0	1.8	7.0	8.8			
	125 Jementah	1.1	0.4	1.6	2.0	0.8	1.8	2.6	1.3	2.7	4.0			
	C145	0.1	0.4	0.7	1.1	0.5	1.1	1.6	1.1	2.5	3.6			
	City Total	18.8	11.5	20.5	32.0	15.3	27.4	42.7	26.9	48.3	75.2			
	Rural	18.2	15.1	9.0	24.1	21.1	7.7	28.8	29.6	7.0	36.6			
	Basin Total		37.0	26.6	29.5	56.1	36.4	35.1	71.5	56.5	55.3	111.8		
	30	45 Temerloh	2.1	1.1	4.8	5.9	1.5	9.2	10.7	2.3	32.3	34.6		
46 Bentong		1.8	1.9	0.8	2.7	2.2	1.5	3.7	3.2	5.4	8.6			
48 Jerantut		1.4	0.4	5.1	5.5	0.9	10.0	10.9	1.8	34.7	36.5			
49 Raub		2.1	2.0	2.3	4.3	2.6	4.4	7.0	4.0	15.5	19.5			
50 Kuala Lipis		1.0	0.8	1.0	1.8	1.0	1.5	2.5	1.5	3.4	4.9			
118 Bahau		1.1	0.9	0.7	1.6	1.1	1.0	2.1	1.7	1.6	3.3			
130 Mentakab		1.1	0.8	3.6	4.4	1.1	7.0	8.1	1.9	24.5	26.4			
131 Teriang		0.5	0.7	0.9	1.6	1.0	1.5	2.5	1.8	3.9	5.7			
C137		1.4	2.1	2.5	4.6	2.6	3.8	6.4	3.3	7.3	10.6			
C138		0.2	0.4	0.7	1.1	1.0	1.5	2.5	1.7	3.9	5.6			
C144		0.2	0.3	0.6	0.9	1.6	2.4	4.0	2.2	5.1	7.3			
C152		0.0	0.0	0.0	0.0	0.9	1.4	2.3	1.5	3.4	4.9			
C153		1.0	0.9	1.1	2.0	1.0	1.5	2.5	1.3	2.8	4.1			
C154		0.5	0.7	0.9	1.6	0.8	1.3	2.1	1.1	2.5	3.6			
C155		0.3	0.3	0.5	0.8	1.0	1.5	2.5	1.3	2.8	4.1			
C156		0.0	0.0	0.1	0.1	2.8	4.0	6.8	3.5	7.9	11.4			
City Total		14.7	13.3	25.6	38.9	23.1	53.5	76.6	34.1	157.0	191.1			
Rural		17.9	18.4	7.9	26.3	23.8	7.4	31.2	34.7	9.4	44.1			
Basin Total		32.6	31.7	33.5	65.2	46.9	60.9	107.8	68.8	166.4	235.2			
Sub-total		188.1	124.8	164.8	289.6	170.9	222.2	393.1	254.9	425.1	680.0			
(State Total for N. Sembilan)		(62.0)	(37.1)	(65.1)	(102.2)	(47.5)	(83.0)	(130.5)	(70.6)	(126.3)	(196.9)			

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

Table 13

ESTIMATED AND PROJECTED D&I WATER DEMAND  
BY BASIN IN N. SEMBILAN/MELAKA (2/2)Unit: 10<sup>6</sup> m<sup>3</sup>/y

Basin No.	City/Rural	Estimated				Projected								
		1980				1985			1990			2000		
		D&I	D	I	Total	D	I	Total	D	I	Total	D	I	Total
18	29 Selemban	15.9	15.5	8.3	23.8	20.2	10.9	31.1	32.0	17.2	49.2			
	Rural	8.0	7.3	3.1	10.4	9.2	2.9	12.1	14.9	3.2	18.1			
	Basin Total	23.9	22.8	11.4	34.2	29.4	13.8	43.2	46.9	20.4	67.3			
19	31 Melaka	12.1	7.0	10.2	17.2	8.2	18.2	26.4	12.4	45.0	57.4			
	119 Tampin	1.0	0.8	0.7	1.5	1.0	1.0	2.0	1.5	1.6	3.1			
	120 Kelebang	0.9	0.7	1.0	1.7	0.9	2.0	2.9	1.4	5.2	6.6			
	121 Bukit Baru	2.5	1.5	2.0	3.5	1.8	4.1	5.9	2.7	10.5	13.2			
	City Total	16.5	10.0	13.9	23.9	11.9	25.3	37.2	18.0	62.3	80.3			
	Rural	10.4	11.0	3.3	14.3	14.7	3.4	18.1	20.3	3.6	23.9			
	Basin Total	26.9	21.0	17.2	38.2	26.6	28.7	55.3	38.3	65.9	104.2			
20	33 Tangkak	1.1	1.1	0.2	1.3	1.3	0.2	1.5	2.0	0.3	2.3			
	Rural	13.5	4.0	1.0	5.0	5.1	0.9	6.0	7.8	11.0	18.8			
	Basin Total	14.6	5.1	1.2	6.3	6.4	1.1	7.5	9.8	11.3	21.1			
	Sub-total	65.4	48.9	29.8	78.7	62.4	43.6	106.0	95.0	97.6	192.6			
	(State Total for Melaka)	(30.2)	(25.7)	(16.9)	(42.6)	(32.4)	(28.2)	(60.6)	(46.8)	(64.8)	(111.6)			
	Total	253.5	173.7	194.6	368.3	233.3	265.8	499.1	349.9	522.7	872.6			
	(States Total for N. Sembilan/Melaka)	(92.0)	(62.8)	(82.0)	(144.8)	(79.9)	(111.2)	(191.1)	(117.4)	(191.1)	(308.5)			

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

Table 14 ESTIMATED AREA OF IRRIGATED PADDY FIELD  
IN N. SEMBILAN/MELAKA

Unit: ha

Basin No.	Name	Scheme	1980		1990		2000	
			Main Season	Off Season	Main Season	Off Season	Main Season	Off Season
<u>N. Sembilan</u>								
16.	Langat	Minor	1,481	983	1,503	1,005	1,519	1,005
17.	Sepang	Minor	81	69	81	69	81	69
18.	Linggi	Minor	2,879	1,769	2,901	1,791	2,960	1,791
19.	Melaka	Minor	620	499	640	519	640	519
21.	Muar+	Minor	4,557	1,981	5,004	3,369	5,326	3,535
30.	Pahang	Minor	1,419	1,075	1,615	1,175	1,615	1,175
Total for N. Sembilan			11,037	6,376	11,744	7,928	12,141	8,094
<u>Melaka</u>								
18.	Linggi		1,188	303	1,420	600	1,420	600
19.	Melaka		5,746	867	6,557	2,530	6,897	2,652
20.	Kesang		1,618	1,057	1,800	1,200	1,800	1,200
Total for Melaka			8,552	2,227	9,777	4,330	10,117	4,452

Table 15 ESTIMATED IRRIGATION WATER DEMAND FOR  
PADDY IN N. SEMBILAN/MELAKA

Unit: 10<sup>6</sup> m<sup>3</sup>/y

Basin No.	Name	Scheme	1980	1990	2000
<u>N. Sembilan</u>					
16.	Langat	Minor	44	41	41
17.	Sepang	Minor	3	3	3
18.	Linggi	Minor	84	77	78
19.	Melaka	Minor	20	19	19
21.	Muar+	Minor	118	137	145
30.	Pahang	Minor	41	45	45
Total for N. Sembilan			310	322	331
<u>Melaka</u>					
18.	Linggi	Minor	27	33	33
19.	Melaka	Minor	119	150	158
20.	Kesang	Minor	49	49	49
Total for Melaka			195	232	240

Table 16 RIVER UTILIZATION RATIO BY BASIN IN N. SEMBILAN/  
MELAKA FOR 1990 AND 2000

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

Basin No.	Name	Surface Runoff in Effective Area (1)	1990				2000			
			Source Demand		Ratio	Source Demand		Ratio		
			D&I	Irr.	Total (2)	(2)/(1) (%)	D&I	Irr.	Total (2)	(2)/(1) (%)
17	Selang	224	71	3	74	33	111	3	114	51
18	Linggi	1,204	44	110	154	13	67	111	178	15
19	Melaka	583	56	169	225	39	104	177	281	48
20	Kesang	358	8	72	80	22	11	72	83	23
21	Muar	3,849	70	236	306	8	109	246	355	9
30	Pahang	24,238	108	585	693	3	235	818	1,053	4

Table 17 ANNUAL DEFICIT BY BASIN IN N. SEMBILAN/  
MELAKA FOR 1990 AND 2000

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

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>										
17	23.6	1978	21.8	1963	14.8	1979	11.8	1965	10.7	1977
18	44.2	1979	41.6	1963	26.2	1977	13.9	1961	9.9	1968
19	130.8	1979	121.5	1977	82.3	1963	72.8	1961	59.1	1978
20	25.6	1963	10.0	1965	2.9	1979	2.1	1968	2.0	1973
21	139.0	1963	27.4	1965	14.9	1961	10.3	1962	8.4	1968
<u>2000</u>										
17	46.7	1978	44.7	1963	34.2	1979	28.4	1965	25.5	1977
18	48.6	1979	45.6	1963	30.1	1977	16.0	1961	11.0	1968
19	171.6	1979	164.3	1977	118.5	1963	96.7	1961	89.9	1978
20	26.3	1963	10.5	1965	3.3	1979	2.1	1968	2.1	1973
21	161.3	1963	35.3	1965	23.1	1961	15.0	1962	11.0	1968



Table 18 ASSUMED DEVELOPMENT OF LAND DISPOSAL  
IN PALM OIL MILLS AND RUBBER FACTORIES  
IN N. SEMBILAN/MELAKA

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

Table 19 DISCHARGE RATIO, RUNOFF RATIO, INFILTRATION  
RATIO AND BOD CONCENTRATION OF EFFLUENT  
ASSUMED UNDER PRESENT PURIFICATION LEVEL  
IN N. SEMBILAN/MELAKA

Pollution Source	Year	Dis-charge Ratio	BOD Concentration (mg/lit)	Runoff Ratio	Infil-tration Ratio
<b>Domestic</b>					
Urban sewerage	1990 & 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
<b>Manufacture</b>					
Urban sewerage	1990 & 2000	1.0	30	1.0	0.2
Urban non-sewerage	1990	1.0	185(NS), 120(MA)	0.6	0
Rural	2000	1.0	195(NS), 110(MA)	0.1	0
<b>Palm Oil Mill</b>					
With P.S./ <u>1</u>	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
<b>Rubber Factories</b>					
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/ <u>2</u>	0.1	0

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

Table 20 PROPOSED FLOOD FORECASTING AND WARNING SYSTEM IN N. SEMBILAN/MELAKA

Basin No.	River Basin	People Rel'ved by F/F (10 <sup>3</sup> )	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
N. SEMBILAN				
18	Linggi	14.6	0.9	5MP
21	Muar	2.5	0.7	5MP
MELAKA				
19	Melaka	25.2	1.1	5MP

Table 21 WATER SOURCE DEVELOPMENT PLAN FOR ALTERNATIVE B1  
IN N. SEMBILAN/MELAKA

(1) DAM

Location		Facilities	Purpose	Catchment Area (km <sup>2</sup> )	Active Storage Capacity (106m <sup>3</sup> )	Net Supply Capacity (106m <sup>3</sup> /y)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
State	Basin No.							
<u>Selamban***</u>								
N. Sembilan*	18	Terip dam	WS, IR	23	43	41	21	1985 - 1989
<u>Melaka***</u>								
N. Sembilan*	21	Muar dam	WS, IR, FM	209	36	37	20	1990 - 1994
Pahang/ N. Sembilan*	21	Palong dam	WS	316	140	107	27	1985 - 1989
Pahang*	30	Bera dam	WS	258	171	180	21	1985 - 1989
<u>Port Dickson***</u>								
N. Sembilan*	30	Teriang dam	WS	60	105	42	225	1985 - 1989
N. Sembilan*	30	Gelami dam	WS	58	9	18	27	1990 - 1994
<u>Kelang Valley***</u>								
N. Sembilan*	30	Kenaboi dam	WS	118	136	83	237**	1988 - 1992
N. Sembilan*	30	Kongkoi dam	WS	54	63	33	224**	1992 - 1996

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m <sup>3</sup> /s)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
21	Muar diversion (barrage & canal)	Johor to Melaka 21 to 19 & 20	15	160	1985 - 1989
30	Kenaboi diversion (tunnel)	N. Sembilan to Selangor 30 to 16-15	5	11**	1988 - 1992
30	Kongkoi diversion (tunnel)	N. Sembilan to Selangor 30 to 16-15	2	2**	1992 - 1996
30	Teriang diversion (pipe line)	N. Sembilan 30 to 17	Stage 1: 3 Stage 2: 1	525 300	1985 - 1989 1990 - 1994
30	Bera diversion (anal)	Pahang to N. Sembilan 30 to 21	13	32	1985 - 1989

Remarks; IR = Irrigation; WS = Water Supply; FM = Flood Mitigation

\* = The state where the facilities are located.

\*\* = For diversion to Kelang Valley.

\*\*\* = Town or area where water be supplied.

Construction cost is the financial cost at 1980 constant price.

Table 22 WATER SOURCE DEVELOPMENT PLAN FOR ALTERNATIVE B2  
IN N. SEMBILAN/MELAKA

(1) DAM

Location		Facilities	Purpose	Catchment Area (km <sup>2</sup> )	Active Storage Capacity (10 <sup>6</sup> m <sup>3</sup> )	Net Supply Capacity (10 <sup>6</sup> m <sup>3</sup> /y)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
State	Basin No.							
<u>Selemban***</u>								
N. Sembilan*	18	Terip dam	WS, IR	23	40	38	19	1985 - 1989
<u>Melaka***</u>								
Pahang/ N. Sembilan*	21	Palong dam	WS, IR, FM	316	56	46	16	1985 - 1989
<u>Port Dickson***</u>								
N. Sembilan*	30	Teriang dam	WS	60	105	42	225	1985 - 1989
N. Sembilan*	30	Gelami dam	WS	58	9	15	25	1990 - 1994
<u>Kelang Valley***</u>								
N. Sembilan*	30	Kenaboi dam	WS	118	136	83	237**	1990 - 1994

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m <sup>3</sup> /s)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
21	Muar diversion (barrage & canal)	Johor to Melaka 21 to 19 & 20	13	139	1985 - 1989
30	Teriang diversion (pipe line)	N. Sembilan 30 to 17	Stage 1: 3 Stage 2: 1	525 253	1985 - 1989 1990 - 1994
30	Kenaboi diversion (tunnel)	N. Sembilan to Selangor 30 to 16-15	5	11**	1990 - 1994

Remarks: IR = Irrigation; WS = Water Supply; FM = Flood Mitigation

\* = The State where the facilities are located.

\*\* = For diversion to Kelang Valley.

\*\*\* = Town or area where water be supplied.

Construction cost is the financial cost at 1980 constant price.

Table 23 WATER SOURCE DEVELOPMENT PLAN FOR ALTERNATIVE B3  
IN N. SEMBILAN/MELAKA

(1) DAM

Location		Facilities	Purpose	Catchment Area (km <sup>2</sup> )	Active Storage Capacity (10 <sup>6</sup> m <sup>3</sup> )	Net Supply Capacity (10 <sup>6</sup> m <sup>3</sup> /y)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
State	Basin No.							
<u>Selemban***</u>								
N. Sembilan*	18	Terip dam	WS, IR	23	26	25	13	1985 - 1989
<u>Melaka***</u>								
Pahang/ N. Sembilan*	21	Palong dam	WS, IR	316	30	20	13	1985 - 1989
<u>Port Dickson***</u>								
N. Sembilan*	30	Teriang dam	WS	60	70	36	166	1985 - 1989

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m <sup>3</sup> /s)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
21	Muar diversion (barrage & canal)	Johor to Melaka 21 to 19 & 20	8	80	1985 - 1989
30	Teriang diversion (pipe line)	N. Sembilan 30 to 17	1	477	1985 - 1989

Remarks; IR = Irrigation; WS = Water Supply; FM = Flood Mitigation  
\* = The State where the facilities and located.  
\*\*\*= Town or area where water be supplied.  
Construction cost is the financial cost at 1980 constant price.

Table 24 OUTLINE OF FLOOD MITIGATION PROGRAM BY ALTERNATIVE  
IN N. SEMBILAN/MELAKA

Basin No.	Basin Name	R.I. (km)	Dam (nos)	F.W. (km)	Pold. (nos)	N.S. (10 <sup>3</sup> )	P.P. (10 <sup>3</sup> )	F.A. (10 <sup>3</sup> ha)	C.C. (M\$10 <sup>6</sup> )
<u>N. SEMBILAN</u>									
<u>ALTERNATIVE F1</u>									
16	Langat	19	-	-	-	-	6	1	7
18	Linggi	71	-	-	-	-	39	6	33
21	Muar	103	1	-	-	-	44	6	58
30	Pahang	24	-	-	-	-	12	1	18
	<b>Total</b>	<b>217</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>101</b>	<b>14</b>	<b>116</b>
<u>ALTERNATIVE F2</u>									
18	Linggi	15	-	-	-	-	24	1	5
21	Muar	53	1	-	-	-	39	3	27
	<b>Total</b>	<b>68</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>63</b>	<b>4</b>	<b>32</b>
<u>ALTERNATIVE F3</u>									
16	Langat	19	-	-	-	-	6	1	7
18	Linggi	71	-	-	-	-	39	6	33
21	Muar	53	1	-	-	-	39	3	27
	<b>Total</b>	<b>143</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>84</b>	<b>10</b>	<b>67</b>
<u>MELAKA</u>									
<u>ALTERNATIVE F1</u>									
18	Linggi	32	-	-	-	-	31	4	12
19	Melaka	32	-	5	-	-	66	7	30
20	Kesang	49	-	-	-	-	28	9	30
	<b>Total</b>	<b>113</b>	<b>-</b>	<b>5</b>	<b>-</b>	<b>-</b>	<b>125</b>	<b>20</b>	<b>72</b>
<u>ALTERNATIVE F2</u>									
18	Linggi	26	-	-	-	-	29	3	10
19	Melaka	-	-	5	-	-	52	4	9
20	Kesang	19	-	-	-	-	15	7	20
	<b>Total</b>	<b>45</b>	<b>-</b>	<b>5</b>	<b>-</b>	<b>-</b>	<b>96</b>	<b>14</b>	<b>39</b>
<u>ALTERNATIVE F3</u>									
18	Linggi	32	-	-	-	-	31	4	12
19	Melaka	32	-	5	-	-	66	7	30
20	Kesang	49	-	-	-	-	28	9	30
	<b>Total</b>	<b>113</b>	<b>-</b>	<b>5</b>	<b>-</b>	<b>-</b>	<b>125</b>	<b>20</b>	<b>72</b>

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 25. RECOMMENDED WATER SUPPLY DEVELOPMENT PLAN  
FOR CITIES/TOWNS IN N. SEMBILAN/MELAKA

Basin No.	Code No.	City/Town	1985			1990			2000		
			TC	SF	SP	TC	SF	SP	TC	SF	SP
17	28	Port Dickson	77.5	85	28.9	103.3	90	38.7	166.6	100	64.0
18	29	Seremdan	59.5	100	175.0	77.5	100	210.0	122.5	100	290.0
19	119	Tampin	3.6	85	9.4	4.7	90	10.8	6.8	100	14.0
21	30	Kuala Pilah	5.2	85	11.1	6.6	90	12.6	10.1	100	16.0
30	118	Bahau	3.8	85	10.2	4.9	90	11.7	7.7	100	16.0
N. Semblian State			149.6	96	234.6	197.0	97	283.8	313.7	100	400.0
19	31	Melaka	35.6	85	79.9	51.5	90	88.2	105.2	100	112.0
	120	Kelebang	3.6	85	8.5	5.8	90	9.9	12.1	100	13.0
	121	Bukit Baru	7.1	85	17.0	11.8	90	19.8	24.1	100	26.0
Melaka State			46.3	85	105.4	69.1	90	117.9	141.4	100	151.0
Total			195.9	92	340.0	266.1	95	401.7	455.1	100	551.0

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 26 RECOMMENDED TREATED WATER SUPPLY DEVELOPMENT  
PLAN FOR RURAL AREA IN N. SEMBILAN/MELAKA

Basin No.	Basin Name	1985			1990			2000		
		TC	SF	SP	TC	SF	SP	TC	SF	SP
16	Langat	68.1	74.9	264.2	81.1	83.8	315.0	92.8	96.0	290.2
17	Sepang	13.6	74.6	50.1	15.7	82.3	56.6	19.0	91.2	60.9
18	Linggi	21.4	76.9	132.8	27.4	82.0	143.6	43.4	83.4	163.3
19	Melaka	32.8	82.1	214.6	44.9	87.4	236.8	60.3	88.0	229.4
21	Muar	48.2	60.5	257.5	98.2	75.6	319.2	97.0	95.7	346.0
30	Pahang & Penor.	53.9	67.8	323.8	69.3	73.7	350.7	100.4	76.7	369.3
	Sub-total	238.0	-	1,243.0	336.6	-	1,421.9	412.9	-	1,459.1
	N. Sembilan State	51.8	74.0	298.2	60.6	79.0	314.3	64.2	81.2	288.2
18	Linggi	21.4	76.9	132.8	27.4	82.0	143.6	43.4	83.4	163.3
19	Melaka	32.8	82.1	214.6	44.9	87.4	236.8	60.3	88.0	229.4
20	Kesang	12.7	75.0	73.1	16.3	84.1	82.8	50.9	91.2	89.1
	Sub-total	66.9	-	420.5	88.6	-	463.2	154.6	-	481.8
	Melaka State	49.4	82.5	316.8	66.0	87.7	346.5	90.4	88.2	342.3
	Total	304.9	-	1,316.1	425.2	-	1,504.7	567.5	-	1,548.2
	N. Sembilan/Melaka	101.2	78.1	615.1	126.6	83.3	660.8	154.6	84.9	630.5

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 27 RECOMMENDED UNTREATED WATER SUPPLY DEVELOPMENT  
PLAN FOR RURAL AREA IN N. SEMBILAN/MELAKA

Basin No.	Basin Name	Unit: 10 <sup>6</sup> m <sup>3</sup> /y								
		1985			1990			2000		
		SD	SF	SP	SD	SF	SP	SD	SF	SP
16	Langat	0.2	2.6	9.1	0.2	2.7	10.2	0.3	4.0	12.1
17	Selangor	0.0	4.6	3.1	0.1	5.7	3.9	0.2	8.8	5.9
18	Linggi	0.4	7.5	13.0	0.4	10.6	18.5	1.1	16.6	32.6
19	Melaka	0.3	5.7	15.0	0.4	8.0	21.6	0.9	11.9	31.1
21	Muar	0.6	6.0	25.7	0.7	6.4	27.2	0.5	4.3	15.4
30	Pahang & Penor	1.9	18.8	89.8	2.5	12.9	100.1	3.7	23.3	112.5
	Sub-total	3.4	-	155.7	4.3	-	181.5	6.7	-	209.6
	N. Sembilan State	0.9	8.6	34.7	1.1	12.0	47.8	6.7	18.8	66.8
18	Linggi	0.4	7.5	13.0	0.4	10.6	18.5	1.1	16.6	32.6
19	Melaka	0.3	5.7	15.0	0.4	8.0	21.6	0.9	11.9	31.1
20	Kesang	0.1	5.4	5.3	0.1	6.8	7.7	0.3	8.8	8.6
	Sub-total	0.8	-	33.3	0.9	-	46.8	2.3	-	72.3
	Melaka State	0.5	5.6	21.5	0.6	7.8	30.9	1.4	11.8	45.7
	Total	4.2	-	161.0	5.2	-	188.2	9.0	-	218.2
	N. Sembilan/Melaka	1.4	7.1	56.2	1.7	9.9	78.6	8.3	15.1	112.5

Remarks; SD: Source demand in the rural area in the corresponding year in 10<sup>6</sup> m<sup>3</sup>/y  
 SF: Service factor in the rural area in %  
 SP: Served population in the rural area in 10<sup>3</sup> persons

Table 28. RECOMMENDED WATER SOURCE DEVELOPMENT PLAN  
IN MELAKA/NEGERI SEMBILAN

(1) DAM

Location		Facilities	Purpose	Catchment Area (km <sup>2</sup> )	Active Storage Capacity (10 <sup>6</sup> m <sup>3</sup> )	Net Supply Capacity (10 <sup>6</sup> m <sup>3</sup> /y)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
State	Basin No.							
<u>Selamban***</u>								
N. Sembilan*	18	Terip dam	WS, IR	23	43	41	21	1985 - 1989
<u>Melaka***</u>								
N. Sembilan*	21	Muar dam	WS, IR	209	36	37	20	1990 - 1994
Pahang/ N. Sembilan*	21	Palong dam	WS	316	140	107	27	1985 - 1989
<u>Port Dickson***</u>								
N. Sembilan*	30	Teriang dam	WS	60	105	42	225	1985 - 1989
N. Sembilan*	30	Gelami dam	WS	58	9	18	27	1990 - 1994
<u>Kelang Valley***</u>								
N. Sembilan*	30	Kenaboi dam	WS	118	136	83	237**	1988 - 1992
N. Sembilan*	30	Kongkoi dam	WS	54	69	33	224**	1992 - 1996

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m <sup>3</sup> /s)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
21	Muar diversion (barrage & canal)	Johor to Melaka 21 to 19 & 20	15	160	1985 - 1989
30	Kenaboi diversion (tunnel)	N. Sembilan to Selangor 30 to 16-15	5	11**	1988 - 1992
30	Kongkoi diversion (tunnel)	N. Sembilan to Selangor 30 to 16-15	2	2**	1992 - 1996
30	Teriang diversion (pipe line)	N. Sembilan 30 to 17	Stage 1: 3 Stage 2: 1	525 300	1985 - 1989 1990 - 1994

Remarks: WS = Water Supply; IR = Irrigation; FM = Flood Mitigation  
 \* = The State where the facilities are located.  
 \*\* = For diversion to Kelang Valley.  
 \*\*\* = Town or area where water be supplied.  
 Construction cost is the financial cost at 1980 constant price.

Table 29 RECOMMENDED PLAN FOR IMPROVEMENT OF PURIFICATION SYSTEM IN PALM OIL MILLS AND RUBBER FACTORIES IN TREATMENT CAPACITY IN N. SEMBILAN/MELAKA

Unit: m<sup>3</sup>/d

Basin		1981 - 1990			1991 - 2000		
No.	Name	Palm Oil	Rubber	Total	Palm Oil	Rubber	Total
16	Langat	678	1,300	1,976	904	4	908
17	Sepang	80	72	152	240	76	316
18	Linggi	1,072	5,888	6,960	40	900	940
19	Melaka	0	5,732	5,732	0	1,152	1,152
20	Kesang	192	1,060	1,252	0	144	144
21	Muar	1,292	7,076	8,368	1,332	1,224	2,556
Total		3,312	21,128	24,440	2,516	3,500	6,016

Table 30 RECOMMENDED PUBLIC SEWERAGE DEVELOPMENT PLAN FOR WATER POLLUTION ABATEMENT IN N. SEMBILAN/MELAKA

Basin No.	City/Town No. Name		1990			2000		
			Treatment Capacity (10 <sup>3</sup> m <sup>3</sup> /d)	Service Factor (%)	Served Population (10 <sup>3</sup> )	Treatment Capacity (10 <sup>3</sup> m <sup>3</sup> /d)	Service Factor (%)	Served Population (10 <sup>3</sup> )
18	C29	Seremban	33	45	95	115	100	290
Total			33	-	95	115	-	290

Table 31 ASSUMED PUBLIC SEWERAGE DEVELOPMENT NOT AFFECTING RIVER WATER QUALITY IN N. SEMBILAN/MELAKA

Basin No.	City/Town No. Name		1990			2000		
			Treatment Capacity (10 <sup>3</sup> m <sup>3</sup> /d)	Service Factor (%)	Population Served (10 <sup>3</sup> )	Treatment Capacity (10 <sup>3</sup> m <sup>3</sup> /d)	Service Factor (%)	Population Served (10 <sup>3</sup> )
17	C28	Port Dickson	65	40	26	206	80	51
19	C31	Melaka	32	50	49	112	80	90
Total			97	-	75	318	-	141

Table 32 POLLUTION LOAD IN 2000 BY BASIN UNDER WITH-AND-WITHOUT IMPLEMENTATION OF RECOMMENDED PLAN IN N. SEMBILAN/MELAKA

Basin No.	Basin Name	Without Project					With Project				
		BOD Load into River (ton/d)				Max. BOD in River (mg/lit)	BOD Load into River (ton/d)				Max. BOD in River (mg/lit)
		PR	UT	RA	Total		PR	UI	RA	Total	
16	Langat	8	3	2	13	9	8	1	2	11	6
17	Sepang	1	0	1	2	20	0	0	1	1	6
18	Linggi	12	9	2	23	292	0	2	2	4	23
19	Melaka	8	3	1	12	85	0	3	1	4	14
20	Kesang	2	0	0	2	37	1	0	0	1	9
21	Muar	20	7	1	28	30	0	5	1	6	7
30	Pahang	41	37	1	79	4	41	37	1	79	4
Total		92	59	8	159	-	50	48	8	106	-

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

Table 33 RECOMMENDED FLOOD MITIGATION PROGRAM IN N. SEMBILAN/MELAKA

Basin No.	Name of River	R.I. (km)	F.W. (km)	Dam (nos)	Pold. (nos)	N.S. (10 <sup>3</sup> )	P.P. (10 <sup>3</sup> )	F.A. (10 <sup>3</sup> ha)	C.C. (M\$10 <sup>6</sup> )
<b>N. SEMBILAN</b>									
<u>By 1990</u>									
16	Langat	-	-	-	-	-	-	-	-
18	Linggi	15	-	-	-	-	24	1	5
21	Muar	-	-	-	-	-	-	-	-
30	Pahang	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>15</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>24</b>	<b>1</b>	<b>5</b>
<u>By 2000</u>									
18	Linggi	15	-	-	-	-	24	1	5
21	Muar	53	1	-	-	-	39	3	27
	<b>Total</b>	<b>68</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>63</b>	<b>4</b>	<b>32</b>
<b>MELAKA</b>									
<u>By 1990</u>									
18	Linggi	12	-	-	-	-	17	2	5
19	Melaka	-	5	-	-	-	-	-	-
20	Kesang	-	-	-	-	-	-	-	-
	<b>Total</b>	<b>12</b>	<b>5</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>17</b>	<b>2</b>	<b>5</b>
<u>By 2000</u>									
18	Linggi	26	-	-	-	-	29	3	10
19	Melaka	-	5	-	-	-	52	4	9
20	Kesang	19	-	-	-	-	15	7	20
	<b>Total</b>	<b>45</b>	<b>5</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>96</b>	<b>14</b>	<b>39</b>

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 34 ASSUMED UNIT CONSTRUCTION COST (1/2)

1. <u>Compensation on Land (M\$10<sup>6</sup>/km<sup>2</sup>)</u>			
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. <u>Resettlement (M\$10<sup>3</sup>/household)</u>			
Urban	30	Rural	10
3. <u>Civilwork</u>			
Dam	M\$48-66 per m <sup>3</sup> of embankment volume		
Canal	M\$50-94/m per m <sup>3</sup> /s of discharge capacity		
Tunnel	M\$160-182/m per m <sup>3</sup> /s of discharge capacity		
Pipeline	M\$990-1,980/m per m <sup>3</sup> /s of discharge capacity		
Barrage/Weir	M\$1,320/m per m <sup>3</sup> /s of 100-y maximum capacity		
Pumping station	M\$7,700-14,300 m <sup>3</sup> /s of discharge capacity		
4. <u>River Facilities</u>			
<u>Channel improvement (M\$10<sup>6</sup>/km)</u>		<u>Floodway (M\$10<sup>6</sup>/km)</u>	
200 m <sup>3</sup> /s	0.2 - 0.4	200 m <sup>3</sup> /s	0.2 - 0.5
500 m <sup>3</sup> /s	0.3 - 0.6	500 m <sup>3</sup> /s	0.4 - 0.9
1,000 m <sup>3</sup> /s	0.4 - 0.8	1,000 m <sup>3</sup> /s	0.5 - 1.2
10,000 m <sup>3</sup> /s	1.2 - 2.9	2,000 m <sup>3</sup> /s	0.7 - 1.8
<u>Polder</u>			
Protection bund	M\$150-700 x 10 <sup>3</sup> /km		
Drainage system	M\$540 x 10 <sup>3</sup> /km		
Drainage pump	M\$150-380 x 10 <sup>3</sup> per m <sup>3</sup> /s		

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

Table 35 ASSUMED UNIT CONSTRUCTION COST (2/2)

5. <u>D&amp;I Water Supply System</u>	
Pipeline	M\$430/m per m <sup>3</sup> /s of discharge capacity
Treatment plant	M\$710 per m <sup>3</sup> /d of capacity
Distribution system	M\$1,300 per m <sup>3</sup> /d of capacity
6. <u>Sewerage System</u>	
	M\$157 x 10 <sup>6</sup> per 100 x 10 <sup>3</sup> m <sup>3</sup> /d
7. <u>D&amp;I Pre-treatment System</u>	
Aerated lagoon	M\$38 x 10 <sup>6</sup> per 100 x 10 <sup>3</sup> m <sup>3</sup> /d
Rapid sandfilter bed	M\$112 x 10 <sup>6</sup> per 100 x 10 <sup>3</sup> m <sup>3</sup> /d
8. <u>Power Facilities</u>	
<u>Generating equipment</u>	
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
<u>Transmission line</u>	M\$162-194 x 10 <sup>3</sup> per km
9. <u>Irrigation Facilities</u>	
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 36 ESTIMATED PUBLIC DEVELOPMENT EXPENDITURE  
FOR RECOMMENDED PLAN IN N. SEMBILAN/  
MELAKA/NORTHWEST JOHOR

		Unit: M\$10 <sup>6</sup>				
		4MP	5MP	6MP	7MP	Total
Source Development	/1	103	891	311	0	1305
Irrigation	N. Sembilan	8	13	7	0	28
	Melaka	11	19	6	0	36
	N.W. Johor	9	14	2	0	25
	Sub-total	28	46	15	0	89
Inland Fishery	N. Sembilan	3	3	35	53	94
	Melaka	0	0	0	0	0
	N.W. Johor	1	1	2	2	6
	Sub-total	4	4	37	55	100
Public Water Supply	N. Sembilan	75	133	138	55	401
	Melaka	47	83	85	34	249
	N.W. Johor	48	84	85	34	251
	Sub-total	170	300	308	123	901
Public Water Supply (Pretreatment facilities)	N. Sembilan	22	23	17	6	66
	Melaka	30	35	26	10	101
	N.W. Johor	20	24	17	7	68
	Sub-total	70	82	60	23	235
Public Sewerage (Effective for river water pollution abatement)	N. Sembilan	27	45	46	18	136
	Melaka	0	0	0	0	0
	N.W. Johor	9	16	16	7	48
	Sub-total	36	61	62	25	184
Public Sewerage (Others)	N. Sembilan	44	75	77	31	227
	Melaka	24	41	42	17	124
	N.W. Johor	0	0	0	0	0
	Sub-total	68	116	119	48	351
Flood Mitigation	N. Sembilan	0	7	14	12	33
	Melaka	5	1	17	17	40
	N.W. Johor	0	0	0	4	4
	Sub-total	5	8	31	33	77
<b>Total</b>		<b>484</b>	<b>1508</b>	<b>943</b>	<b>307</b>	<b>3242</b>

Remark; /1: Including the expenditures for the States of N. Sembilan and Melaka and northwest Johor.



Table 37. ESTIMATED PUBLIC RECURRENT EXPENDITURE  
FOR RECOMMENDED PLAN IN N. SEMBILAN/  
MELAKA/NORTHWEST JOHOR

		Unit: M\$10 <sup>6</sup>				
		4MP	5MP	6MP	7MP	Total
Source Development	/1	0	6	27	33	66
Irrigation						
	N. Sembilan	0	0	2	2	4
	Melaka	0	1	2	3	6
	N.W. Johor	0	0	2	3	5
	Sub-total	0	1	6	8	15
Inland Fishery						
	N. Sembilan	0	0	1	5	6
	Melaka	0	0	0	0	0
	N.W. Johor	0	0	0	1	1
	Sub-total	0	0	1	6	7
Public Water Supply						
	N. Sembilan	0	13	26	38	77
	Melaka	0	8	16	24	48
	N.W. Johor	0	8	16	24	48
	Sub-total	0	29	58	86	173
Public Water Supply (Pretreatment facilities)						
	N. Sembilan	0	3	5	6	14
	Melaka	0	5	7	10	22
	N.W. Johor	0	3	5	7	15
	Sub-total	0	11	17	23	51
Public Sewerage (Effective for river water pollution abatement)						
	N. Sembilan	0	9	18	26	53
	Melaka	0	0	0	0	0
	N.W. Johor	0	3	6	9	18
	Sub-total	0	12	24	35	71
Public Sewerage (Others)						
	N. Sembilan	0	15	30	43	88
	Melaka	0	8	16	23	47
	N.W. Johor	0	0	0	0	0
	Sub-total	0	23	46	66	135
Flood Mitigation						
	N. Sembilan	0	0	3	9	12
	Melaka	0	2	3	11	16
	N.W. Johor	0	0	0	0	0
	Sub-total	0	2	6	20	28
<b>Total</b>		<b>0</b>	<b>84</b>	<b>185</b>	<b>277</b>	<b>546</b>

Remark; /1: Including the expenditures for the States of N. Sembilan and Melaka and northwest Johor.

Table 38 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED  
 PLAN FOR WATER DEMAND AND SUPPLY BALANCE  
 IN N. SEMBILAN/MELAKA/NORTHWEST JOHOR

Item	Amount
<b>1. National Economic Development</b>	
<b>1.1 Economic Benefit</b>	
Irrigation	(M\$10 <sup>6</sup> ) 5
D&I water supply	(M\$10 <sup>6</sup> ) 118
Fish culture	(M\$10 <sup>6</sup> ) 4
Reservoir recreation	(M\$10 <sup>6</sup> ) 2
Total	(M\$10 <sup>6</sup> ) 129
<b>1.2 Economic Cost</b>	
Irrigation	(M\$10 <sup>6</sup> ) 2
D&I water supply	(M\$10 <sup>6</sup> ) 72
Fish culture	(M\$10 <sup>6</sup> ) 4
Dams, barrages & diversion facilities	(M\$10 <sup>6</sup> ) 39
Total	(M\$10 <sup>6</sup> ) 117
1.3 EIRR	(%) 10
<b>2. Environmental Quality</b>	
<b>2.1 Beneficial Effect</b>	
Safe maintenance flow period (2000)	See Table
Surface area of lake created	(km <sup>2</sup> ) 18
<b>2.2 Adverse Effect</b>	
Possible reduction in kind of fish immediately downstream of dams and barrages	(nos. of site) 6
<b>3. Social Well-being</b>	
<b>3.1 Beneficial Effect</b>	
Number of farm households benefited by proposed irrigation in 2000	(10 <sup>3</sup> ) 9
Number of people served by proposed public water supply in 2000	(10 <sup>3</sup> ) 1,792
Safe supply period (2000)	See Table
<b>3.2 Adverse Effect</b>	
Number of people to be removed for construction of facilities	(10 <sup>2</sup> ) 4

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

Table 39' SAFE SUPPLY PERIOD AND SAFE RIVER MAINTENANCE  
FLOW PERIOD IN 2000 WITH RECOMMENDED PLAN  
IMPLEMENTED IN N. SEMBILAN/MELAKA

Unit: days

Basin No.	Basin Name	Safe Supply Period		Safe Maintenance Flow Period	
		Plan Implemented	Natural Flow	Plan Implemented	Natural Flow
17	Sepang	365	143	365	133
18	Linggi	365	239	365	187
19	Melaka	365	87	365	72
20	Kesang	365	212	365	207
21	Muar	365	132	365	132

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

Table 40 BENEFICIAL AND ADVERSE EFFECTS OF  
RECOMMENDED PLAN FOR WATER POLLUTION  
ABATEMENT IN N. SEMBILAN/MELAKA/NORTHWEST  
JOHOR

Item	Amount
1. National Economic Development	
1.1 Economic Benefit	
Sewerage	(M\$10 <sup>6</sup> ) 10
Saving in pre-treatment for D&I water supply	(M\$10 <sup>6</sup> ) 35
Total	(M\$10 <sup>6</sup> ) 45
1.2 Economic Cost	
Sewerage	(M\$10 <sup>6</sup> ) 26
Private purification facilities /2	(M\$10 <sup>6</sup> ) 2
Pre-treatment for D&I water supply	(M\$10 <sup>6</sup> ) 11
Total	(M\$10 <sup>6</sup> ) 39
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 = 853 km)	(km) 797/550 <sup>/1</sup>
Length of river stretch where BOD concentration is not more than 5 mg/lit in 2000 compared with without project condition (Study length = 853 km)	(km) 664/476 <sup>/1</sup>
2.2 Adverse Effect	-
3. Social Well-Being	
3.1 Beneficial Effects	
Number of people served by proposed sewerage system in 2000	(10 <sup>3</sup> ) 537
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 Selangor, and Pahang.

/2: Including the rubber factories and palm oil mills  
in such part of the State of Selangor, Johor and  
Pahang as located in Basin 16, 17, 20, 21 and 30.

Table 41 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED  
 PLAN FOR FLOOD MITIGATION IN N. SEMBILAN/MELAKA/  
 NORTHWEST JOHOR

Item		Recommended Plan
1. National Economic Development		
1.1 Economic Benefit		
Damage reduction	(M\$10 <sup>6</sup> )	4.0
1.2 Economic Cost		
Flood mitigation work	(M\$10 <sup>6</sup> )	2.0
1.3 EIRR	(%)	13
2. Environmental Quality		
2.1 Beneficial Effect		
Length of improved stretch	(km)	113
2.2 Adverse Effect		-
3. Social Well-Being		
3.1 Beneficial Effect		
Number of protected people by proposed facilities in 2000	(10 <sup>3</sup> )	159
Population served by proposed flood warning system in 2000	(10 <sup>3</sup> )	42
Area relieved from flood hazards	(10 <sup>3</sup> ha)	19
3.2 Adverse Effect		
Number of people to be removed for construction of facilities	(10 <sup>3</sup> )	2

Table 42 SUMMARY OF FUTURE ECONOMIC NET VALUE  
OF WET PADDY BY TYPE OF SCHEME IN  
N. SEMBILAN/MELAKA

	Yield (ton/ha)	Unit Price (M\$/ton)	Gross Value (M\$/ha)	Produc- tion Cost (M\$/ha)	Net Value (M\$/ha)
(1) Major Irrigation Scheme					
Double cropping	-	-	-	-	-
Single cropping	-	-	-	-	-
(2) Minor Irrigation Scheme					
- Negeri Sembilan					
Double cropping	7.8	640	4,992	1,688	3,304
Single cropping	3.7	640	2,368	819	1,549
- Melaka					
Double cropping	7.8	640	4,992	1,695	3,297
Single cropping	3.7	640	2,368	823	1,545
(3) Rainfed Scheme					
- Negeri Sembilan					
Single cropping	2.1	640	1,344	793	551
- Melaka					
Single cropping	2.1	640	1,344	774	570

Table 43 ESTIMATED AND PROJECTED SERVICE FACTOR AND PER CAPITA DAILY USE OF DOMESTIC WATER IN N.SEMBILAN/MELAKA UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

City/Rural	Service Factor (%)				Per Capita Daily Use (lpcd)			
	Estimated		Projected		Estimated		Projected	
	1980	1985	1990	2000	1980	1985	1990	2000
<u>N.SEMBILAN</u>								
1. <u>Urban Area</u>								
28 Port Dickson	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
29 Seremban	100.0	100.0	100.0	100.0	170.0	180.0	195.0	220.0
30 Kuala Pilah	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
118 Tampin	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
119 Bahau	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
2. <u>Rural Area</u>								
PWD Rural	66.0	74.0	77.7	79.6	75.0	95.0	115.0	155.0
MOH Rural	5.4	8.6	11.8	18.4	40.0	45.0	55.0	65.0
3. <u>Non-Pipe-Served Area</u> - - - - 40.0 40.0 40.0 40.0								
<u>MELAKA</u>								
1. <u>Urban Area</u>								
31 Melaka	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
120 Kelebang	73.4	85.0	90.0	95.0	75.0	170.0	185.0	210.0
121 Bukit Baru	80.0	85.0	90.0	95.0	160.0	170.0	185.0	210.0
2. <u>Rural Area</u>								
PWD Rural	70.0	82.5	87.2	87.3	75.0	95.0	115.0	155.0
MOH Rural	3.4	5.6	7.8	11.7	40.0	45.0	55.0	65.0
3. <u>Non-Pipe-Served Area</u> - - - - 40.0 40.0 40.0 40.0								

Table 44 ESTIMATED AND PROJECTED D&I WATER DEMAND  
BY BASIN UNDER THE CONDITION OF LOWER  
ECONOMIC GROWTH IN N. SEMBILAN/MELAKA (1/2)

Unit: 10<sup>6</sup> m<sup>3</sup>/y

Basin No.	City/Rural	Estimated				Projected					
		1980 D&I	D	I	Total	1990			2000		
		D	I	Total	D	I	Total	D	I	Total	
16	26 Kajang Chua	6.6	2.6	6.0	8.6	3.3	6.4	9.7	4.6	7.5	12.1
	115 Semenyih	2.1	0.8	2.0	2.8	0.9	1.7	2.6	1.1	2.1	3.2
	City Total	8.7	3.4	8.0	11.4	4.2	8.1	12.3	5.7	9.6	15.3
	Rural	28.6	13.7	19.0	32.7	20.6	13.7	34.3	38.3	9.5	47.8
	Basin Total	37.3	17.1	27.0	44.1	24.8	21.8	46.6	44.0	19.1	63.1
17	28 Poru Dickson	24.5	2.4	43.5	45.9	3.4	51.2	54.6	5.1	66.8	71.9
	Rural	5.9	2.5	4.0	6.5	3.3	3.0	6.3	4.9	2.2	7.1
	Basin Total	30.4	4.9	47.5	52.4	6.7	54.2	60.9	10.0	69.0	79.0
18	29 Selemban	15.9	15.0	7.8	22.8	18.5	9.1	27.6	25.4	12.0	37.4
	Rural	7.0	6.9	3.0	9.9	8.2	2.8	11.0	10.8	3.1	13.9
	Basin Total	22.9	21.9	10.8	32.7	26.7	11.9	38.6	36.2	15.1	51.3
19	31 Melaka	12.1	6.8	9.5	16.3	7.6	13.6	21.2	9.0	25.5	34.5
	119 Tampin	1.0	0.8	0.7	1.5	0.9	0.9	1.8	1.1	1.1	2.2
	120 Kelebang	0.9	0.7	1.0	1.7	0.8	1.5	2.3	1.1	3.0	4.1
	121 Bukit Baru	2.5	1.5	2.0	3.5	1.7	3.1	4.8	2.1	6.0	8.1
	City Total	16.5	9.8	13.2	23.0	11.0	19.1	30.1	13.3	35.6	48.9
	Rural	10.4	10.5	3.3	13.8	13.9	3.3	17.2	19.9	3.5	23.4
Basin Total	26.9	20.3	16.5	36.8	24.9	22.4	47.3	33.2	39.1	72.3	
21	30 Kuala Pilah	1.6	0.9	1.5	2.4	1.0	1.8	2.8	1.2	2.4	3.6
	32 Segmat	4.2	3.4	2.9	6.3	5.0	4.0	9.0	8.4	6.3	14.7
	34 Muar	9.7	5.1	9.6	14.7	5.9	11.4	17.3	4.2	17.3	21.5
	122 Labis	2.2	0.8	2.8	3.6	1.0	3.4	4.4	1.3	5.1	6.4
	125 Jementah	1.1	0.3	1.3	1.6	0.5	1.5	2.0	1.0	1.9	2.9
	CI45	0.2	0.3	0.6	0.9	0.4	0.0	0.4	0.6	1.6	2.2
	City Total	19.0	10.8	18.7	29.5	13.8	22.1	35.9	16.7	34.6	51.3
	Rural	18.2	14.5	8.8	23.3	20.5	7.5	28.0	32.4	7.2	39.6
	Basin Total	37.2	25.3	27.5	52.8	34.3	29.6	63.9	49.1	41.8	90.9
	30	45 Temerloh	2.1	1.1	4.5	5.6	1.3	7.3	8.6	1.7	20.3
46 Bentong		1.8	1.8	0.7	2.5	2.0	1.1	3.1	2.4	3.2	5.6
48 Jeramtut		1.4	1.4	4.8	6.2	0.9	7.7	8.6	1.3	21.5	22.8
49 Raub		2.1	2.0	2.1	4.1	2.4	3.6	6.0	3.0	9.6	12.6
50 Kuala Lipis		2.0	0.8	0.9	1.7	0.9	1.1	2.0	1.1	2.2	3.3
118 Bahau		1.1	0.8	0.7	1.5	1.0	0.9	1.9	1.2	1.1	2.3
130 Mentakab		1.1	0.8	3.4	4.2	1.0	5.5	6.5	1.4	15.2	16.6
131 Teriang		0.5	0.7	0.8	1.5	0.9	1.1	2.0	1.3	2.5	3.8

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



Table 45 ESTIMATED AND PROJECTED D&I WATER DEMAND  
BY BASIN UNDER THE CONDITION OF LOWER  
ECONOMIC GROWTH IN N. SEMBILAN/MELAKA (2/2)

Unit: 10<sup>6</sup> m<sup>3</sup>/y

Basin No.	City/Rural	Estimated			Projected			2000			
		1980 D&I	1985 D	1985 I	1985 Total	1990 D	1990 I	1990 Total	D	I	Total
30	C137	1.4	1.8	2.1	3.9	2.3	2.9	5.2	2.7	5.1	7.8
	C138	0.2	0.3	0.6	0.9	0.9	1.1	2.0	1.3	2.5	3.8
	C144	0.2	0.3	0.5	0.8	1.4	0.0	1.4	1.8	3.4	5.2
	C152	0.0	0.0	0.0	0.0	0.8	1.0	1.8	1.2	2.4	3.6
	C153	1.0	0.8	0.9	1.7	0.9	1.1	2.0	1.1	2.0	3.1
	C154	0.5	0.4	0.7	1.1	0.5	0.9	1.4	0.6	1.6	2.2
	C155	0.3	0.2	0.4	0.6	0.9	1.1	2.0	1.1	2.0	3.1
	C156	0.0	0.0	0.1	0.1	2.5	3.0	5.5	2.9	5.4	8.3
	City Total	15.7	13.2	23.2	36.4	20.6	39.4	60.0	26.1	100.0	126.1
	Rural	17.4	18.3	7.5	25.8	24.0	7.3	31.3	41.3	9.3	50.6
Basin Total	33.1	31.5	30.7	62.2	44.6	46.7	91.3	67.4	109.3	176.7	
Sub-total N. Sembilan	187.8	121.0	160.0	281.0	162.0	186.6	348.6	239.9	293.4	533.3	
18	29 Selemban	15.9	15.0	7.8	22.8	18.5	9.1	27.6	25.4	12.0	37.4
	Rural	7.0	6.9	3.0	9.9	8.2	2.8	11.0	10.8	3.1	13.9
	Basin Total	22.9	21.9	10.8	32.7	26.7	11.9	38.6	36.2	15.1	51.3
19	31 Melaka	21.0	6.8	9.5	16.3	7.6	13.6	21.2	9.0	25.5	34.5
	119 Tampin	1.0	0.8	0.7	1.5	0.9	0.9	1.8	1.1	1.1	2.2
	120 Kelebang	0.9	0.7	1.0	1.7	0.8	1.5	2.3	1.1	3.0	4.1
	121 Bulit Baru	2.5	1.5	2.0	3.5	1.7	3.1	4.8	2.1	6.0	8.1
	City Total	16.5	9.8	13.2	23.0	11.0	19.1	30.1	13.3	35.6	48.9
	Rural	10.4	10.5	3.3	13.8	13.9	3.3	17.2	19.9	3.5	23.4
Basin Total	26.9	20.3	16.5	36.8	24.9	22.4	47.3	33.2	39.1	72.3	
20	33 Tangkak	1.1	1.0	0.1	1.1	1.2	0.2	1.4	1.5	0.2	1.7
	Rural	3.8	3.7	11.0	14.7	4.9	0.9	5.8	7.0	0.9	7.9
	Basin Total	4.9	4.7	11.1	15.8	6.1	1.1	7.2	8.5	1.1	9.6
Sub-total Melaka	54.7	46.9	38.4	85.3	57.7	35.4	93.1	77.9	55.3	133.2	
Total N. Sembilan/Melaka	192.7	167.9	198.4	366.3	219.7	222.0	441.7	317.8	348.7	666.5	
		92.2	60.2	77.3	137.5	74.9	92.1	167.0	102.0	128.7	230.7

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

Table 46 RECOMMENDED WATER SUPPLY DEVELOPMENT PLAN FOR CITIES/TOWNS IN N. SEMBILAN/MELAKA UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	Code No.	City/Town	1985			1990			2000		
			TC	SF	SP	TC	SF	SP	TC	SF	SP
17	28	Port Dickson	72.6	85	28.1	87.1	90	36.9	115.9	95	50.4
18	29	Seremban	57.0	100	173.0	69.6	100	198.0	94.5	100	240.0
19	119	Tampin	3.6	85	9.4	4.1	90	9.9	6.6	95	11.4
21	30	Kuala Pilah	5.2	85	11.1	5.8	90	11.7	7.1	95	12.4
30	118	Bahau	3.6	85	10.2	4.7	90	10.8	6.9	95	12.4
N. Sembilan State			142.0	96	231.8	171.3	97	267.3	231.0	99	326.6
19	31	Melaka	34.0	85	79.1	42.7	90	83.7	65.5	95	88.4
	120	Kelebang	3.6	85	8.5	4.9	90	9.0	7.9	95	10.5
	121	Bukit Baru	7.1	85	17.0	9.9	90	18.9	15.3	95	20.9
Melaka State			44.7	85	104.6	57.5	90	111.6	88.7	95	119.8
Total			186.7	92	336.4	228.8	95	378.9	319.7	98	446.4

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 47

RECOMMENDED TREATED WATER SUPPLY DEVELOPMENT  
 PLAN FOR RURAL AREA IN N. SEMBILAN/MELAKA  
 UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	Basin Name	1985			1990			2000		
		TC	SF	SP	TC	SF	SP	TC	SF	SP
16	Langet	77.5	74.8	269.0	89.8	82.9	350.0	135.9	94.2	507.4
17	Selang & Others	14.8	74.7	50.2	15.4	81.2	56.1	19.0	89.6	64.0
18	Linggi & Others	19.9	77.0	132.0	24.1	81.1	136.2	31.6	82.5	135.4
19	Melaka & Others	31.3	82.2	215.6	41.9	86.9	242.0	58.2	87.0	252.4
21	Muar & Others	46.1	60.6	260.5	65.4	75.0	333.5	104.6	91.3	422.0
30	Pahang & Penor	52.1	67.8	335.2	69.0	73.2	382.0	117.5	75.9	496.8
	Sub-total	241.7	-	1,262.5	305.6	-	1,499.8	466.8	-	1,878.0
	N. Sembilan State	49.1	74.0	300.4	59.4	77.7	321.7	79.6	79.6	337.4
18	Linggi & Others	19.9	77.0	132.0	24.1	81.1	136.2	31.6	82.5	135.4
19	Melaka & Others	31.3	82.2	215.6	41.9	86.9	242.0	58.2	87.0	252.4
20	Kesang	11.5	75.0	73.2	15.1	83.6	83.2	21.7	90.0	90.6
	Sub-total	62.7	-	420.8	81.1	-	461.4	111.5	-	478.4
	Melaka State	47.0	82.5	317.5	61.2	87.2	350.7	83.8	87.3	361.5
	Total	253.2	-	1,335.7	320.7	-	1,583.0	488.5	-	1,968.6
	N. Sembilan/Melaka	96.1	78.1	617.9	120.6	82.4	672.4	163.4	83.4	698.9

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 48 RECOMMENDED UNTREATED WATER SUPPLY DEVELOPMENT  
 PLAN FOR RURAL AREA IN N. SEMBILAN/MELAKA UNDER  
 THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	Basin Name	1985			1990			2000		
		SD	SF	SP	SD	SF	SP	SD	SF	SP
16	Langat	0.2	2.6	9.2	0.2	2.5	10.5	0.3	2.0	10.6
17	Sepang†	0	4.5	3.0	0.1	5.5	3.8	0.1	7.0	5.0
18	Linggit†	0.4	7.6	13.0	0.4	10.4	17.4	0.8	16.0	26.2
19	Melaka†	0.3	5.8	15.1	0.5	7.9	22.1	1.1	11.9	34.6
21	Muar	0.6	6.1	26.1	0.8	6.5	29.1	0.9	6.4	29.5
30	Pahang	2.0	18.8	93.1	2.6	20.9	108.9	4.5	22.9	149.9
	Sub-total	3.5	-	159.5	4.6	-	191.8	7.7	-	255.8
	N. Sembilan State	0.9	8.6	34.9	1.2	11.8	49.0	2.4	18.4	77.9
18	Linggit†	0.4	7.6	13.0	0.4	10.4	17.4	0.8	16.0	26.2
19	Melaka†	0.3	5.8	15.1	0.5	7.9	22.1	1.1	11.9	34.6
20	Kesang	0.1	5.4	5.3	0.1	6.7	6.7	0.3	8.6	8.7
	Sub-total	0.8	-	33.4	1.0	-	46.2	2.2	-	69.5
	Melaka State	0.5	5.6	21.8	0.7	7.8	31.3	1.5	11.7	48.4
	Total	4.3	-	164.8	4.7	-	198.5	8.0	-	264.5
	N. Sembilan/Melaka	1.4	7.2	56.7	1.9	9.8	80.3	3.9	15.1	126.3

Remarks; SD: Source demand in the rural area in the corresponding year in 10<sup>6</sup> m<sup>3</sup>/y  
 SF: Service factor in the rural area in %  
 SP: Served population in the rural area in 10<sup>3</sup> persons

Table 49 RECOMMENDED SOURCE DEVELOPMENT PLAN IN MELAKA/N. SEMBILAN UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

(1) DAM

Location		Basin No.	Facilities	Purpose	Catchment Area (km <sup>2</sup> )	Active Storage Capacity (10 <sup>6</sup> m <sup>3</sup> )	Net Supply Capacity (10 <sup>6</sup> m <sup>3</sup> /y)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
State									
<u>Selamban***</u>									
N. Sembilan*	18	Terip dam	WS, IR	23	27	26	13	1985 - 1989	
<u>Melaka***</u>									
Pahang/ N. Sembilan*	21	Palong dam	WS	316	140	107	27	1985 - 1989	
<u>Port Dickson***</u>									
N. Sembilan*	30	Teriang dam	WS	60	70	36	166	1985 - 1989	
<u>Kelang Valley***</u>									
N. Sembilan*	30	Kenaboi dam	WS	118	136	83	237**	1991 - 1995	

(2) DIVERSION FACILITIES

Basin No.	Diversion Facilities	Basin Transfer (Basin No.)	Diversion Discharge Capacity (m <sup>3</sup> /s)	Construction Cost (M\$10 <sup>6</sup> )	Construction Period
21	Muar diversion (barrage & canal)	Johor to Melaka 21 to 19 & 20	15	160	1985 - 1989
30	Kenaboi diversion (tunnel)	N. Sembilan to Selangor 30 to 16-15	5	11**	1991 - 1995
30	Teriang diversion (pipe line)	N. Sembilan 30 to 17	1	477	1985 - 1989

Remarks: IR = Irrigation; WS = Water Supply  
 \* = The State where the facilities are located.  
 \*\* = For diversion to Kelang Valley.  
 \*\*\* = Town or area where water be supplied.  
 Construction cost is the financial cost at 1980 constant price.

Table 50 RECOMMENDED PLAN FOR IMPROVEMENT OF PURIFICATION SYSTEM IN PALM OIL MILLS AND RUBBER FACTORIES IN N. SEMBILAN/MELAKA UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Unit: m<sup>3</sup>/d

Basin No.	Basin Name	1981 - 1990			1991 - 2000		
		Palm Oil	Rubber	Total	Palm Oil	Rubber	Total
16	Langat	676	1,300	1,976	904	4	908
17	Selang	80	72	152	240	76	316
18	Linggi	1,072	5,888	6,960	40	900	940
19	Melaka	0	5,732	5,732	0	1,152	1,152
20	Kesang	192	1,060	1,252	0	144	144
21	Muar	1,292	7,076	8,368	1,332	1,224	2,556
Total		3,312	21,128	24,440	2,516	3,500	6,016

Table 51 RECOMMENDED PUBLIC SEWERAGE DEVELOPMENT PLAN FOR WATER POLLUTION ABATEMENT IN N. SEMBILAN/MELAKA UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	City/Town		1990			2000		
			Treatment Capacity (10 <sup>3</sup> m <sup>3</sup> /d)	Service Factor (%)	Served Population (10 <sup>3</sup> )	Treatment Capacity (10 <sup>3</sup> m <sup>3</sup> /d)	Service Factor (%)	Served Population (10 <sup>3</sup> )
18	C29	Seremban	26	40	79	87	100	240

Table 52 ASSUMED PUBLIC SEWERAGE DEVELOPMENT NOT AFFECTING RIVER WATER QUALITY IN N. SEMBILAN/MELAKA UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Basin No.	City/Town		1990			2000		
			Treatment Capacity (10 <sup>3</sup> m <sup>3</sup> /d)	Service Factor (%)	Served Population (10 <sup>3</sup> )	Treatment Capacity (10 <sup>3</sup> m <sup>3</sup> /d)	Service Factor (%)	Served Population (10 <sup>3</sup> )
17	C28	Port Dickson	35	25	10	116	65	34
19	C31	Melaka	18	35	33	55	65	61
Total			53	-	43	171	-	95

Table 53. RECOMMENDED FLOOD MITIGATION PROGRAM  
IN N. SEMBILAN/MELAKA 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 <sup>2</sup> )	P.P. (10 <sup>3</sup> )	F.A. (10 <sup>3</sup> ha)	C.C. (M\$10 <sup>6</sup> )
<u>N. SEMBILAN</u>									
By 1990									
16	Langat	-	-	-	-	-	-	-	-
18	Linggi	15	-	-	-	-	22	1	5
21	Muar	-	-	-	-	-	-	-	-
30	Pahang	-	-	-	-	-	-	-	-
Total		15	-	-	-	-	22	1	5
By 2000									
18	Linggi	15	-	-	-	-	22	1	5
21	Muar	53	1	-	-	-	39	3	27
Total		68	1	-	-	-	61	4	32
<u>MELAKA</u>									
By 1990									
18	Linggi	12	-	-	-	-	15	2	5
19	Melaka	-	5	-	-	-	-	-	-
20	Kesang	-	-	-	-	-	-	-	-
Total		12	5	-	-	-	15	2	5
By 2000									
18	Linggi	26	-	-	-	-	26	3	10
19	Melaka	-	5	-	-	-	52	4	9
20	Kesang	19	-	-	-	-	15	7	20
Total		45	5	-	-	-	93	14	39

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 54 ESTIMATED PUBLIC DEVELOPMENT EXPENDITURE  
FOR RECOMMENDED PLAN IN N. SEMBILAN/  
MELAKA/NORTHWEST JOHOR UNDER THE  
CONDITION OF LOWER ECONOMIC GROWTH

		Unit: M\$10 <sup>6</sup>				
		4MP	5MP	6MP	7MP	Total
Source Development	<sup>/1</sup>	90	753	0	0	843
Irrigation	N. Sembilan	8	13	7	0	28
	Melaka	11	19	6	0	36
	N.W. Johor	9	14	2	0	25
	Sub-total	28	46	15	0	89
Inland Fishery	N. Sembilan	3	3	29	23	58
	Melaka	0	0	0	0	0
	N.W. Johor	1	1	1	1	4
	Sub-total	4	4	30	24	62
Public Water Supply	N. Sembilan	59	98	97	39	293
	Melaka	35	69	52	21	177
	N.W. Johor	38	63	63	25	189
	Sub-total	132	230	212	85	659
Public Water Supply (Pretreatment facilities)	N. Sembilan	22	26	18	7	74
	Melaka	26	32	22	9	89
	N.W. Johor	13	16	11	4	43
	Sub-total	61	74	51	20	206
Public Sewerage (Effective for river water pollution abatement)	N. Sembilan	23	39	39	16	117
	Melaka	0	0	0	0	0
	N.W. Johor	8	12	13	5	38
	Sub-total	31	51	52	21	155
Public Sewerage (Others)	N. Sembilan	29	48	48	20	145
	Melaka	13	21	21	8	63
	N.W. Johor	0	0	0	0	0
	Sub-total	42	69	69	28	208
Flood Mitigation	N. Sembilan	0	7	14	12	33
	Melaka	5	1	17	17	40
	N.W. Johor	0	0	0	4	4
	Sub-total	5	8	31	33	77
<b>Total</b>		<b>393</b>	<b>1235</b>	<b>460</b>	<b>211</b>	<b>2299</b>

Remark; <sup>/1</sup>: Including the expenditures for the States of N. Sembilan and Melaka and northwest Johor.



Table 55 ESTIMATED PUBLIC RECURRENT EXPENDITURE  
FOR RECOMMENDED PLAN IN N. SEMBILAN/  
MELAKA/NORTHWEST JOHOR UNDER THE CONDITION  
OF LOWER ECONOMIC GROWTH

		Unit: M\$10 <sup>6</sup>				
		4MP	5MP	6MP	7MP	Total
Source Development	<sup>/1</sup>	0	5	22	22	49
Irrigation	N. Sembilan	0	0	2	2	4
	Melaka	0	1	2	3	6
	N.W. Johor	0	0	2	3	5
	Sub-total	0	1	6	8	15
Inland Fishery	N. Sembilan	0	0	1	4	5
	Melaka	0	0	0	0	0
	N.W. Johor	0	0	0	1	1
	Sub-total	0	0	1	5	6
Public Water Supply	N. Sembilan	0	10	20	28	58
	Melaka	0	6	11	15	32
	N.W. Johor	0	6	12	17	35
	Sub-total	0	22	43	60	125
Public Water Supply (Pretreatment facilities)	N. Sembilan	0	3	5	7	15
	Melaka	0	4	6	9	19
	N.W. Johor	0	2	3	5	10
	Sub-total	0	9	14	21	44
Public Sewerage (Effective for river water pollution abatement)	N. Sembilan	0	8	15	22	45
	Melaka	0	0	0	0	0
	N.W. Johor	0	3	5	7	15
	Sub-total	0	11	20	29	60
Public Sewerage (Others)	N. Sembilan	0	10	20	27	57
	Melaka	0	4	8	12	24
	N.W. Johor	0	0	0	0	0
	Sub-total	0	14	28	39	81
Flood Mitigation	N. Sembilan	0	0	3	9	12
	Melaka	0	2	3	11	16
	N.W. Johor	0	0	0	0	0
	Sub-total	0	2	6	20	28
<b>Total</b>		0	64	140	204	408

Remark; <sup>/1</sup>: Including the expenditures for the States of N. Sembilan and Melaka and northwest Johor.

Table 56 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED PLAN FOR WATER DEMAND AND SUPPLY BALANCE IN N. SEMBILAN/MELAKA/NORTHWEST JOHOR UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Item	Amount
<b>1. National Economic Development</b>	
<b>1.1 Economic Benefit</b>	
Irrigation	(M\$10 <sup>6</sup> ) 5
D&I water supply	(M\$10 <sup>6</sup> ) 67
Fish culture	(M\$10 <sup>6</sup> ) 3
Reservoir recreation	(M\$10 <sup>6</sup> ) 1
<b>Total</b>	<b>(M\$10<sup>6</sup>) 76</b>
<b>1.2 Economic Cost</b>	
Irrigation	(M\$10 <sup>6</sup> ) 2
D&I water supply	(M\$10 <sup>6</sup> ) 38
Fish culture	(M\$10 <sup>6</sup> ) 3
Dams, barrages & diversion facilities	(M\$10 <sup>6</sup> ) 29
<b>Total</b>	<b>(M\$10<sup>6</sup>) 72</b>
1.3 EIRR	(%) 9
<b>2. Environmental Quality</b>	
<b>2.1 Beneficial Effect</b>	
Safe maintenance flow period (2000)	See Table
Surface area of lake created	(km <sup>2</sup> ) 13
<b>2.2 Adverse Effect</b>	
Possible reduction in kind of fish immediately downstream of dams and barrages	(nos. of site) 3
<b>3. Social Well-being</b>	
<b>3.1 Beneficial Effect</b>	
Number of farm households benefited by proposed irrigation in 2000	(10 <sup>3</sup> ) 9
Number of people served by proposed public water supply in 2000	(10 <sup>3</sup> ) 1,734
Safe supply period (2000)	See Table
<b>3.2 Adverse Effect</b>	
Number of people to be removed for construction of facilities	(10 <sup>2</sup> ) 2

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

Table 57 BENEFICIAL AND ADVERSE EFFECTS OF  
RECOMMENDED PLAN FOR WATER POLLUTION  
ABATEMENT IN N. SEMBILAN/MELAKA/NORTHWEST JOHOR  
UNDER THE CONDITION OF LOWER ECONOMIC GROWTH

Item	Amount
1. National Economic Development	
1.1 Economic Benefit	
Sewerage	(M\$10 <sup>6</sup> ) 5
Saving in pre-treatment for D&I water supply	(M\$10 <sup>6</sup> ) 28
Total	(M\$10 <sup>6</sup> ) 33
1.2 Economic Cost	
Sewerage	(M\$10 <sup>6</sup> ) 18
Private purification facilities/ <sup>2</sup>	(M\$10 <sup>6</sup> ) 2
Pre-treatment for D&I water supply	(M\$10 <sup>6</sup> ) 15
Total	(M\$10 <sup>6</sup> ) 35
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 = 853 km)	(km) 795/573 <sup>/1</sup>
Length of river stretch where BOD concentration is not more than 5 mg/lit in 2000 compared with without project condition (Study length = 853 km)	(km) 736/444 <sup>/1</sup>
2.2 Adverse Effect	
-	
3. Social Well-Being	
3.1 Beneficial Effects	
Number of people served by proposed sewerage system in 2000	(10 <sup>3</sup> ) 423
3.2 Adverse Effect	
-	
Remarks; <sup>/1</sup> : (Length of river stretch with Project)/ (Length of river stretch without Project) and including the river stretch in the State of Selangor and Pahang.	
<sup>/2</sup> : Including the rubber factories and palm oil mills in such part of the State of Selangor, Johor and Pahang as located in Basin 16, 17, 20, 21 and 30.	

Table 58 BENEFICIAL AND ADVERSE EFFECTS OF RECOMMENDED  
 PLAN FOR FLOOD MITIGATION IN N. SEMBILAN/MELAKA/  
 NORTHWEST JOHOR UNDER THE CONDITION OF LOWER  
 ECONOMIC GROWTH

Item		Amount
1. National Economic Development		
1.1 Economic Benefit		
Damage reduction	(M\$10 <sup>6</sup> )	2.6
1.2 Economic Cost		
Flood mitigation work	(M\$10 <sup>6</sup> )	2.0
1.3 EIRR	(%)	10
2. Environmental Quality		
2.1 Beneficial Effect		
Length of improved stretch	(km)	113
2.2 Adverse Effect		
		—
3. Social Well-Being		
3.1 Beneficial Effect		
Number of protected people by proposed facilities in 2000	(10 <sup>3</sup> )	161
Population served by proposed flood warning system in 2000	(10 <sup>3</sup> )	42
Area relieved from flood hazards	(km <sup>2</sup> )	19
3.2 Adverse Effect		
Number of people to be removed for construction of facilities	(10 <sup>3</sup> )	2

## ***FIGURES***



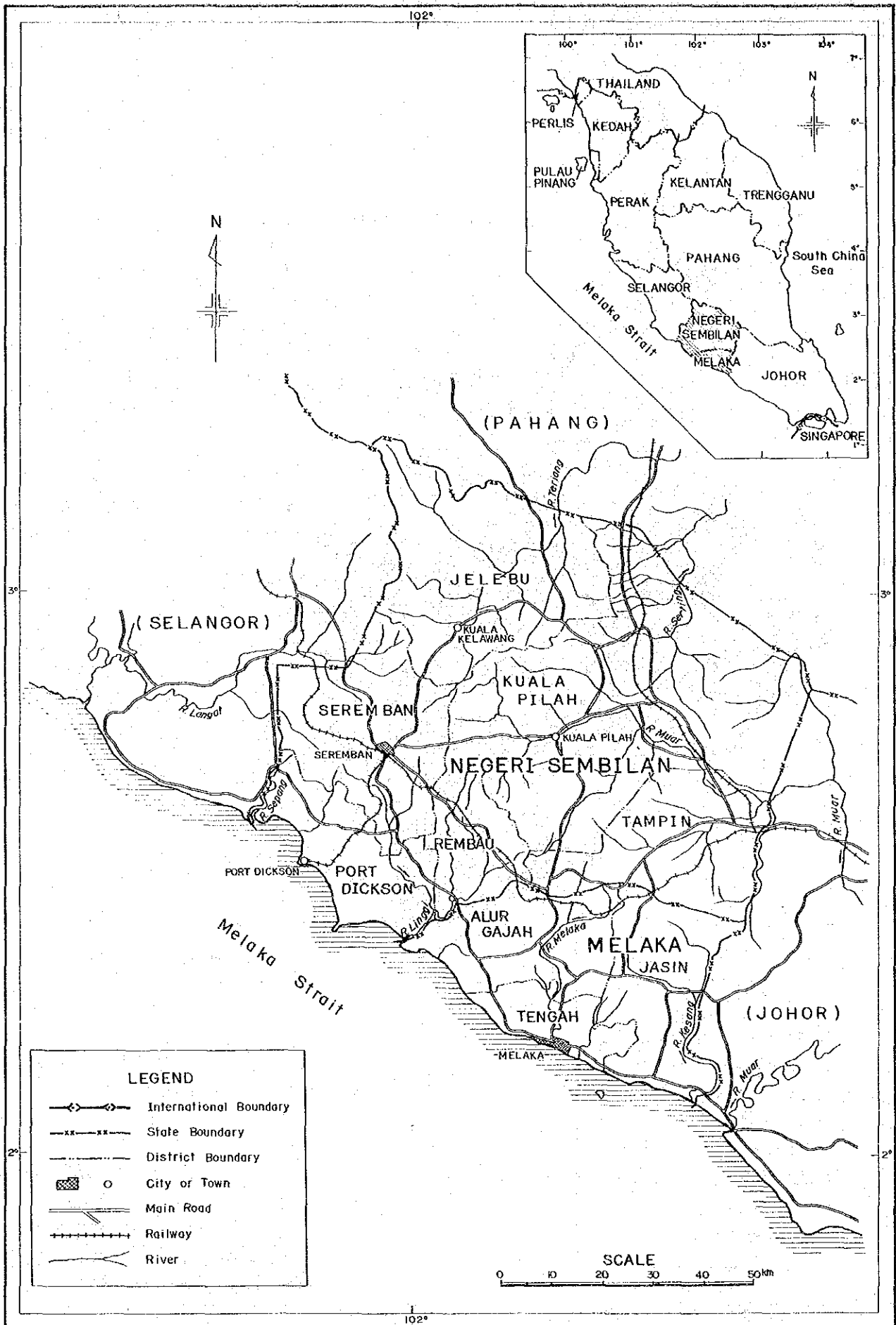
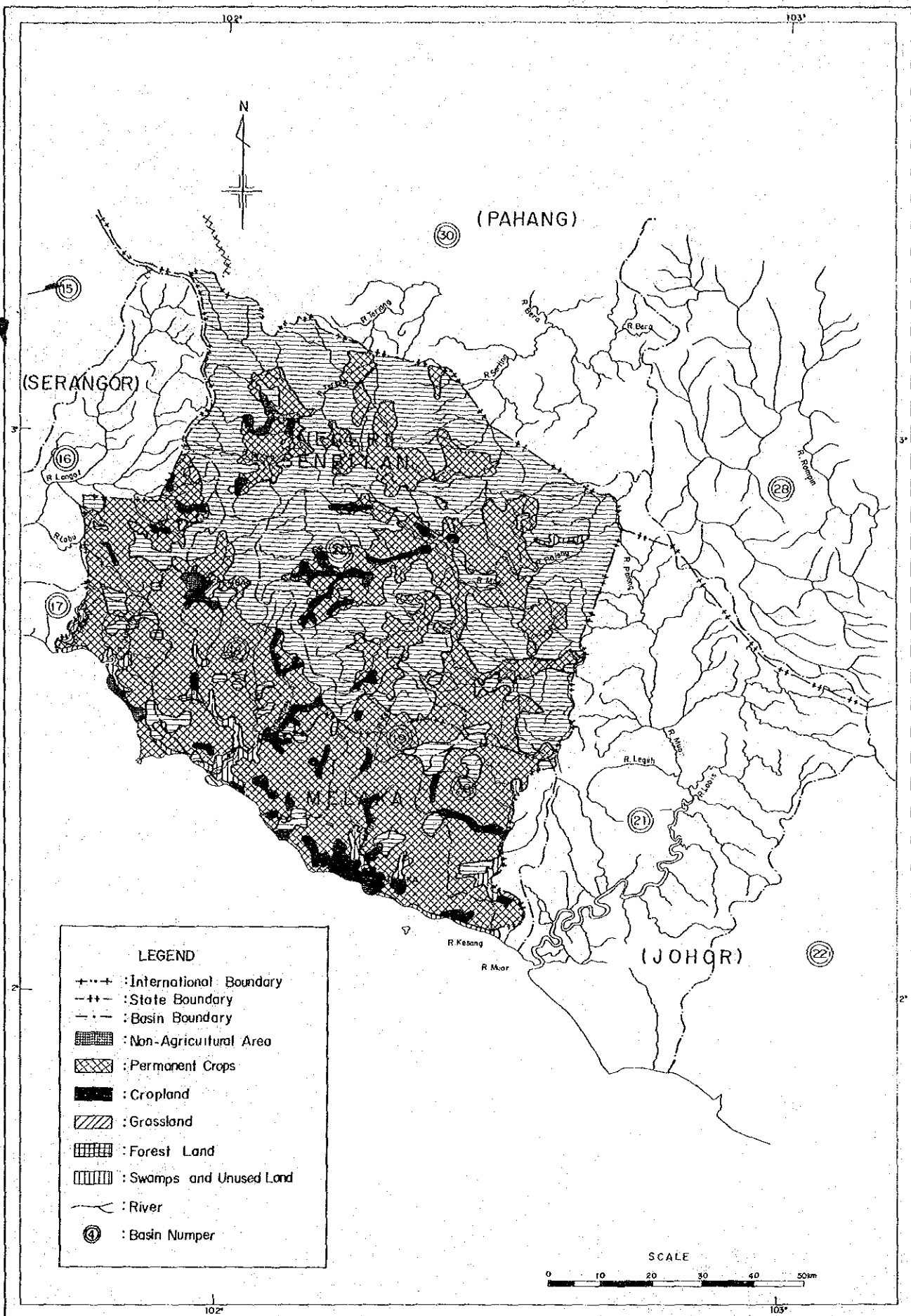


Fig.1 Map of the States of N. Sembilan / Melaka

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**LEGEND**

- + + + : International Boundary
- - - : State Boundary
- · - : Basin Boundary
- [Cross-hatched box] : Non-Agricultural Area
- [Diagonal lines box] : Permanent Crops
- [Solid black box] : Cropland
- [Diagonal lines box] : Grassland
- [Vertical lines box] : Forest Land
- [Horizontal lines box] : Swamps and Unused Land
- [Wavy line] : River
- ① : Basin Number

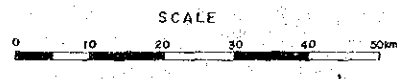


Fig. 2 Present Land Use

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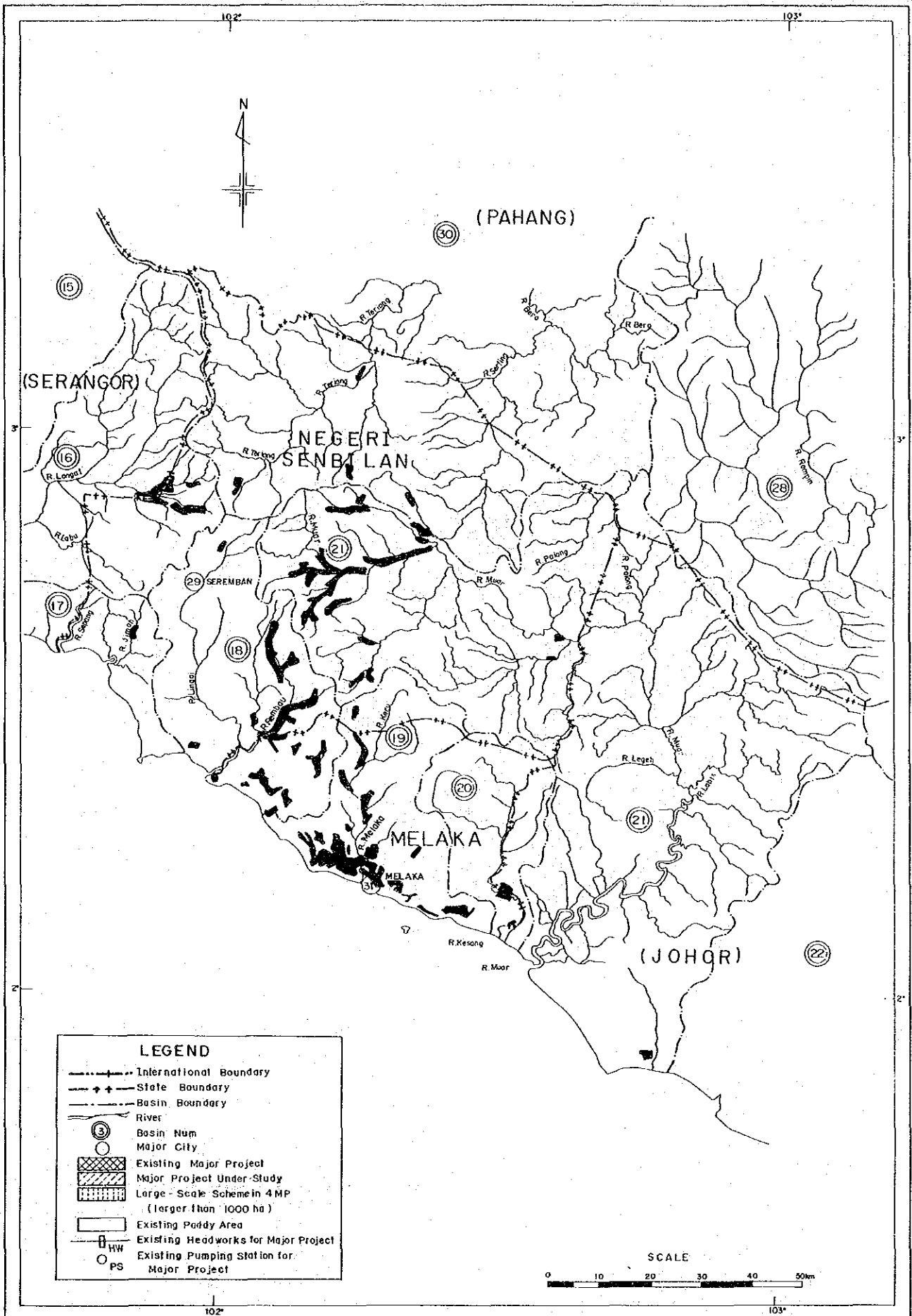


Fig. 3 Location of Paddy Field

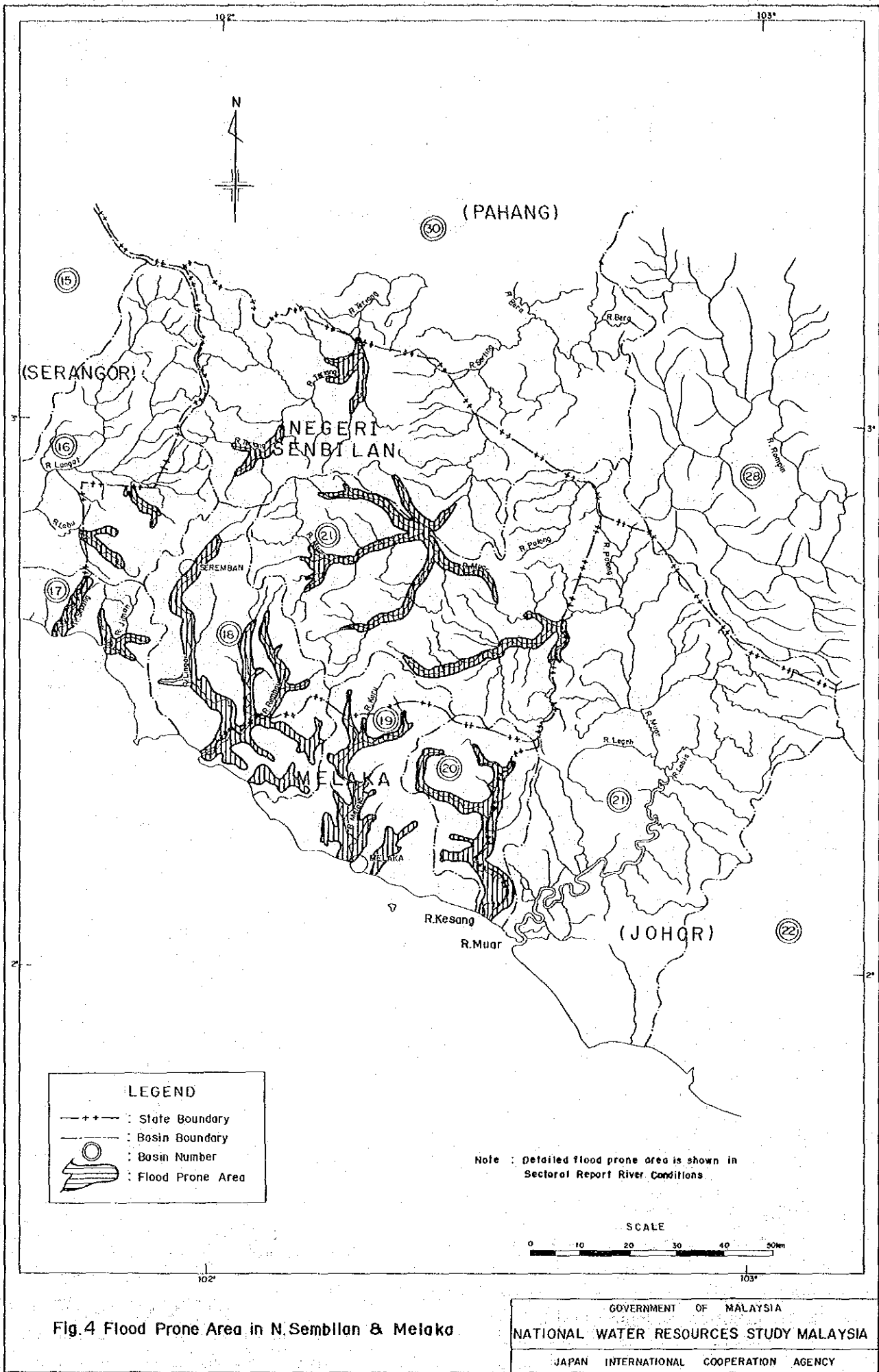


Fig.4 Flood Prone Area in N.Sembilan & Melaka

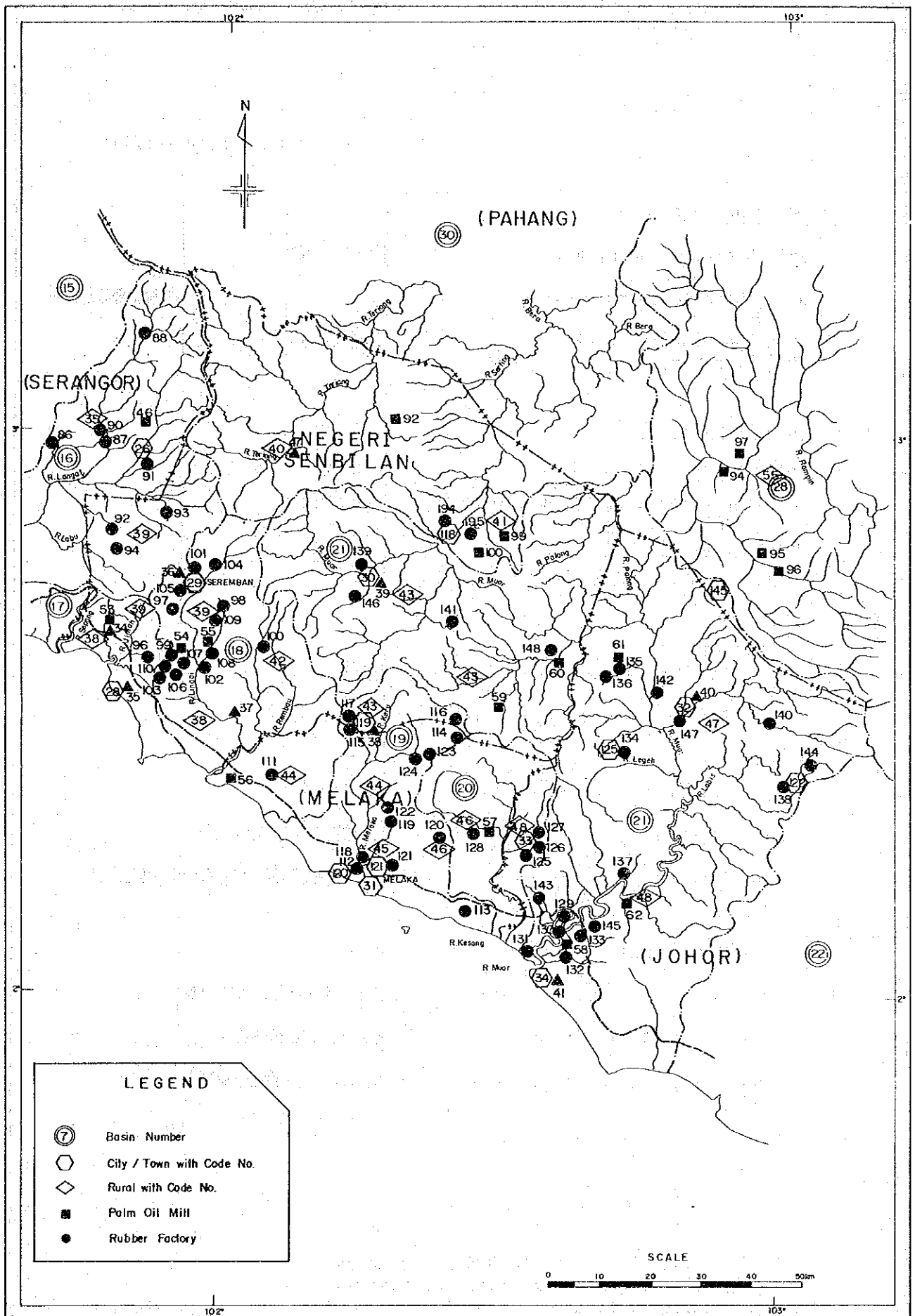


Fig. 5 Location of Demand Centers and Pollution Sources

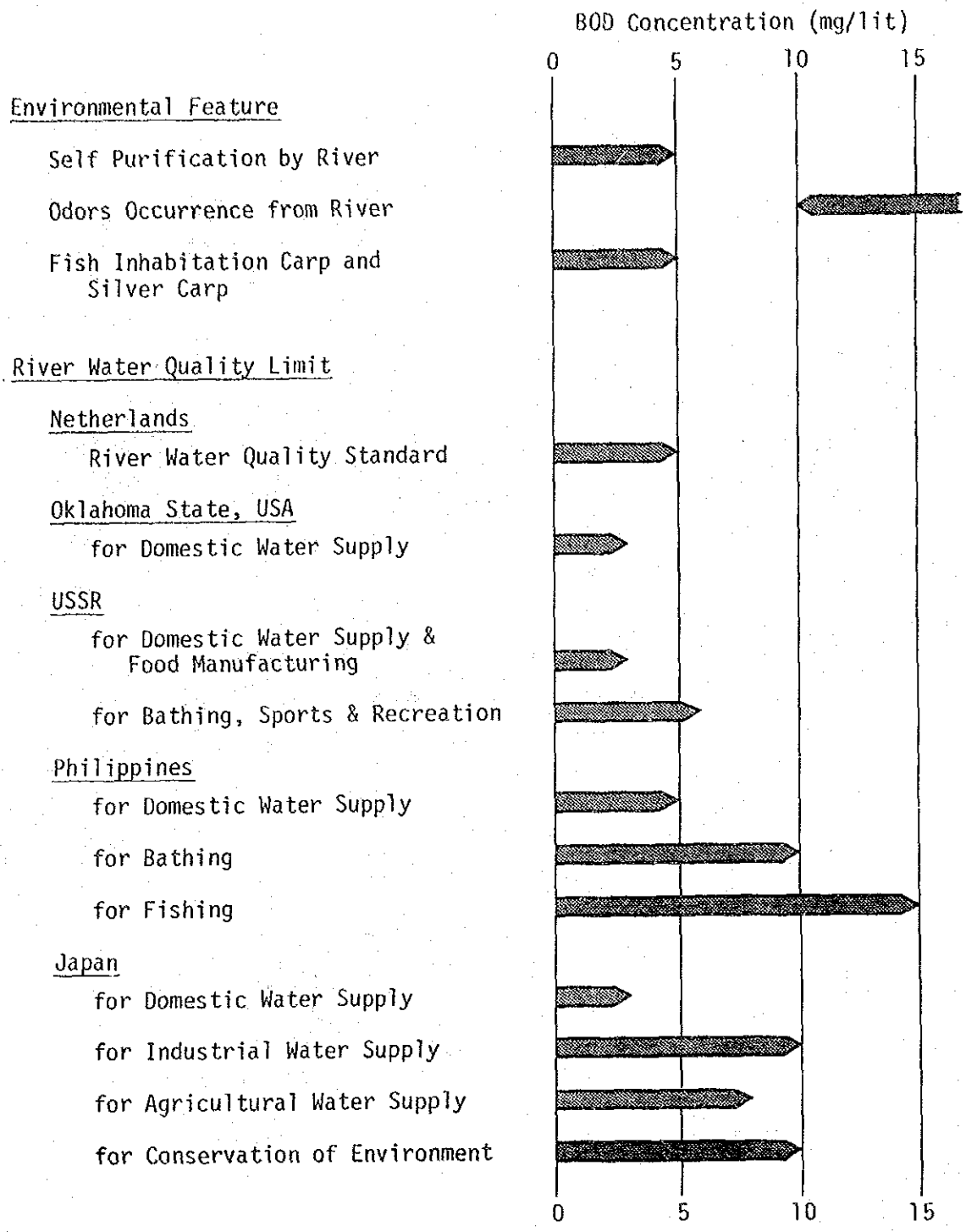


Fig. 6 Relationships between BOD Concentration and Environmental Feature and River Water Quality Limit

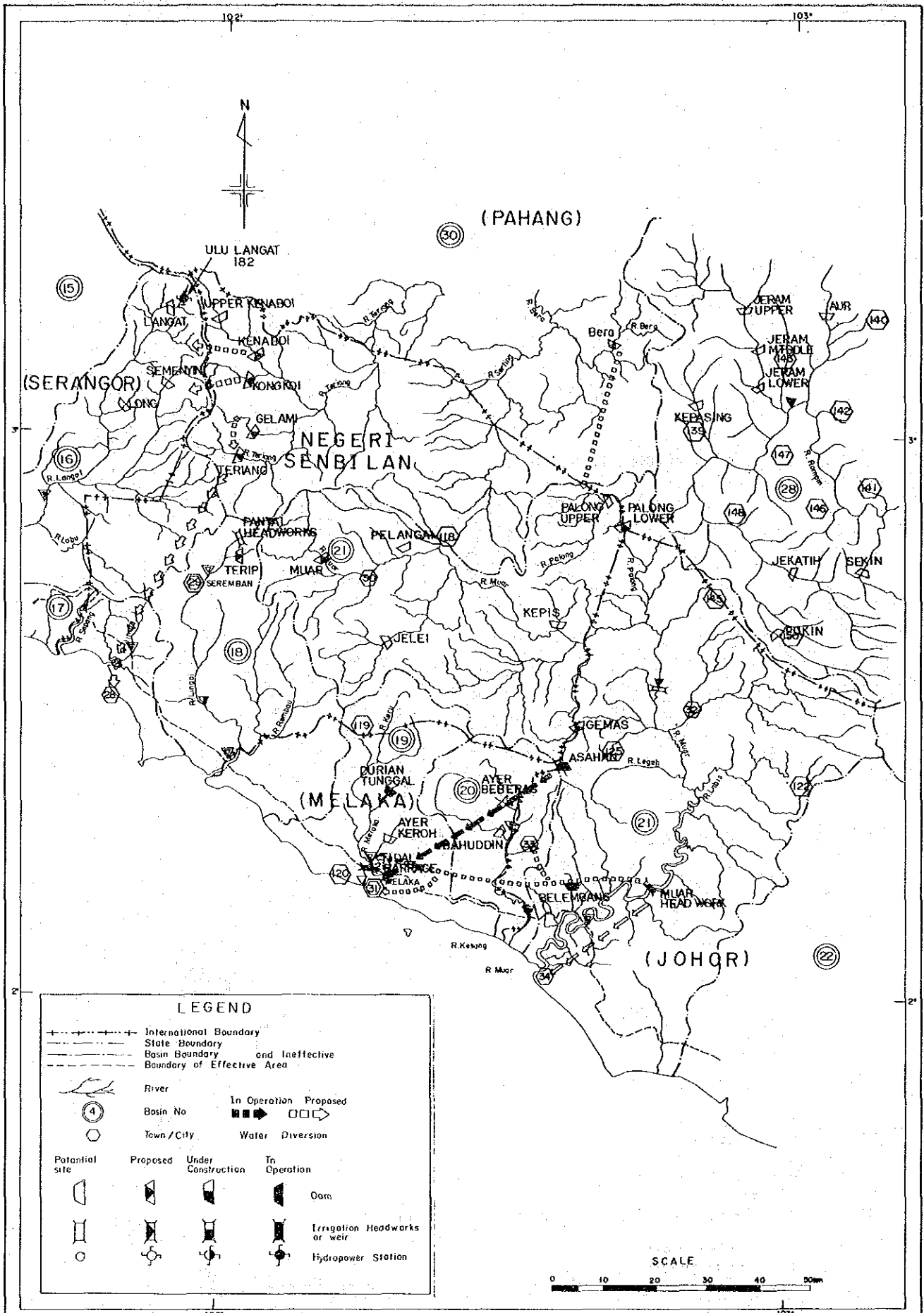


Fig. 7 Location of Potential and Proposed Water Source Facilities, Alternative B1

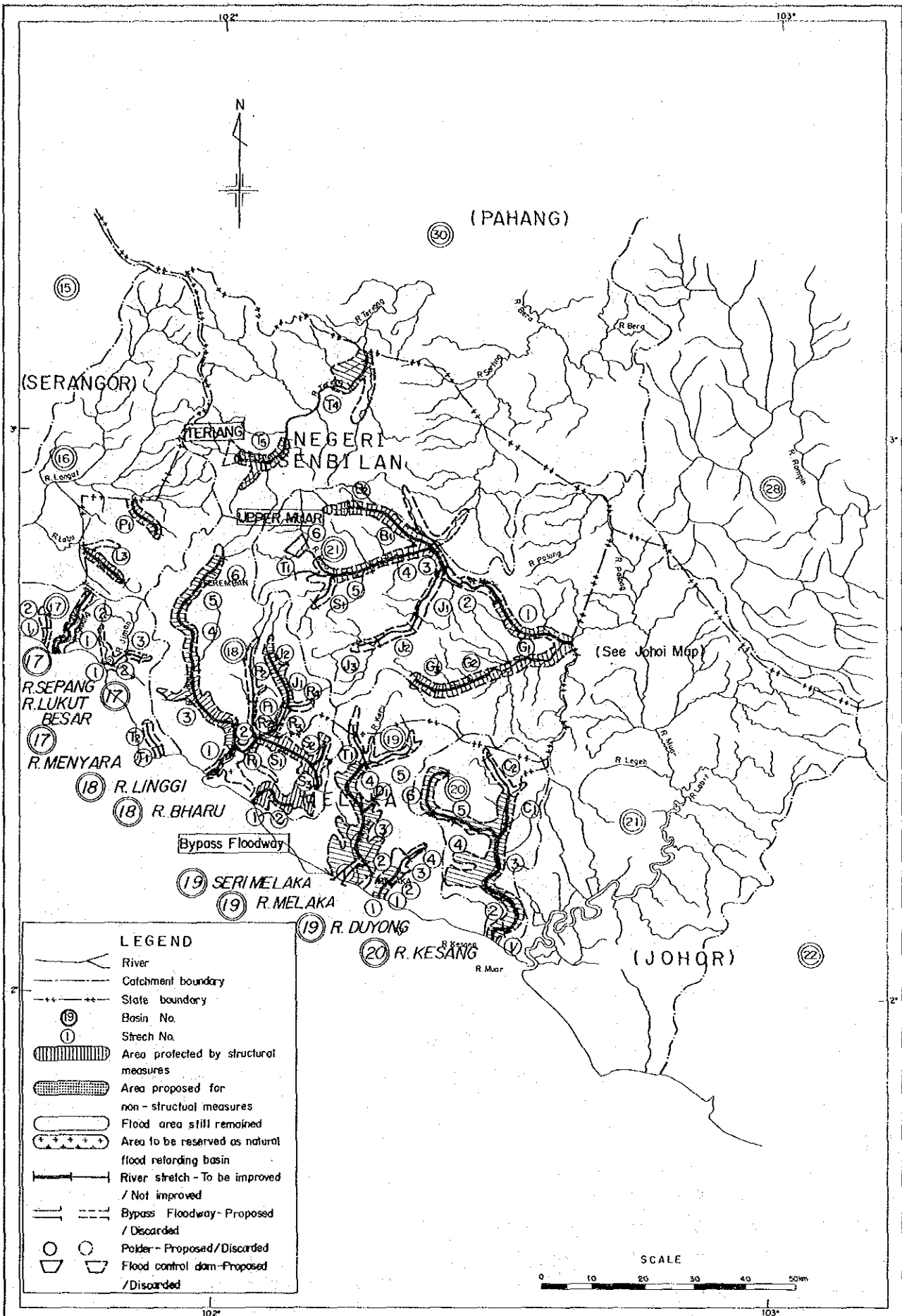


Fig.8 Flood Mitigation Alternatives, Alternative F1

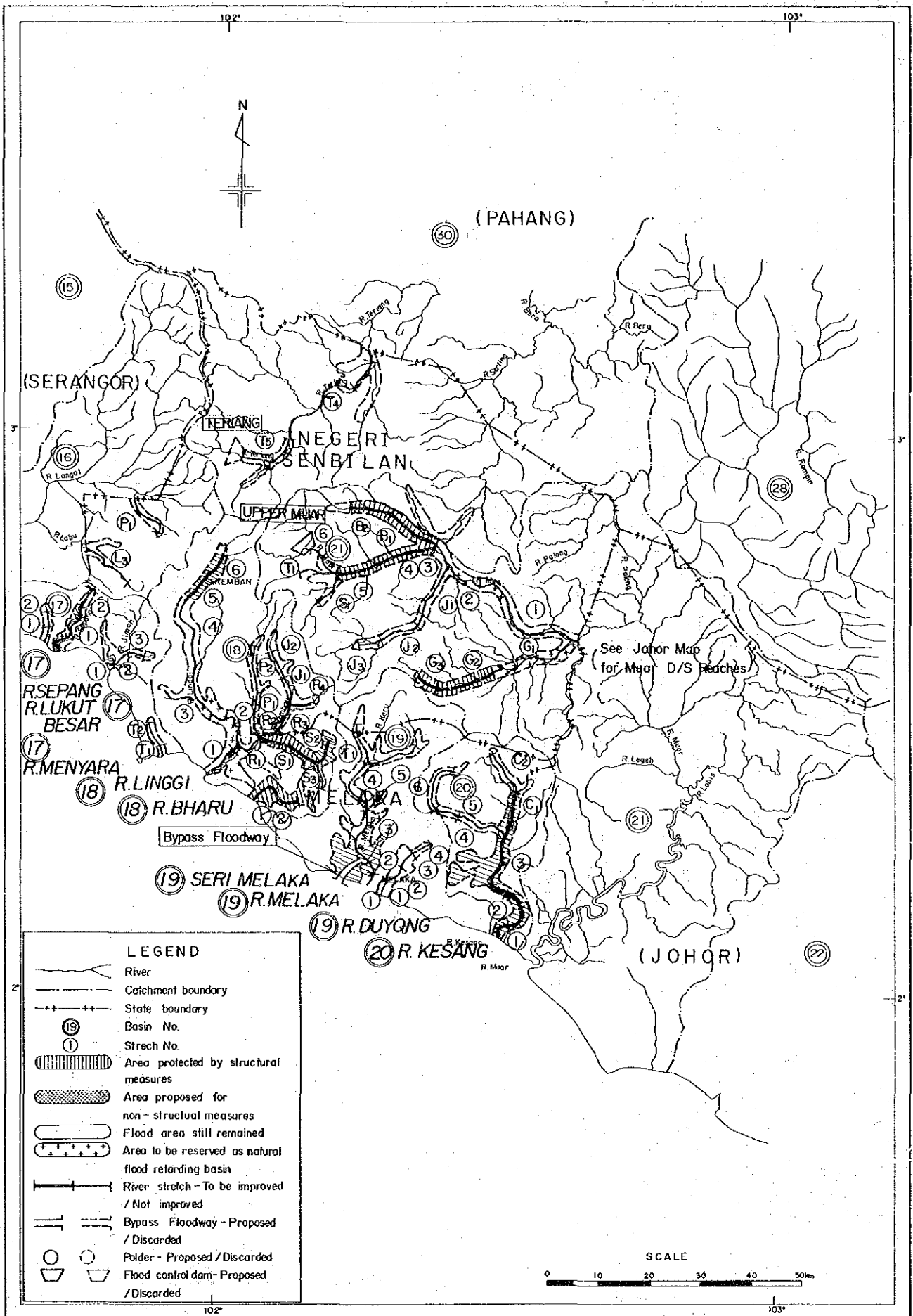


Fig. 9 Flood Mitigation Alternatives, Alternative F2

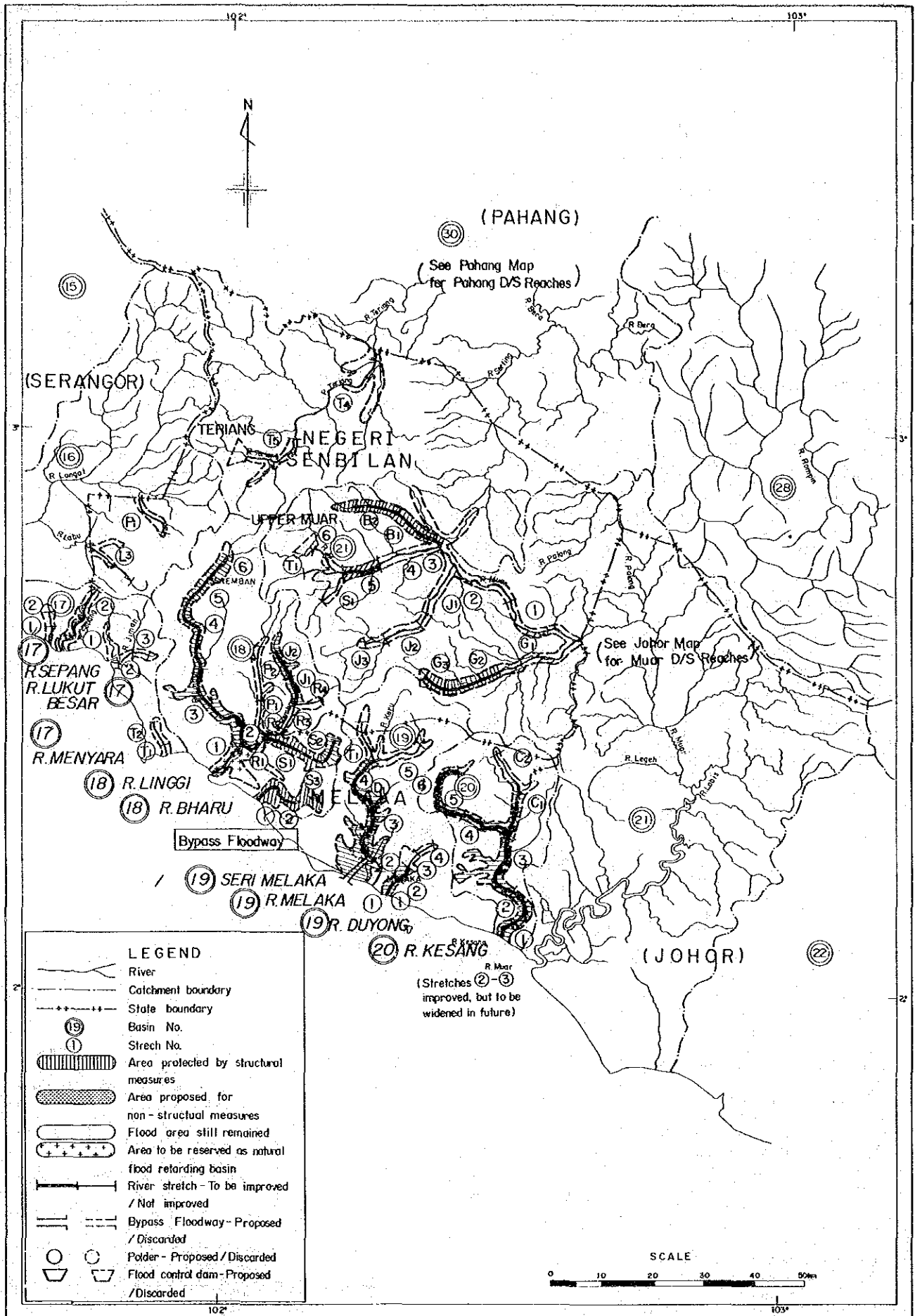
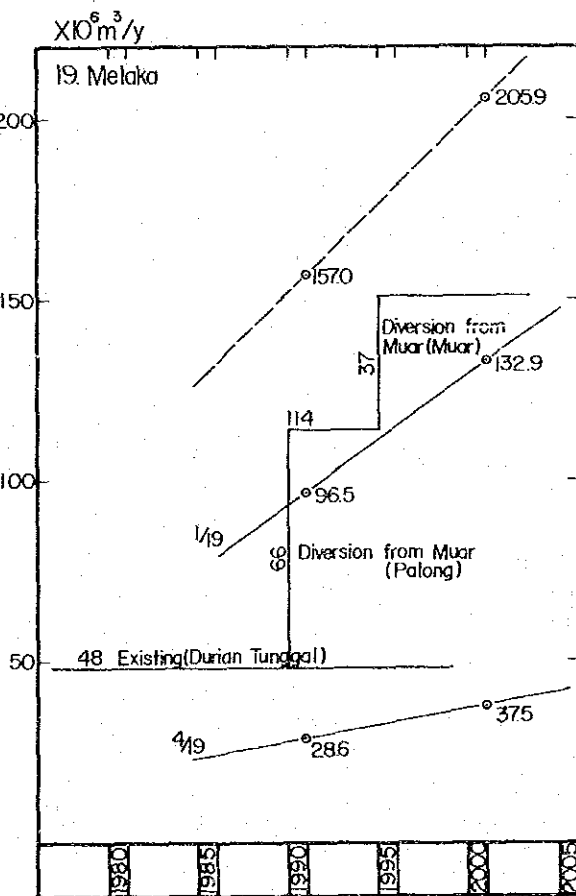
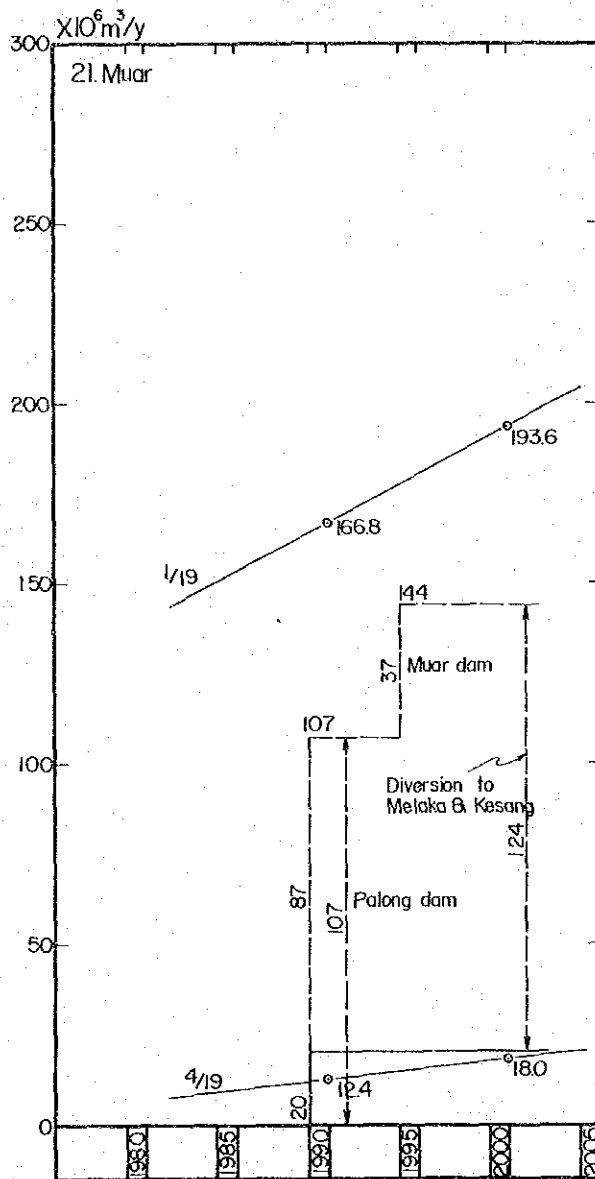
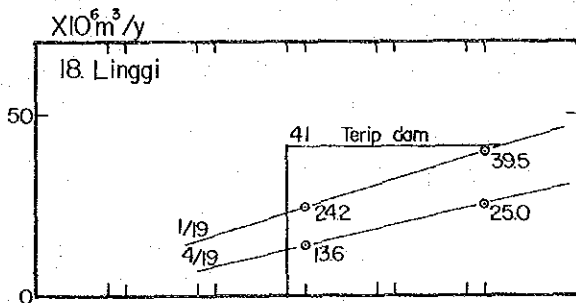
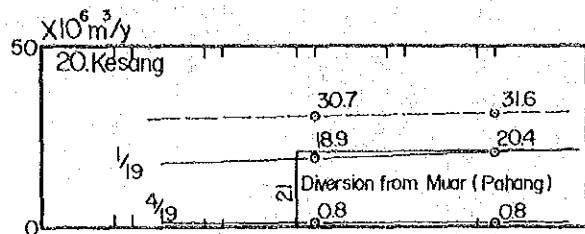
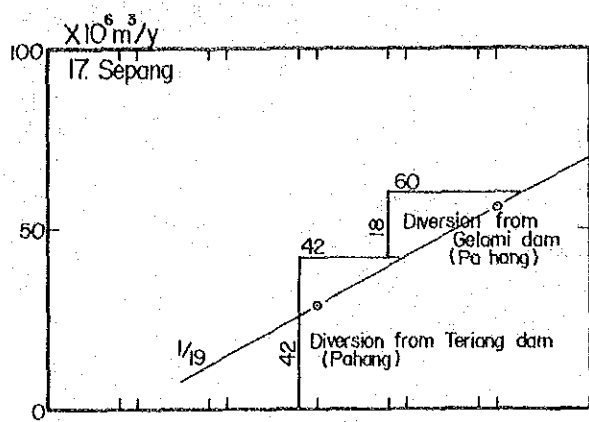


Fig.10 Flood Mitigation Alternatives, Alternative F3





Remarks : —○—○— Deficit after integrated - basin water balance  
 - - - - - Deficit before integration

Fig. 11 Recommended Water Demand and Supply Balance Program For Melaka - Muar Region, and Sepang and Linggi River Basins





