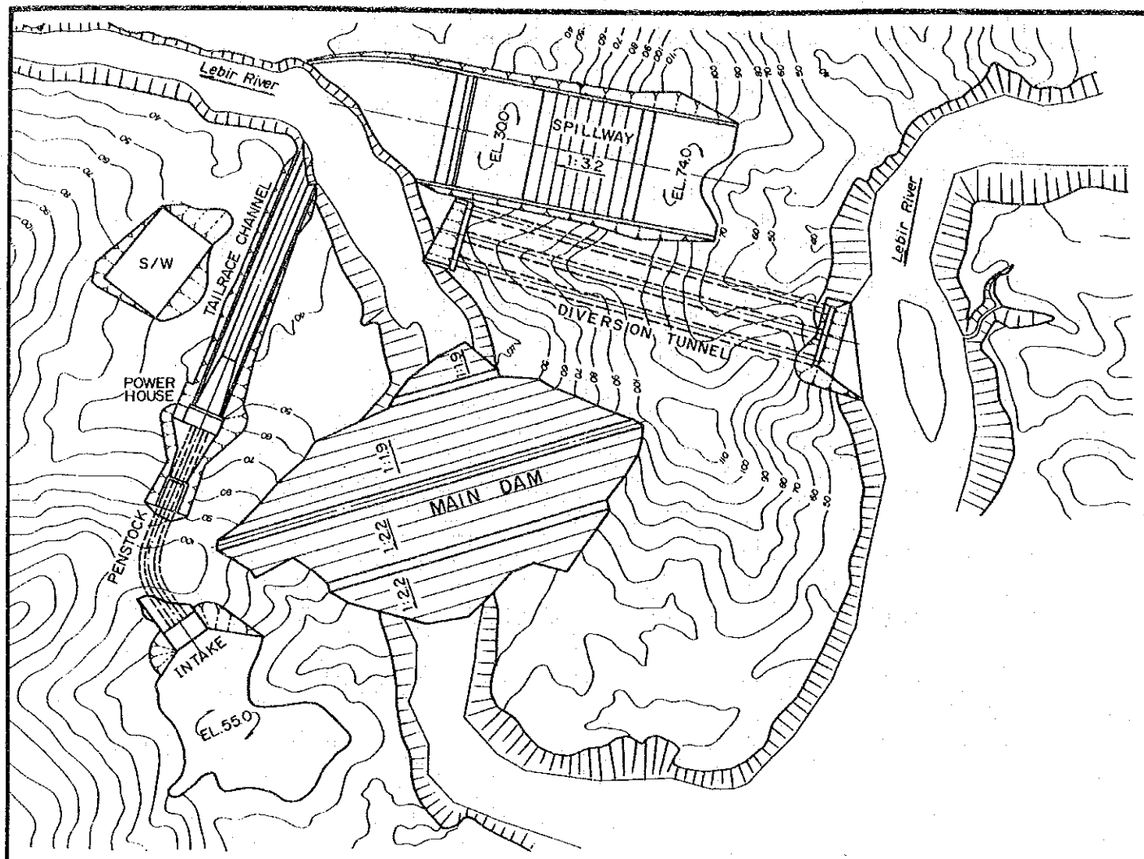
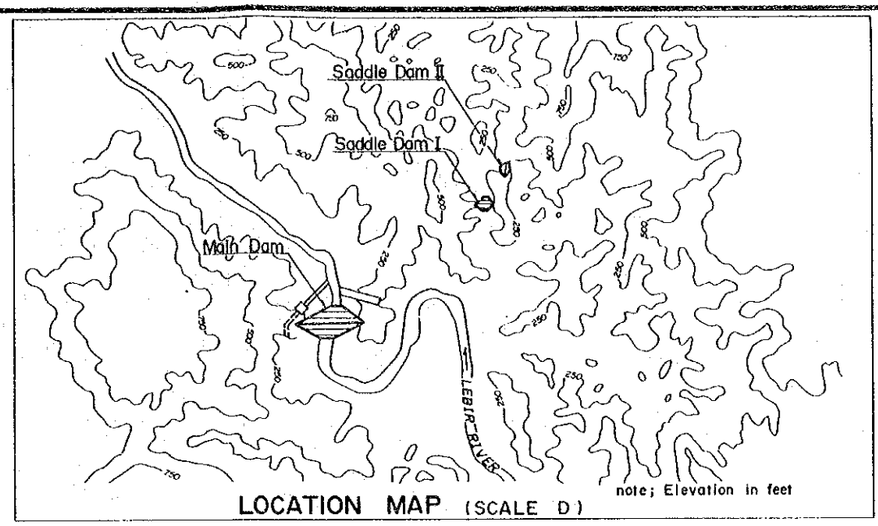
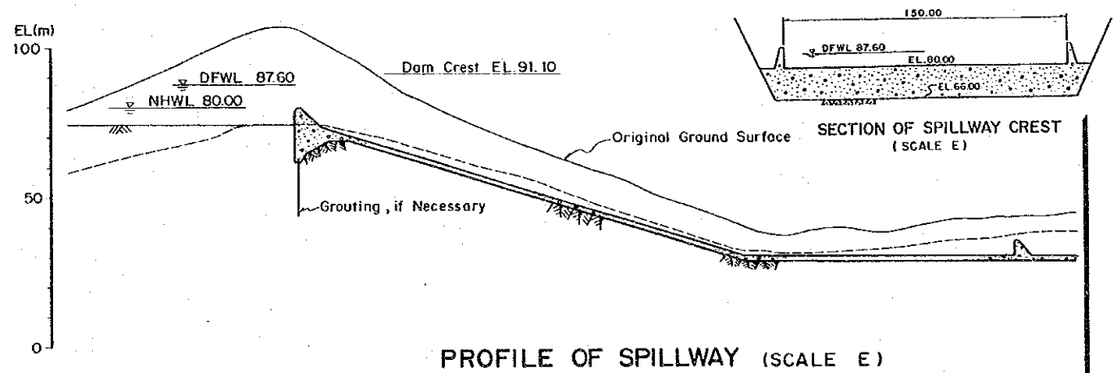


PLAN OF MAIN DAM (SCALE A)

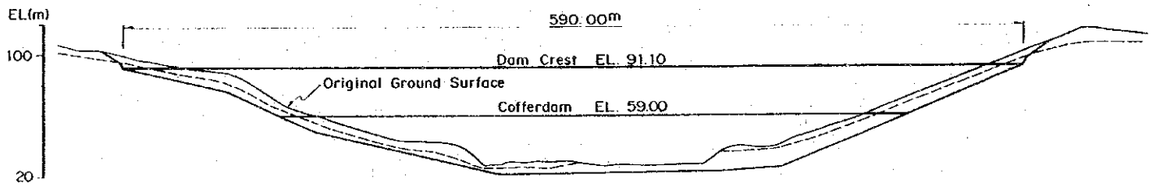


LOCATION MAP (SCALE D)

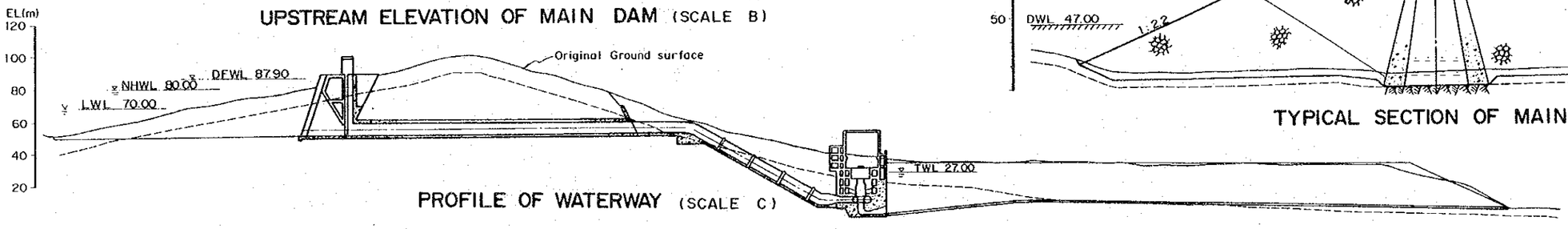


SECTION OF SPILLWAY CREST (SCALE E)

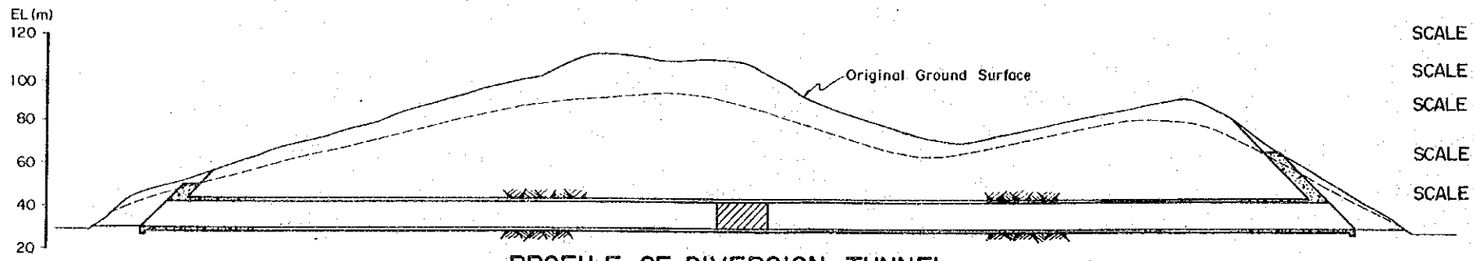
PROFILE OF SPILLWAY (SCALE E)



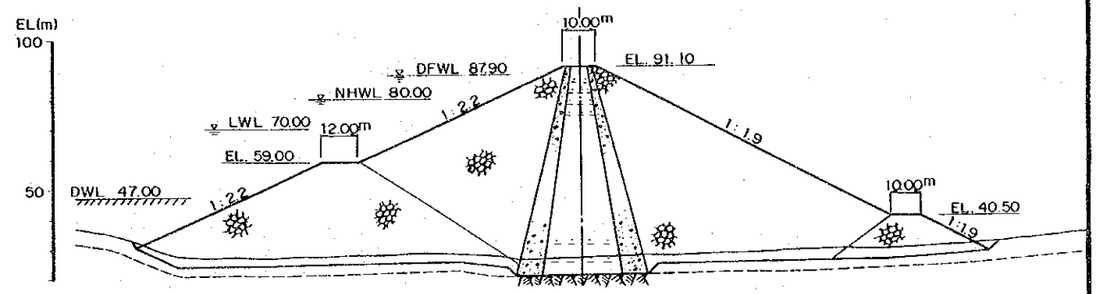
UPSTREAM ELEVATION OF MAIN DAM (SCALE B)



PROFILE OF WATERWAY (SCALE C)



PROFILE OF DIVERSION TUNNEL (SCALE C)



TYPICAL SECTION OF MAIN DAM (SCALE E)

SCALE A 0 100 200 300 400 (m)
SCALE B 100 200 (m)
SCALE C 100 (m)
SCALE D 2 (km)
SCALE E 50 100 (m)

Fig. 3.8 Proposed Development Plan for the Lebir Dam Scheme (1/2)

GOVERNMENT OF MALAYSIA
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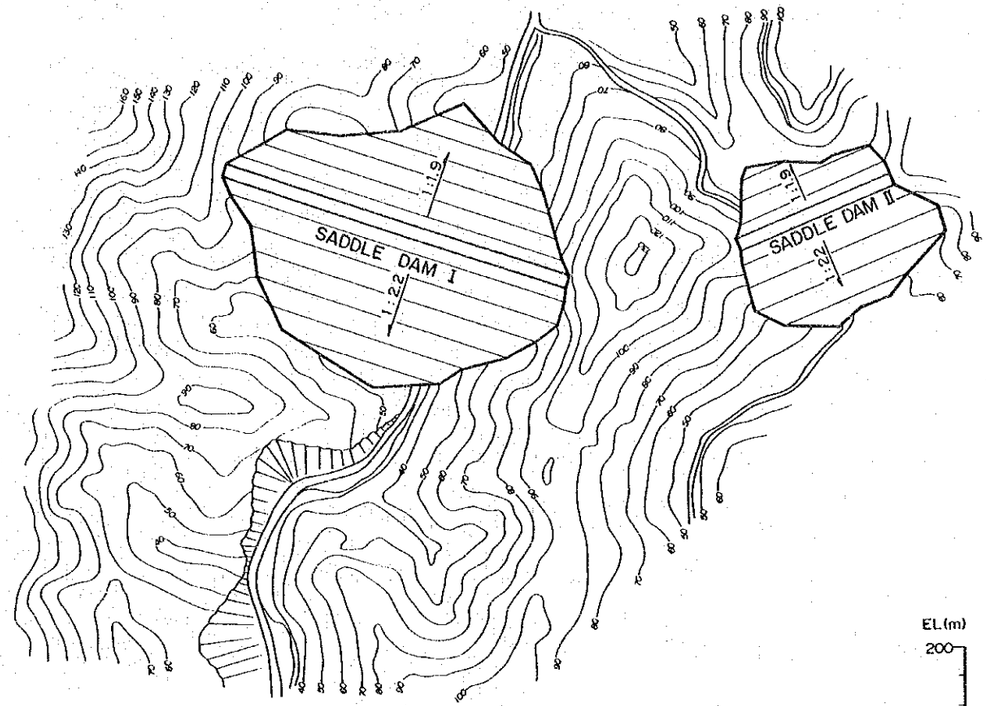
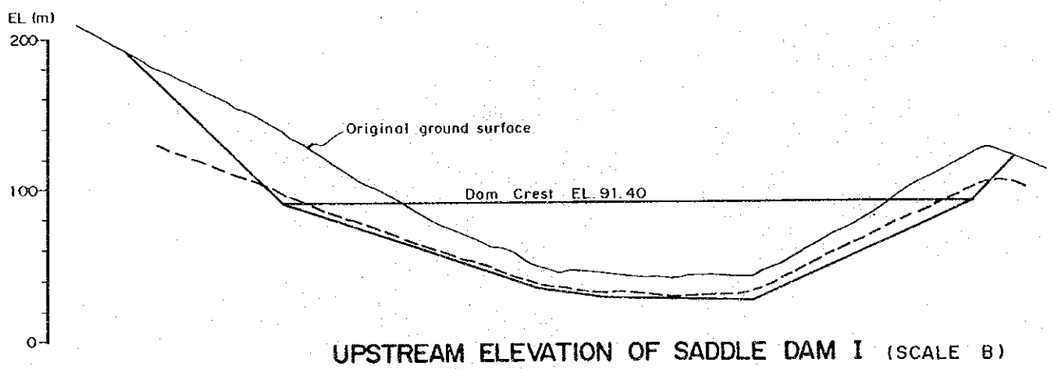
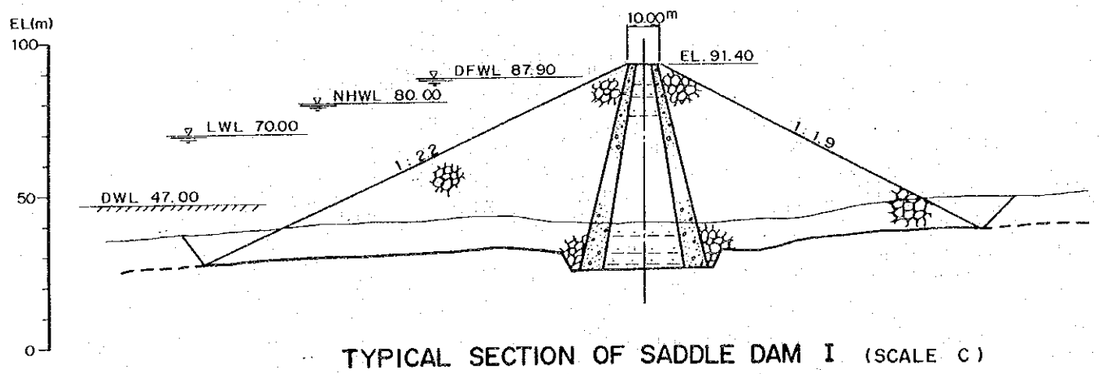
JAPAN INTERNATIONAL COOPERATION AGENCY



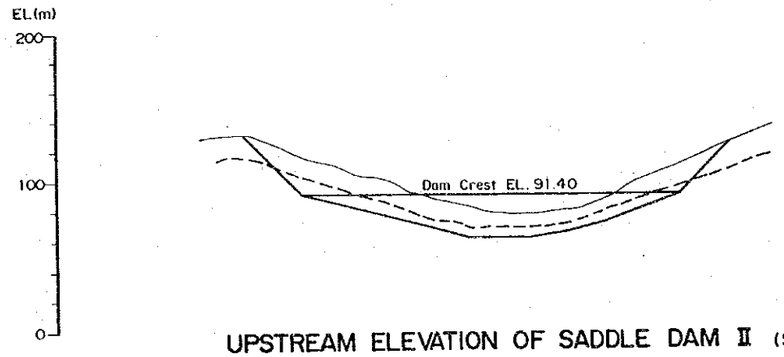
PLAN OF SADDLE DAMS (SCALE A)



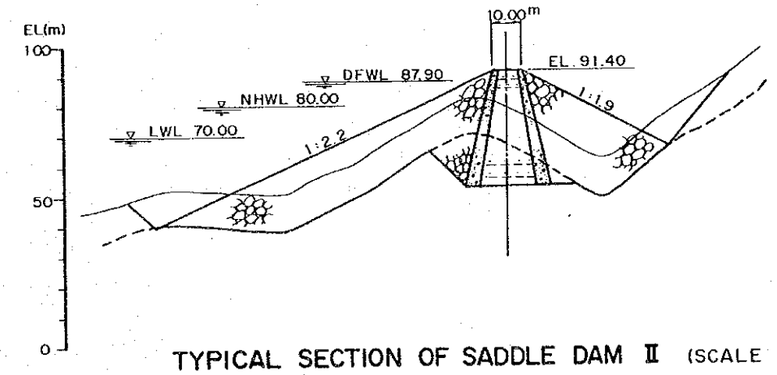
UPSTREAM ELEVATION OF SADDLE DAM I (SCALE B)



TYPICAL SECTION OF SADDLE DAM I (SCALE C)



UPSTREAM ELEVATION OF SADDLE DAM II (SCALE B)



TYPICAL SECTION OF SADDLE DAM II (SCALE B)

SCALE A 0 100 200 (m)
SCALE B 0 100 200(m)
SCALE C 0 50 100 (m)

Fig.3.8
Proposed Development Plan for the Lebir Dam Scheme (2/2)

GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY

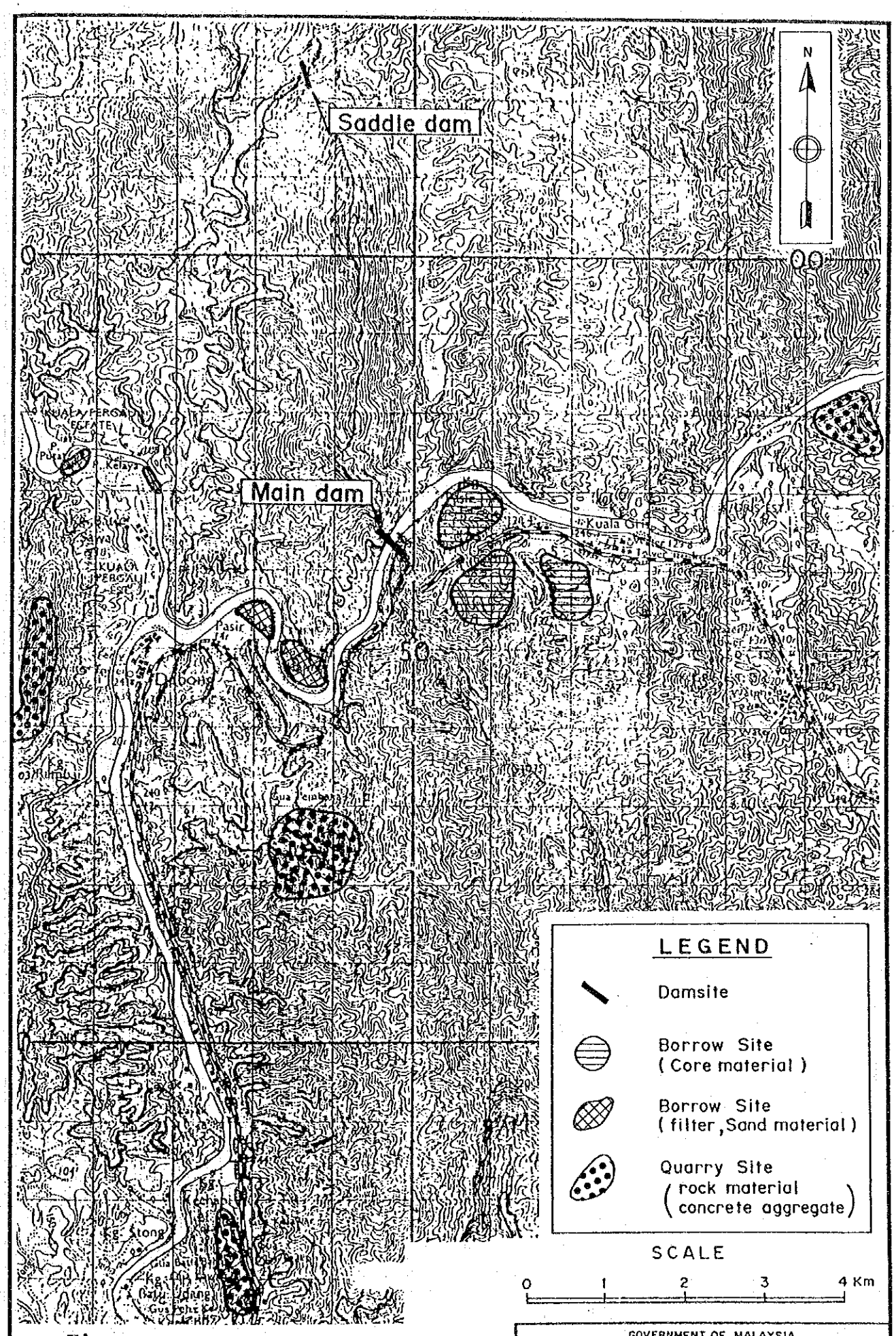


Fig. 3.9

Location Map of Dabong Dam

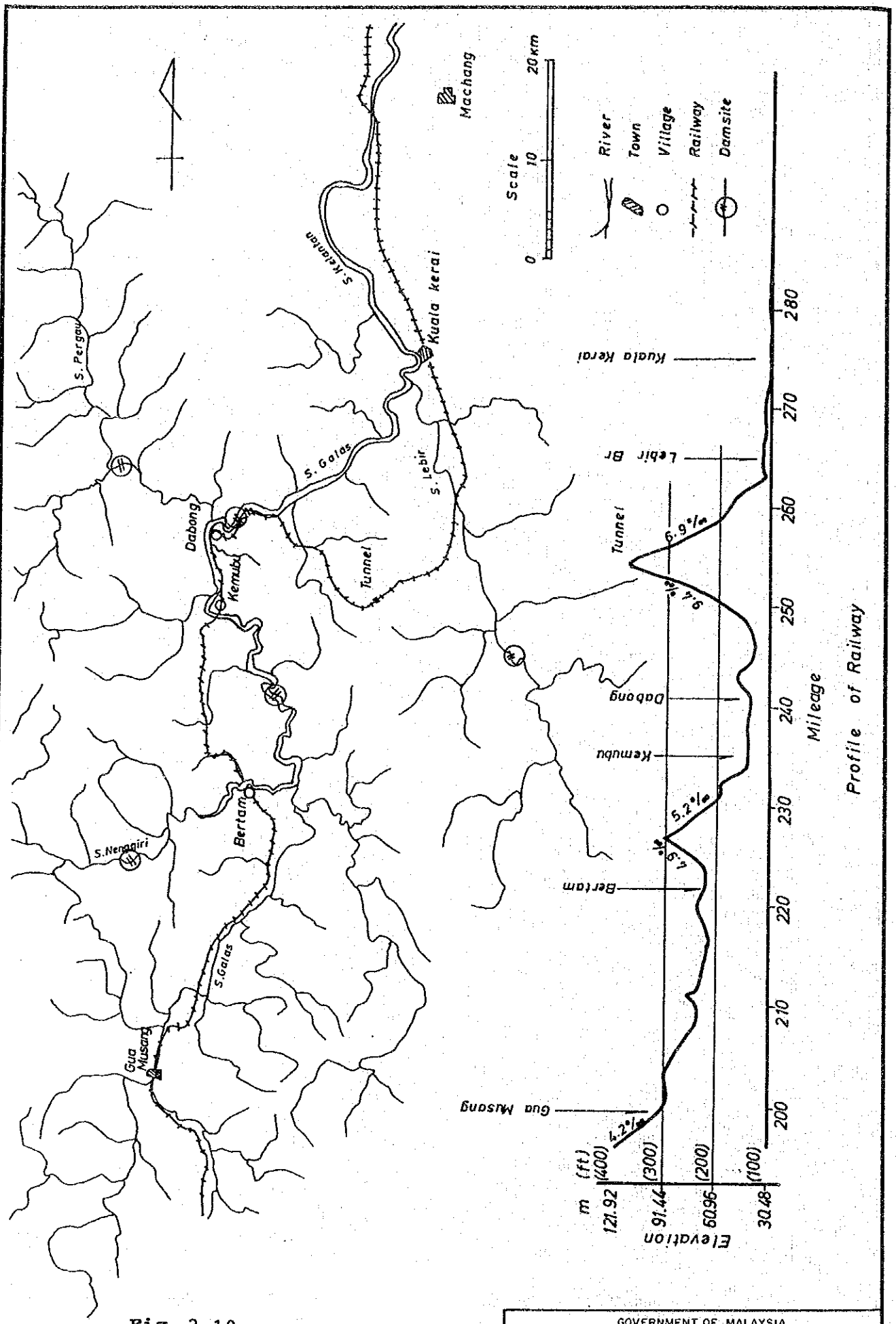


Fig. 3.10

Railway, Plan and Profile

GOVERNMENT OF MALAYSIA
STUDY
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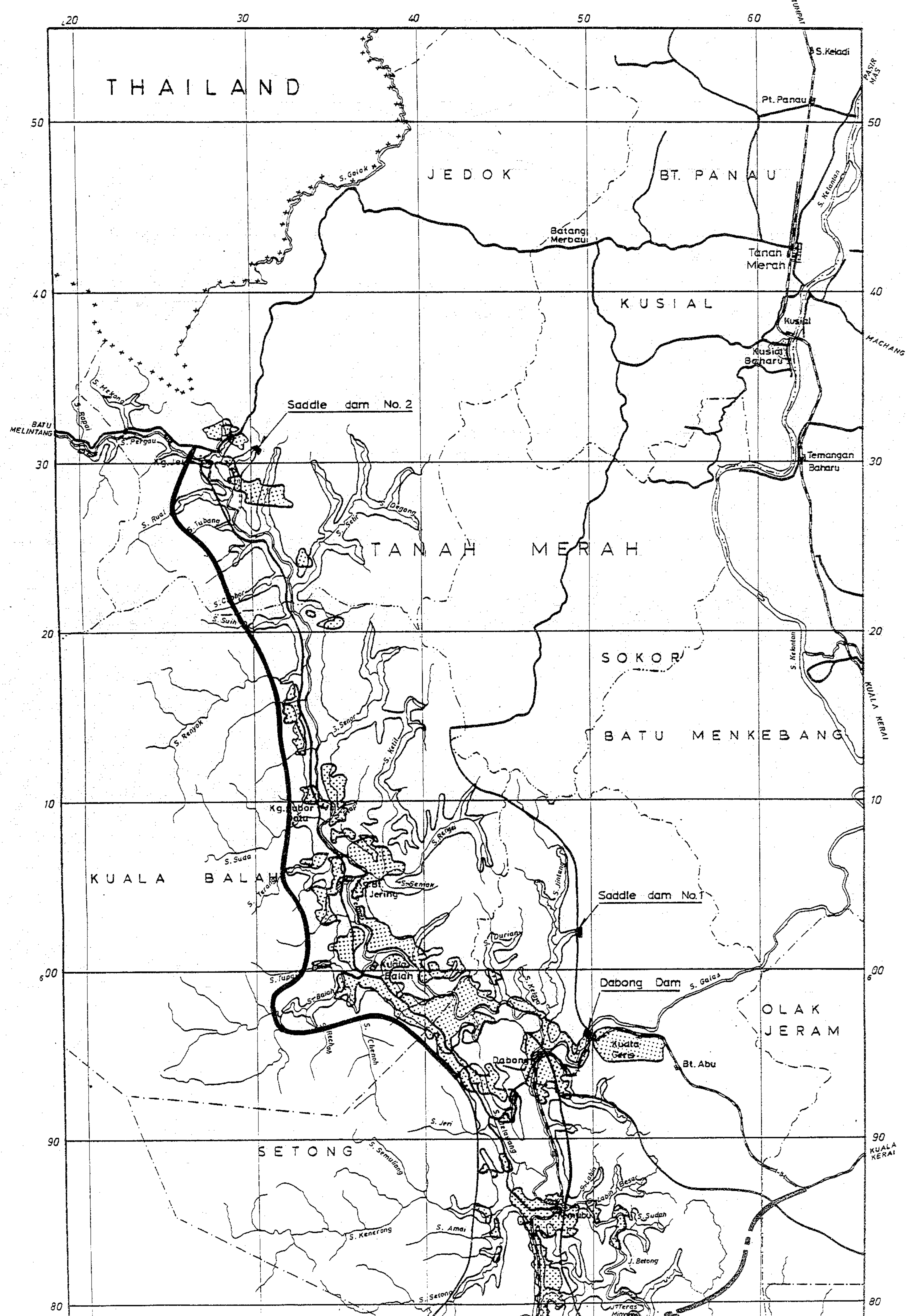
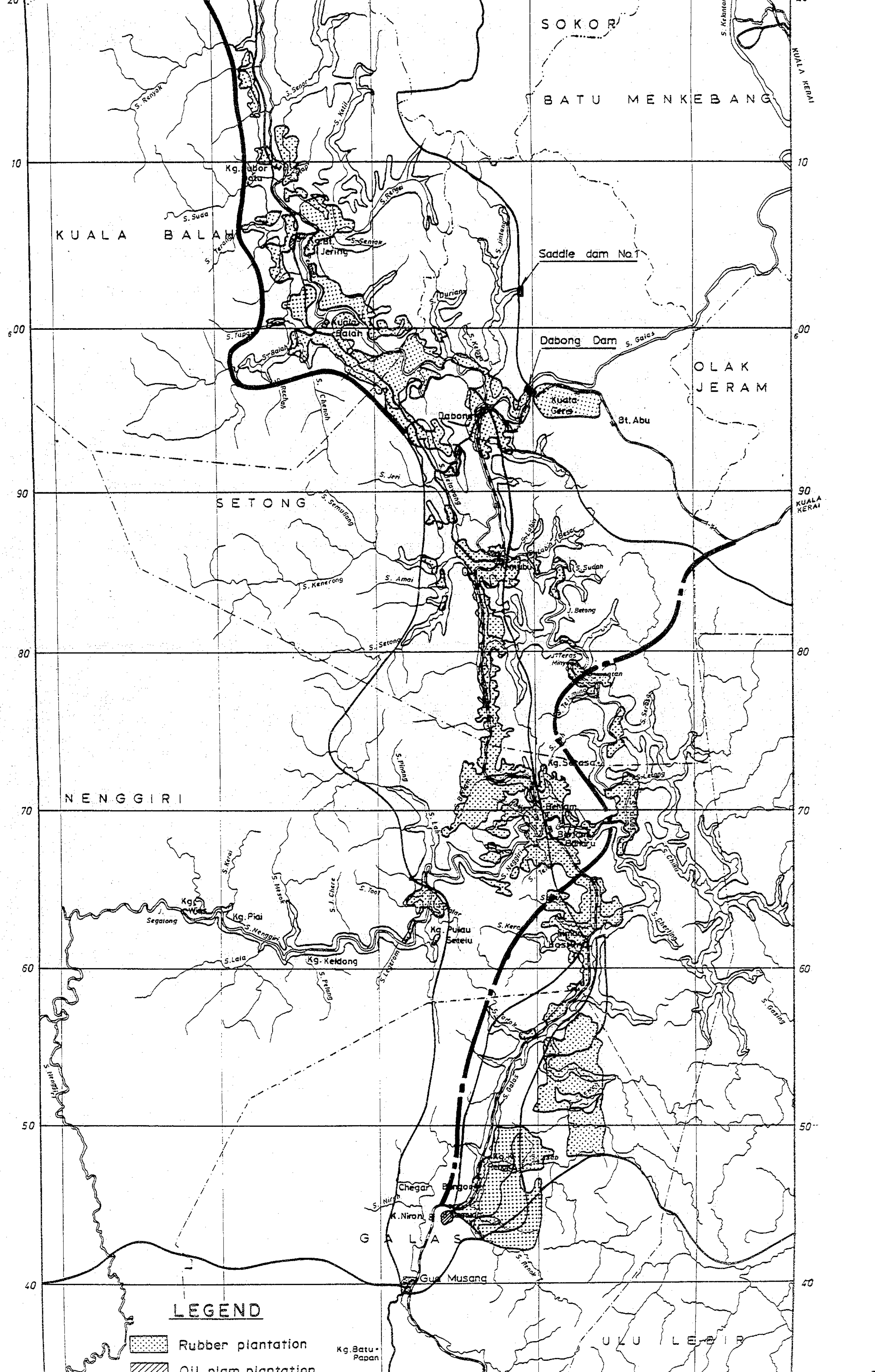
JAPAN INTERNATIONAL COOPERATION AGENCY



THAILAND
JEDOK
BT. PANAU
KUSIAL
TANAH MERAH
SOKOR
BATU MENKEBANG
OLAK JERAM
KUALA BALAH
SETONG
Saddle dam No. 2
Saddle dam No. 1
Dabong Dam
TUMPAT
PASIR MAS
MACHANG
KUALA KERAI
BATU MELINTANG
Tanah Merah
Temangan Baharu
Kusial
Kusial Baharu
Batang Merbau
Pt. Panau
S. Keladi
S. Kelantan
Bt. Abu
Kuala Geris
Dabong
Kg. Budor
S. Galas
S. Jelawang
S. Chenoh
S. Pergau
S. Rapai
S. Tubana
S. Suda
S. Semuliang
S. Kenerong
S. Jeri
S. Amai
S. Setong
S. Galok


SOKOR
BATU MENKEBANG
KUALA KERAI
KUALA BALAH
Saddle dam No.1
Dabong Dam
OLAK JERAM
St. Abu
Kuala Geris
Dabong
Kuala Balah
Kg. Lubor Batu
Bt. Jering
S. Renyok
S. Senor
S. Ketil
S. Suda
S. Rengei
S. Senrak
S. Jintang
Durian
S. Tupai
S. Balah
S. Rechah
S. Chenoh
S. Galas
S. Jeri
SETONG
S. Semuliang
S. Kenerong
S. Amai
S. Setong
S. Sudah
J. Betong
S. Pinang
Kg. Serasa
S. Letang
NENGGIRI
Bertam
Bertam Baharu
S. Chiku
S. Cherting
S. Kerai
S. Mesok
S. J. Chere
S. Toot
Kg. Wias
J. Segalong
Kg. Piai
S. Nenggiri
Kg. Pulau Setelu
S. Lala
Kg. Keldong
S. Pelang
S. Legerom
S. Gasing
S. Galas
Chegar
Bengor
S. Niren
K. Niron
GALAS
Gua Musang
S. Renok
Kg. Batu Papan
ULU LEBIR
LEGEND
Rubber plantation
Oil plam plantation

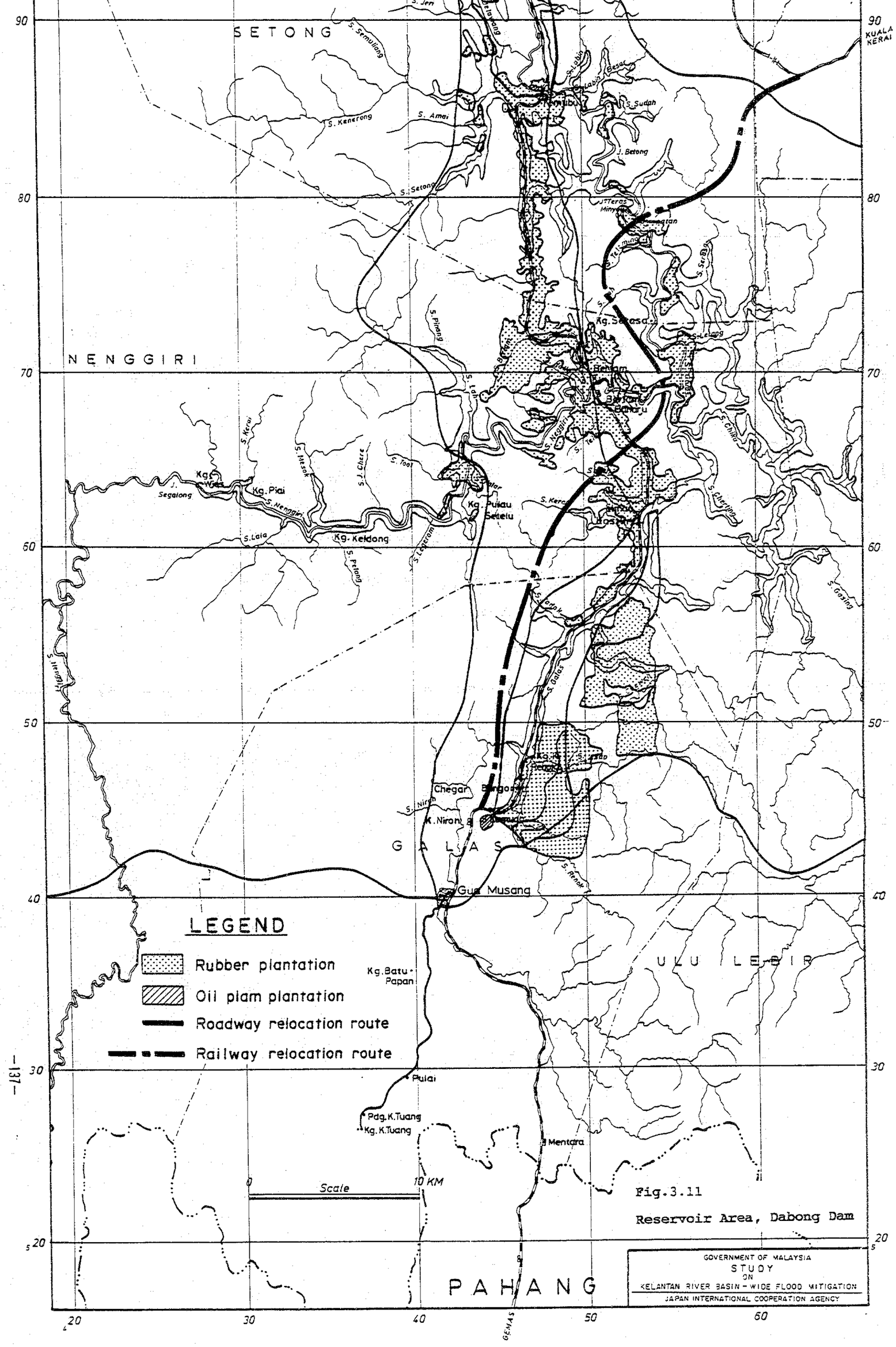


Fig.3.11

Reservoir Area, Dabong Dam

GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY

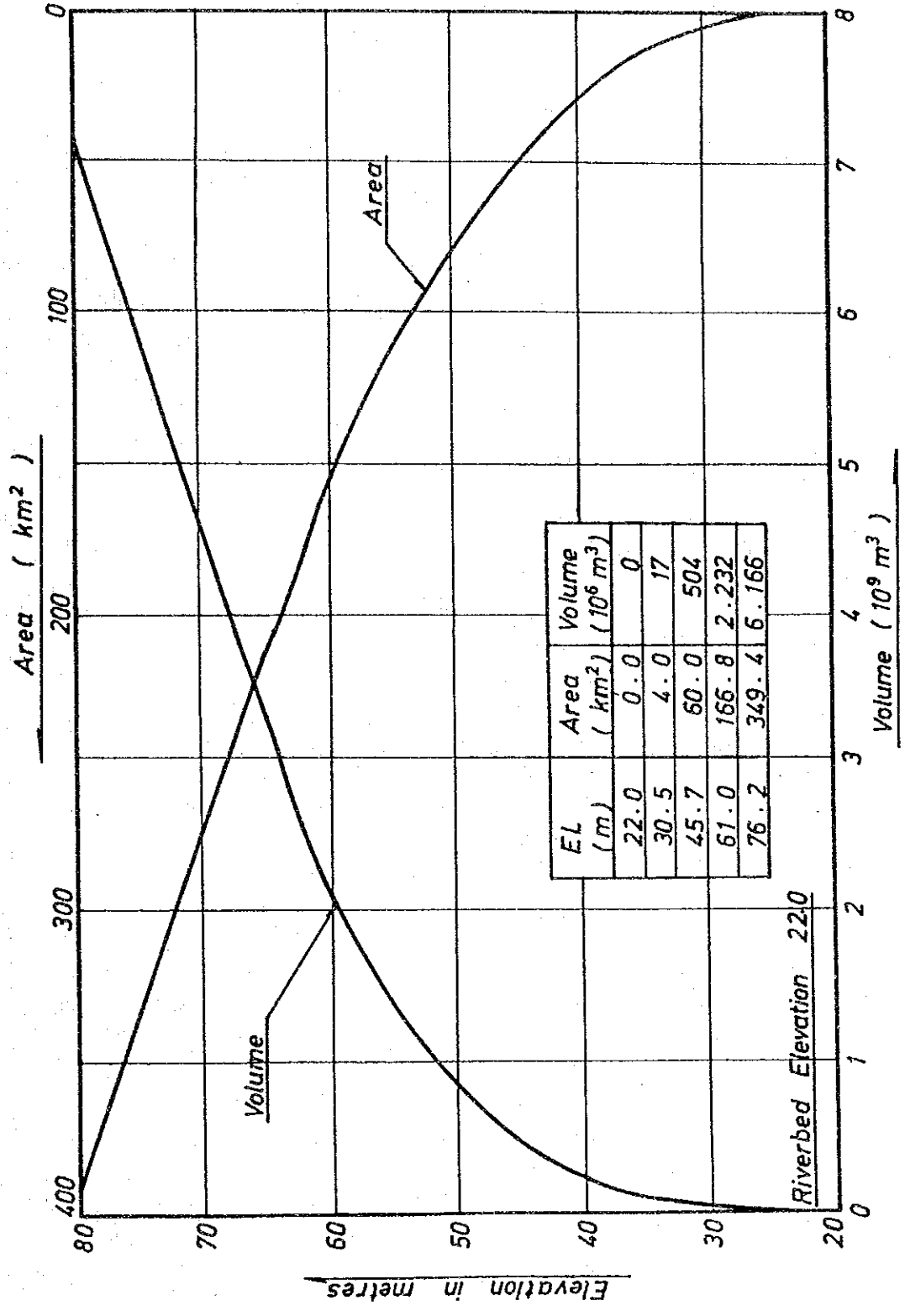
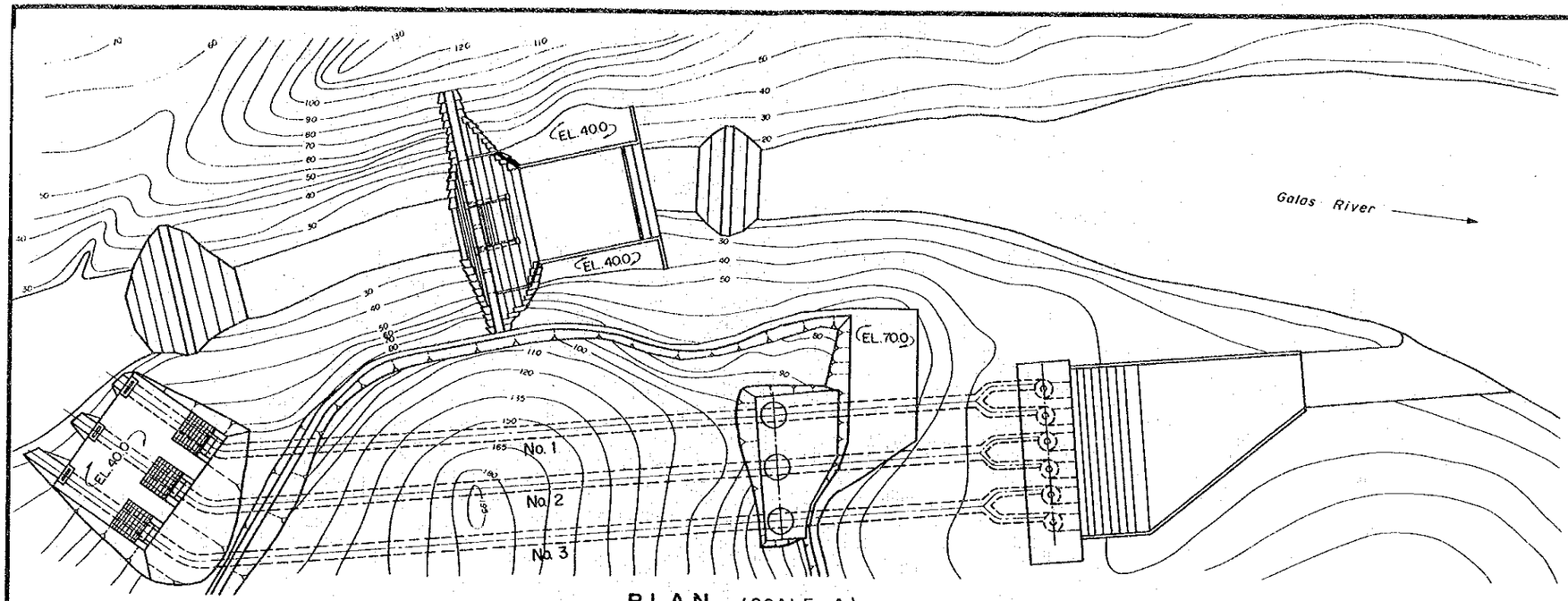


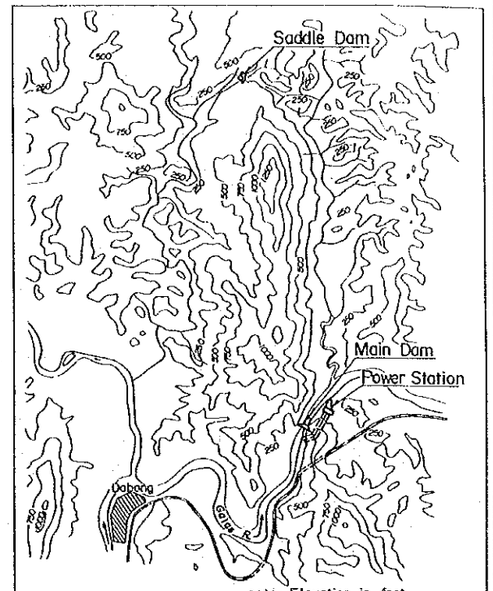
Fig. 3.12

Storage Capacity, Dabong Dam

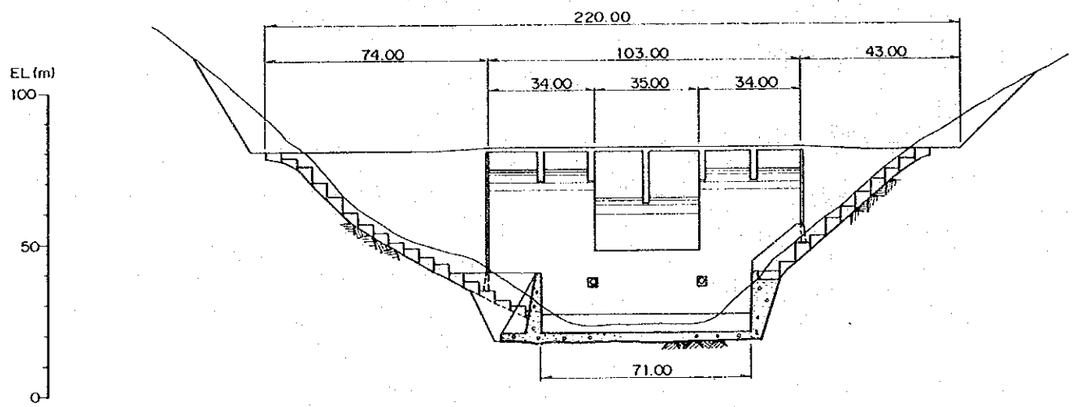
GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY



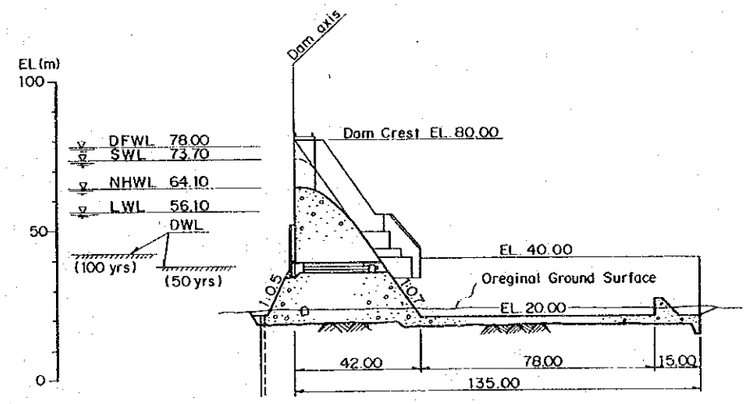
PLAN (SCALE A)



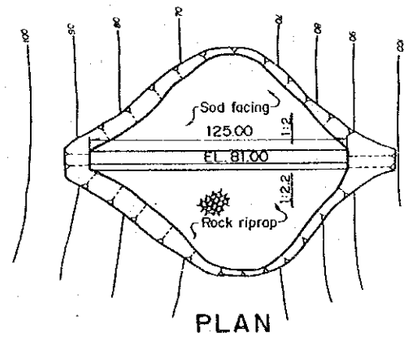
LOCATION MAP (SCALE C)



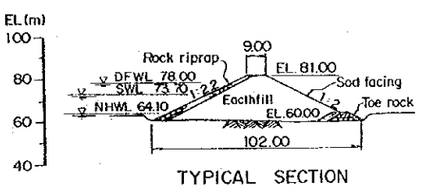
DOWNSTREAM ELEVATION OF DAM (SCALE B)



TYPICAL SECTION OF DAM (SCALE B)

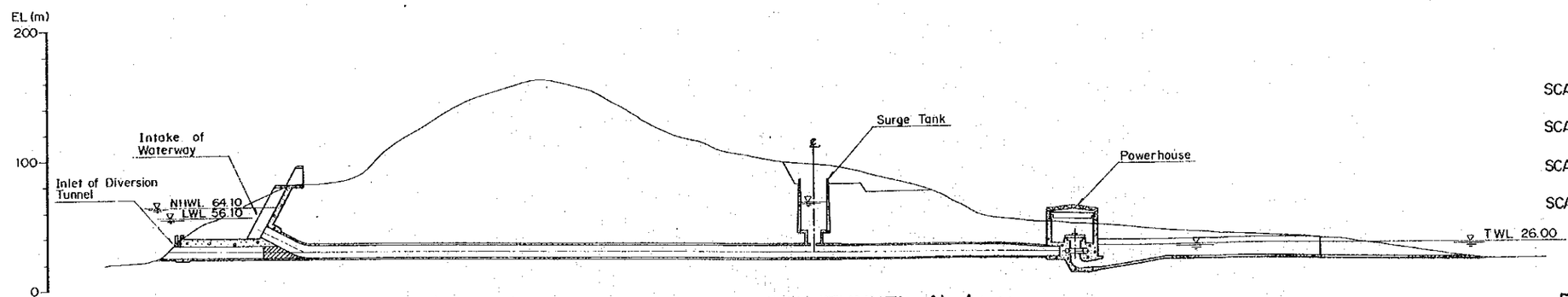


PLAN



TYPICAL SECTION

SADDLE DAM (SCALE D)



PROFILE OF WATERWAY/DIVERSION TUNNEL No. 1 (SCALE A)

SCALE A 0 100 200 (m)

SCALE B 0 50 100 (m)

SCALE C 0 5 10 (km)

SCALE D 0 100 (m)

GOVERNMENT OF MALAYSIA
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Fig.3.13 Proposed Development Plan for the Dabong Dam Scheme

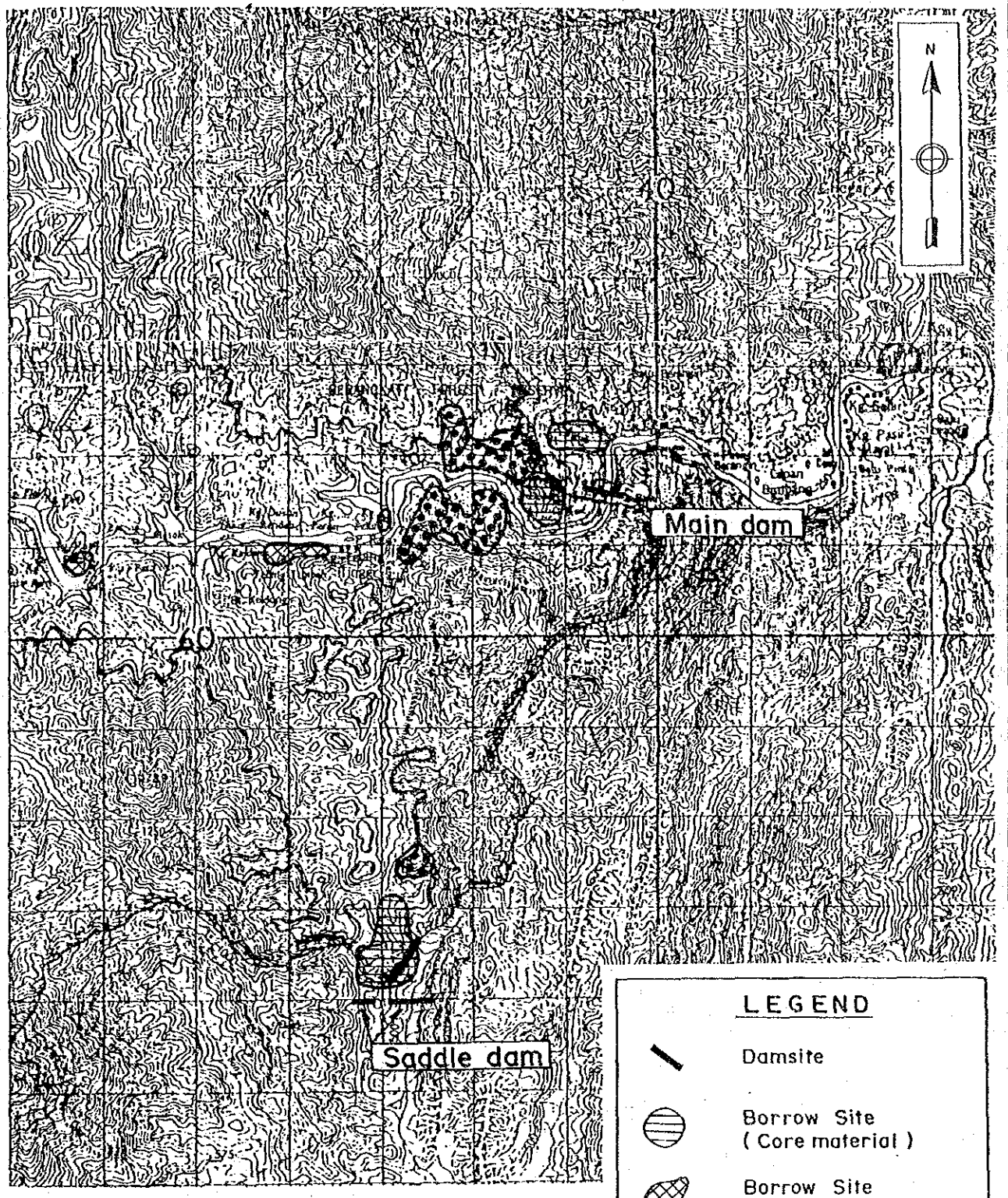


Fig.3.14

Location Map of Nenggiri Dam

GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY

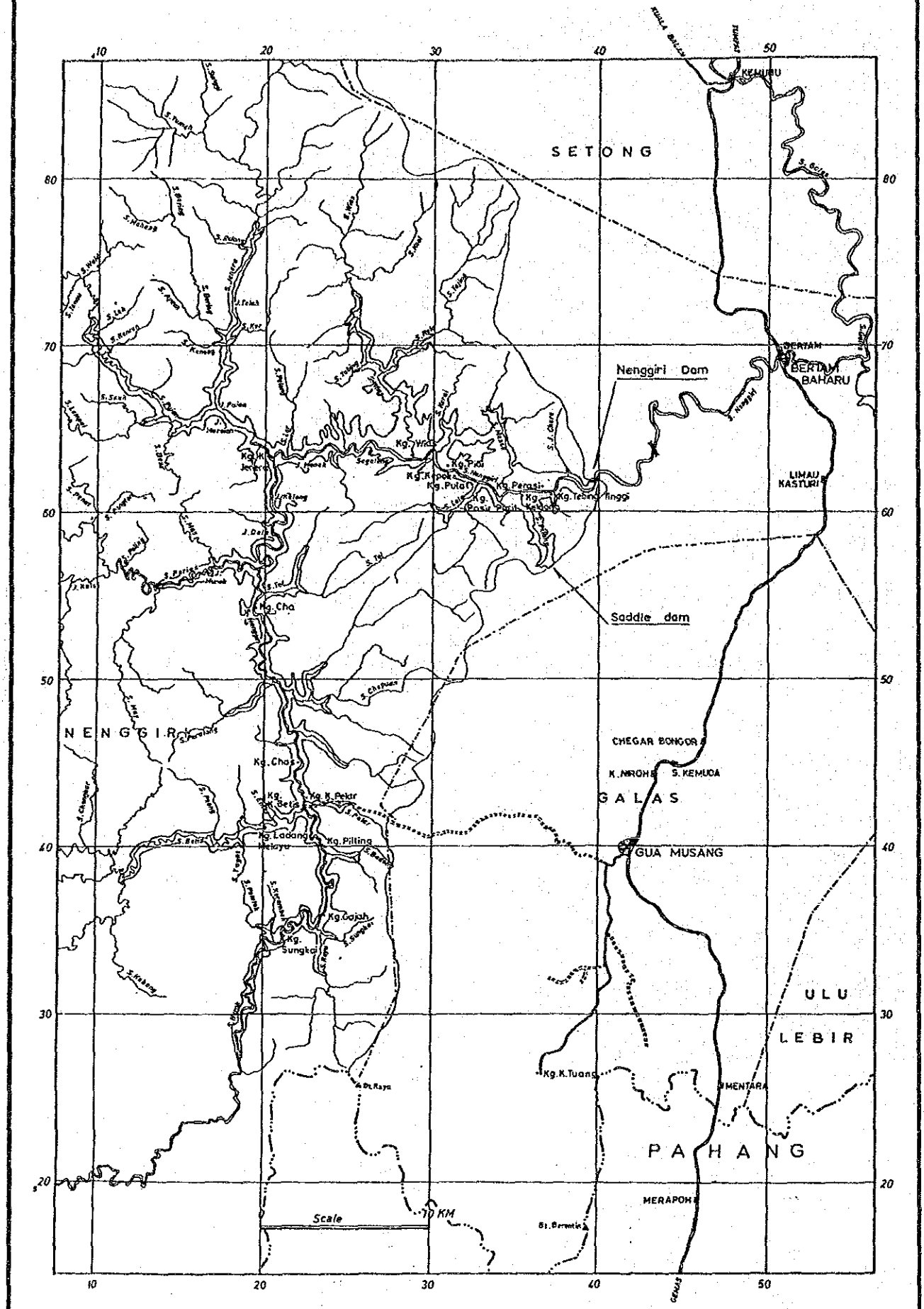
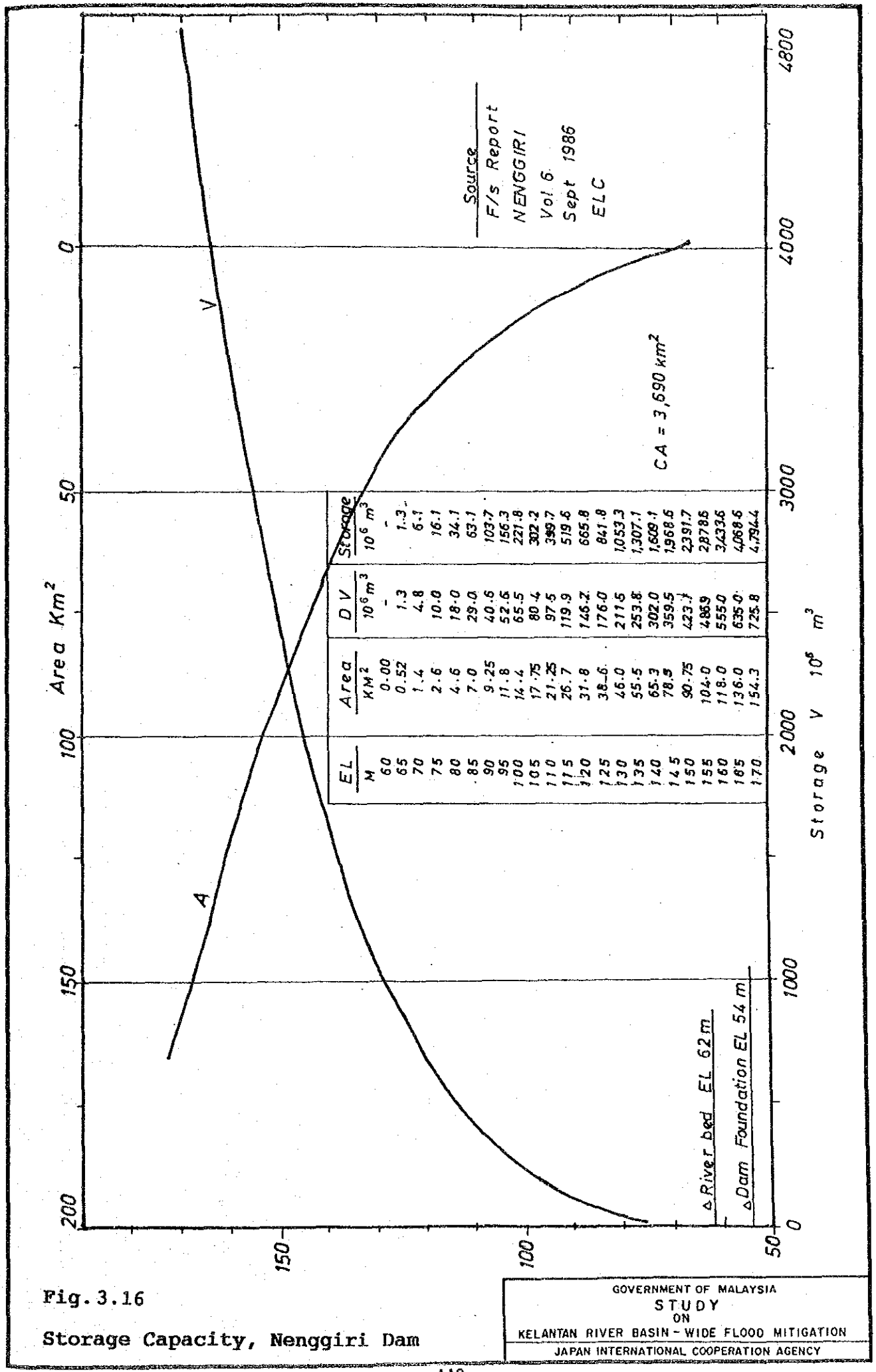


Fig. 3.15

Reservoir Area, Nenggiri Dam

GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY



EL M	Area KM²	DV 10⁶ m³	Storage 10⁶ m³
60	0.00	-	-
65	0.52	1.3	1.3
70	1.4	4.8	6.1
75	2.6	10.0	16.1
80	4.6	18.0	34.1
85	7.0	29.0	63.1
90	9.25	40.6	103.7
95	11.8	52.6	156.3
100	14.4	65.5	221.8
105	17.75	80.4	302.2
110	21.25	97.5	399.7
115	26.7	119.9	519.6
120	31.8	146.2	665.8
125	38.6	176.0	841.8
130	46.0	211.5	1,053.3
135	55.5	253.8	1,307.1
140	65.3	302.0	1,609.1
145	78.5	359.5	1,968.6
150	90.75	423.1	2,391.7
155	104.0	486.9	2,878.6
160	118.0	555.0	3,433.6
165	136.0	635.0	4,068.6
170	154.3	725.8	4,794.4

Fig. 3.16

Storage Capacity, Nenggiri Dam

GOVERNMENT OF MALAYSIA
STUDY
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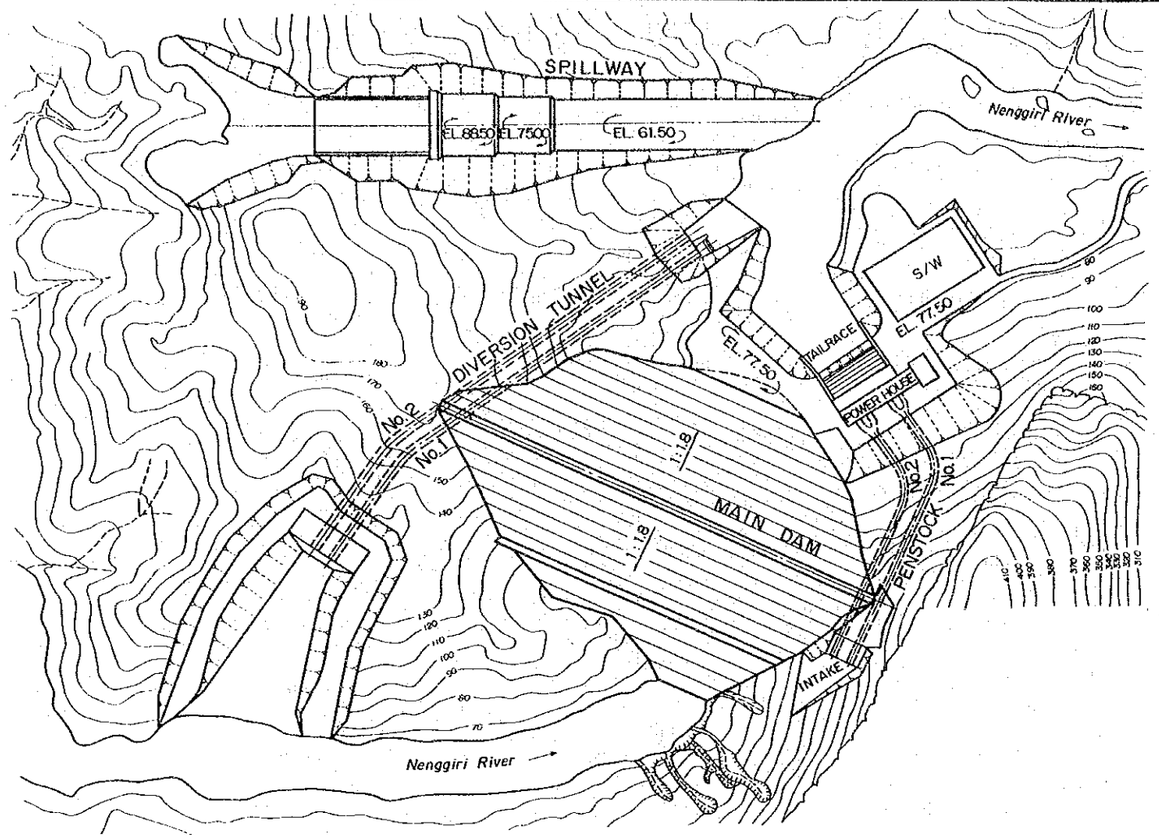
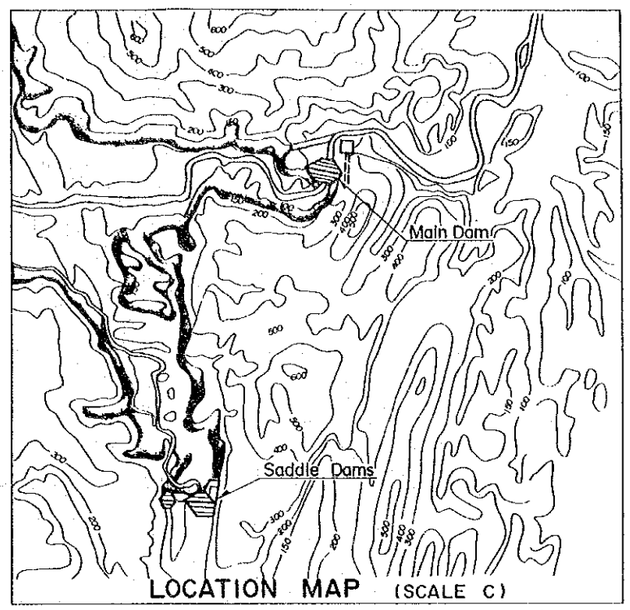
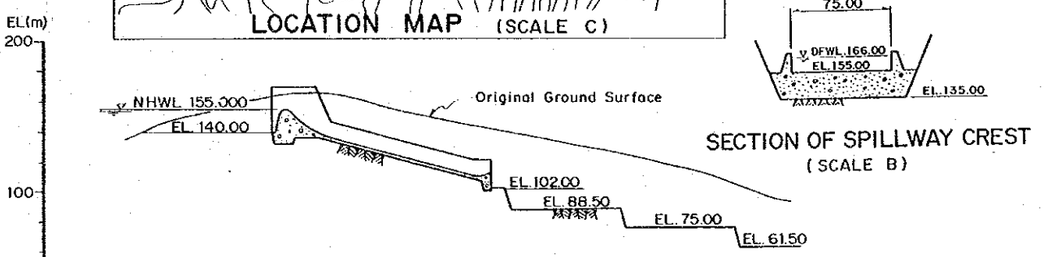
JAPAN INTERNATIONAL COOPERATION AGENCY



PLAN (SCALE A)

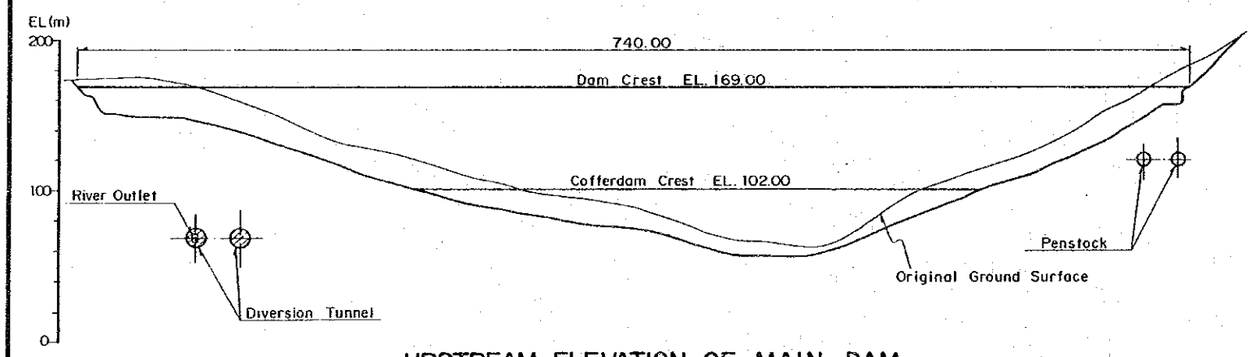


LOCATION MAP (SCALE C)

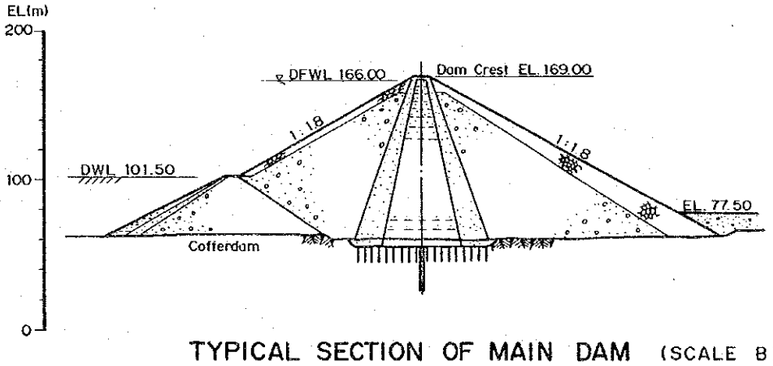


PROFILE OF SPILLWAY (SCALE B)

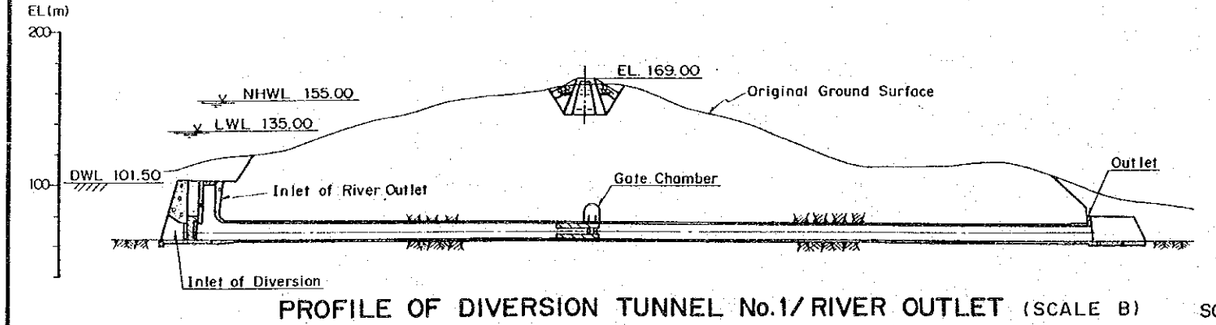
SECTION OF SPILLWAY CREST (SCALE B)



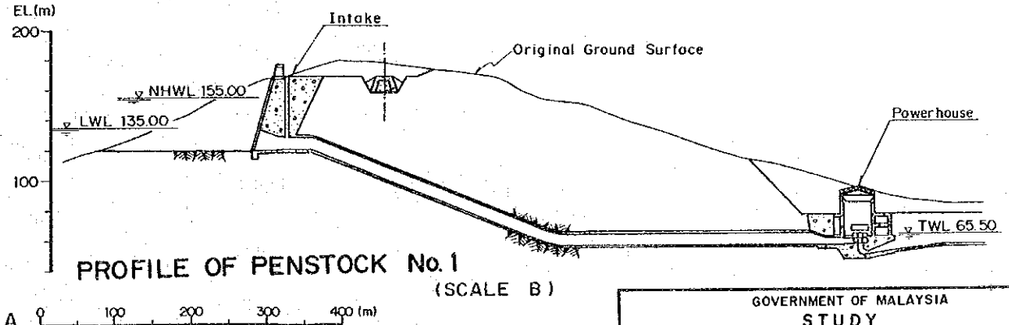
UPSTREAM ELEVATION OF MAIN DAM (SCALE B)



TYPICAL SECTION OF MAIN DAM (SCALE B)



PROFILE OF DIVERSION TUNNEL No.1/ RIVER OUTLET (SCALE B)



PROFILE OF PENSTOCK No.1 (SCALE B)

SCALE A 0 100 200 300 400 (m)
SCALE B 0 100 200 (m)
SCALE C 0 1 2 3 4 5 (km)

GOVERNMENT OF MALAYSIA
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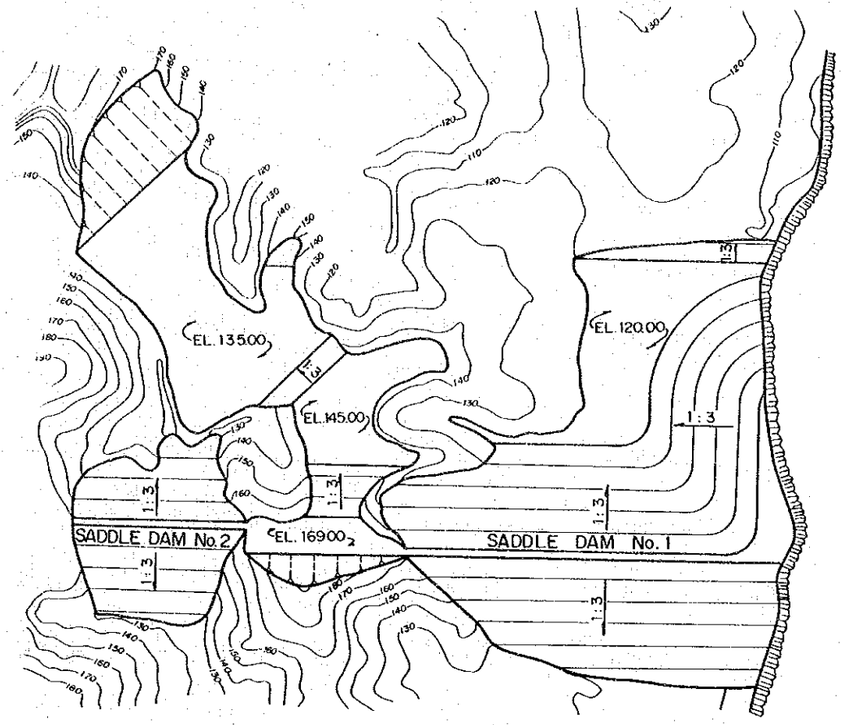
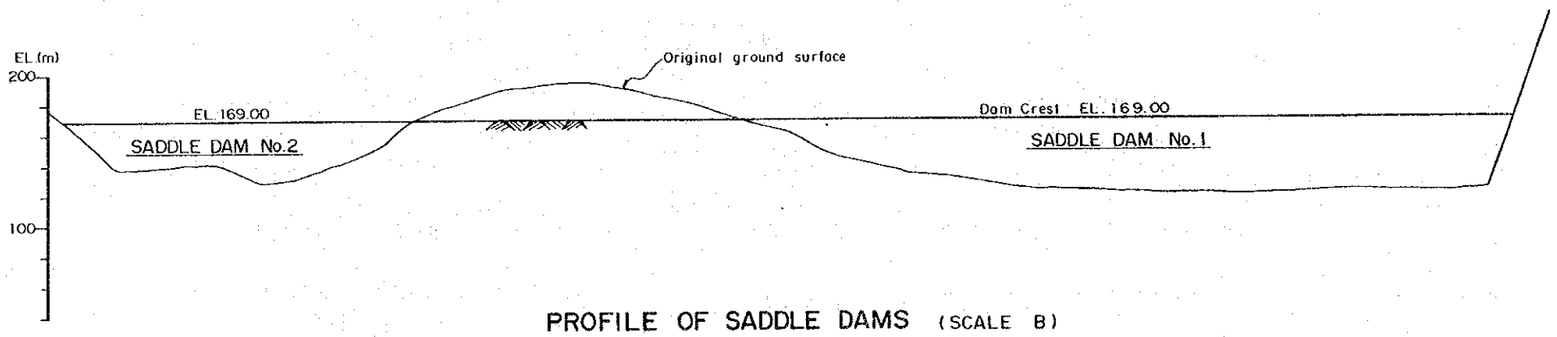
Fig. 3.17 Proposed Development Plan for the Nenggiri Dam Scheme (1/2)



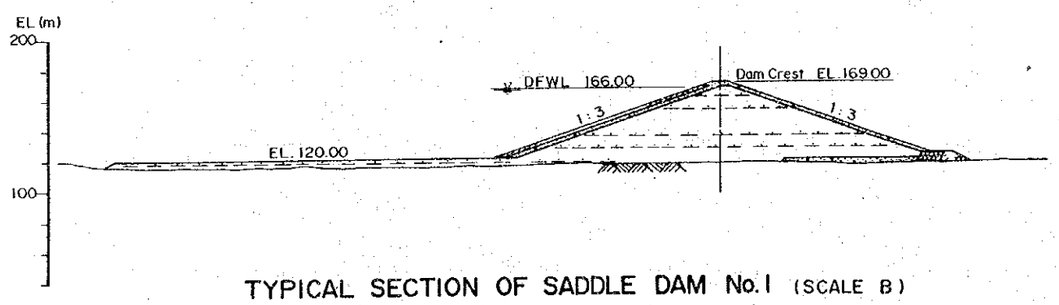
PLAN OF SADDLE DAMS (SCALE A)



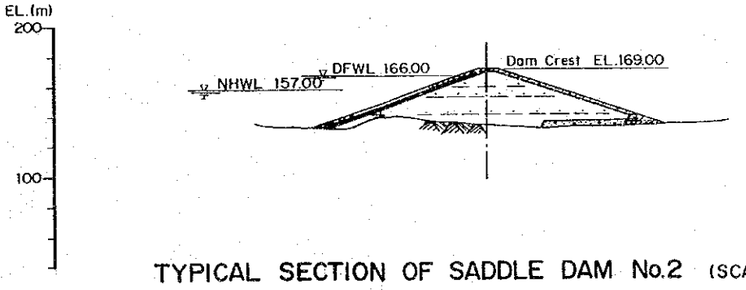
SCALE A 0 100 200 300 400 (m)

SCALE B 0 100 200 (m)

PROFILE OF SADDLE DAMS (SCALE B)



TYPICAL SECTION OF SADDLE DAM No.1 (SCALE B)



TYPICAL SECTION OF SADDLE DAM No.2 (SCALE B)

Fig. 3.17

Proposed Development Plan for the Nenggiri Dam Scheme (2/2)

GOVERNMENT OF MALAYSIA
STUDY
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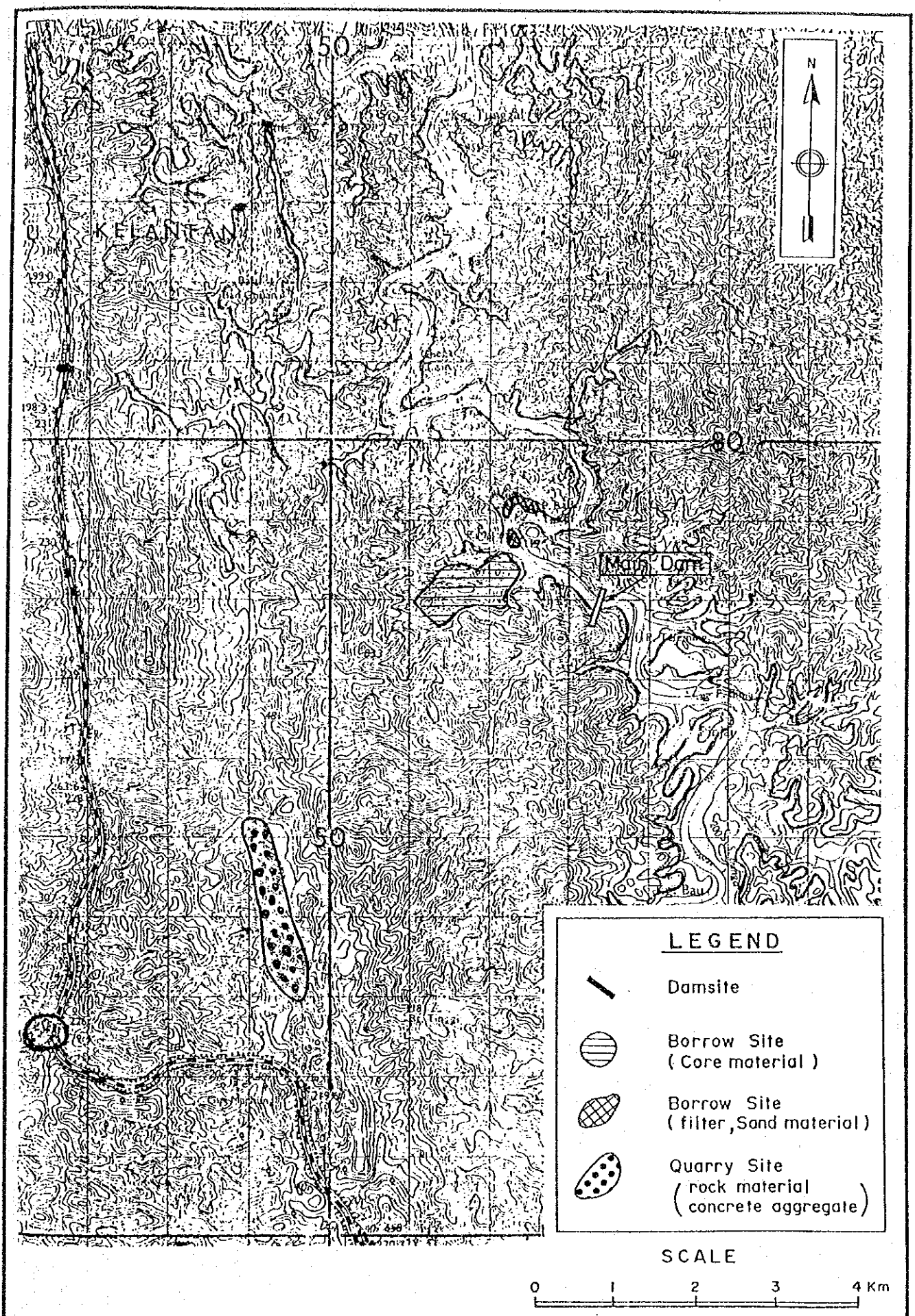
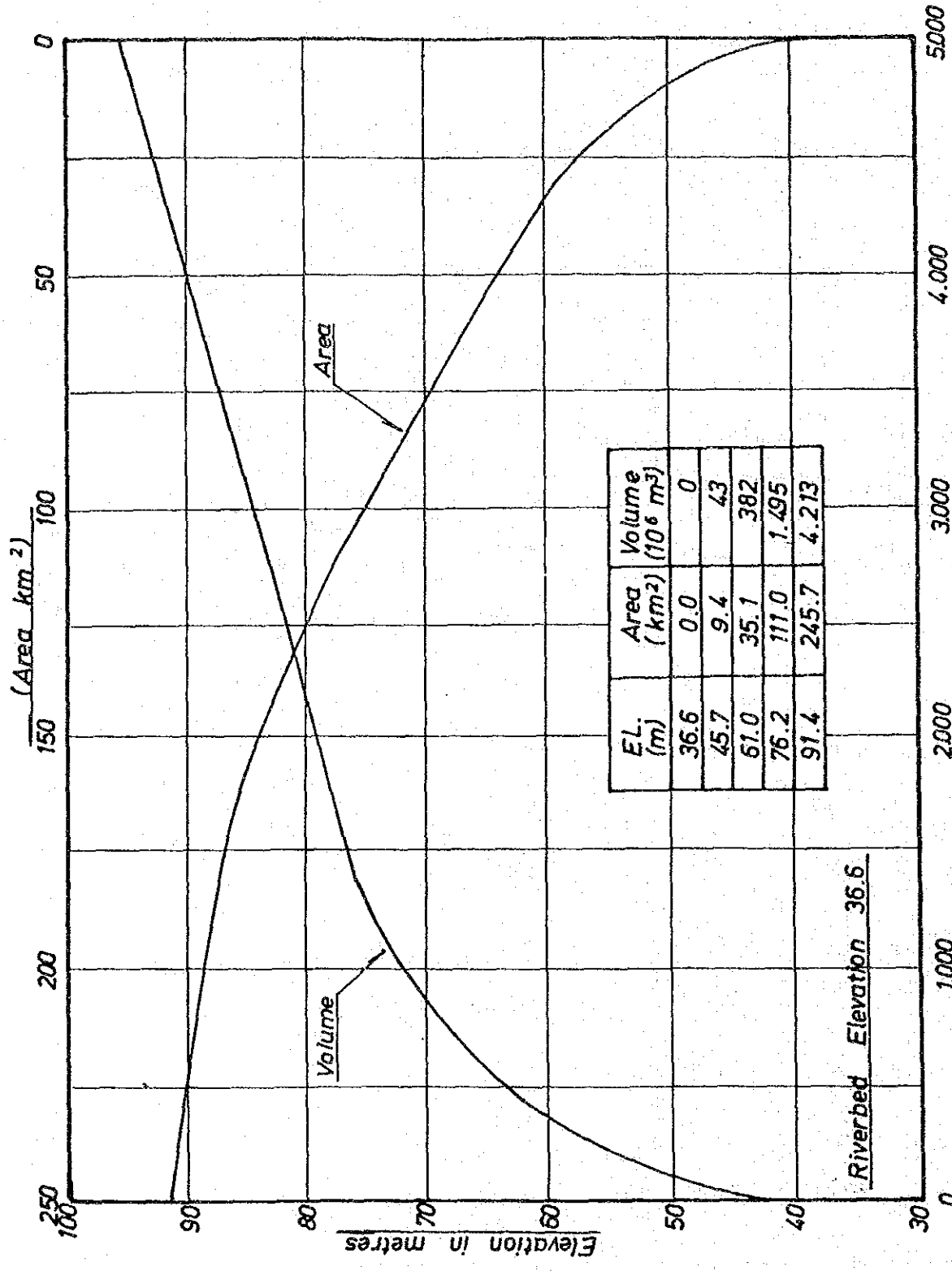


Fig. 3.18

Location Map of Kemubu Dam

GOVERNMENT OF MALAYSIA
STUDY
ON
KELANTAN RIVER BASIN - WIDE FLOOD MITIGATION
JAPAN INTERNATIONAL COOPERATION AGENCY



EL. (m)	Area (km²)	Volume (10⁶ m³)
36.6	0.0	0
45.7	9.4	43
61.0	35.1	382
76.2	111.0	1.495
91.4	245.7	4.213

Fig. 3.19

Storage Capacity, Kemubu Dam

GOVERNMENT OF MALAYSIA
STUDY
ON
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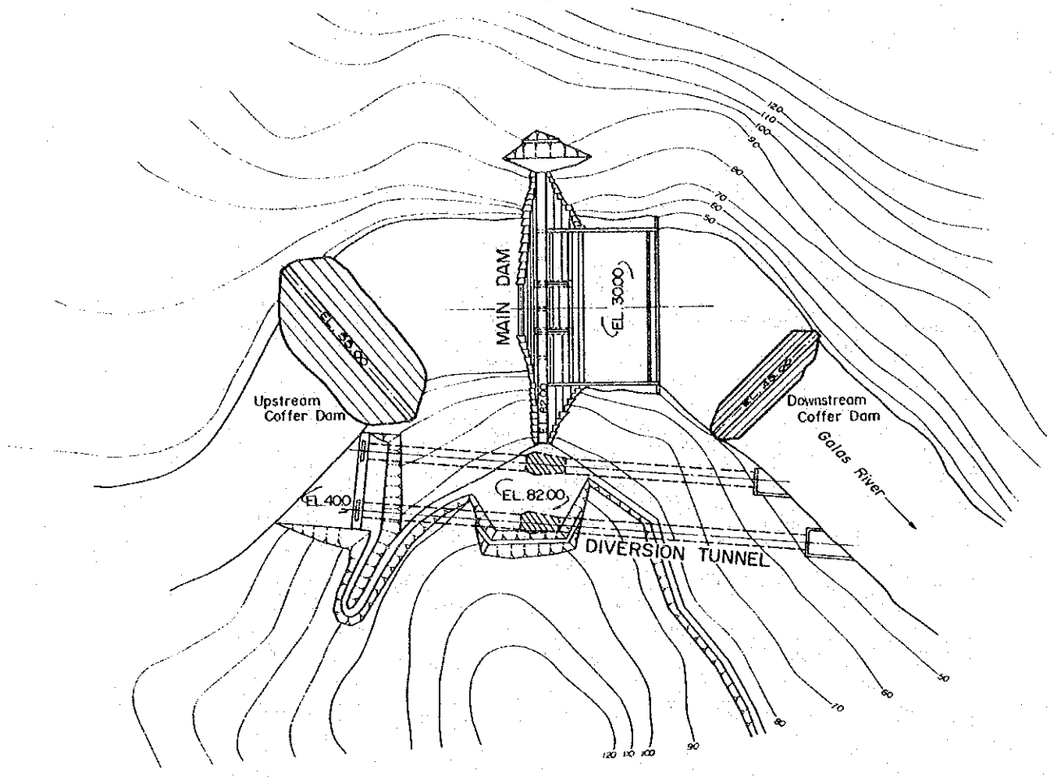
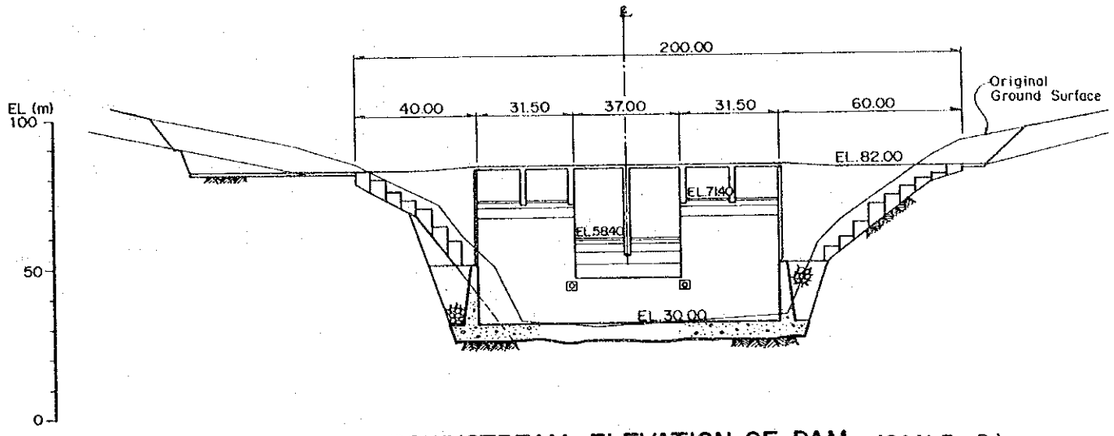
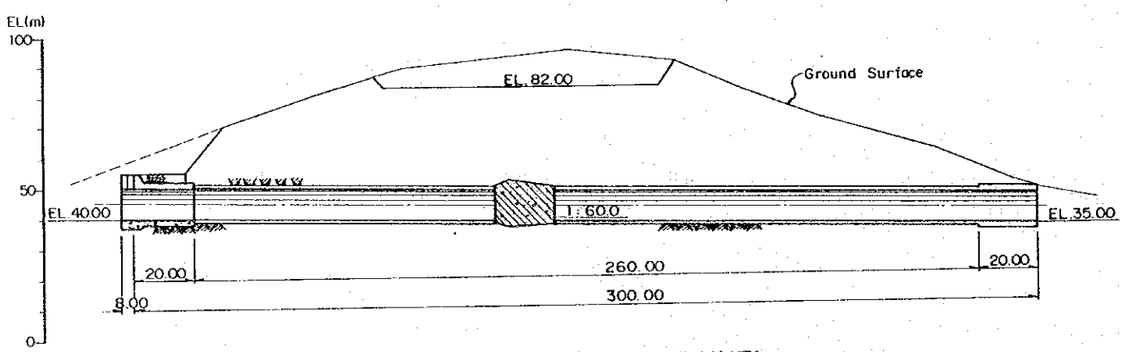
JAPAN INTERNATIONAL COOPERATION AGENCY



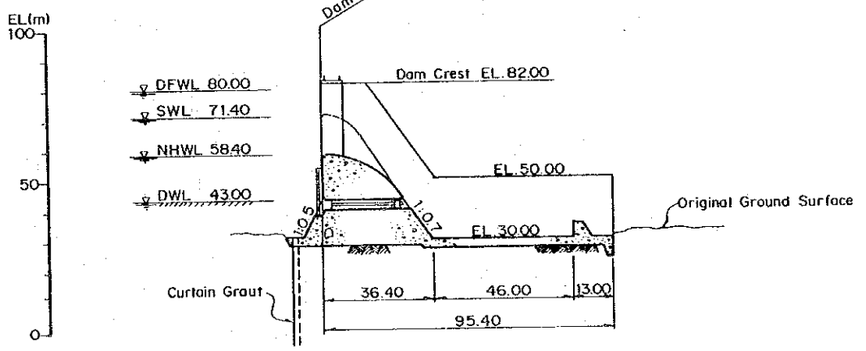
PLAN (SCALE A)



DOWNSTREAM ELEVATION OF DAM (SCALE B)



PROFILE OF DIVERSION TUNNEL (SCALE B)



TYPICAL SECTION OF DAM (SCALE B)

SCALE A 0 100 200 (m)

SCALE B 0 50 100 (m)

Fig. 3.20

Proposed Development Plan for the Kemubu Dam Scheme

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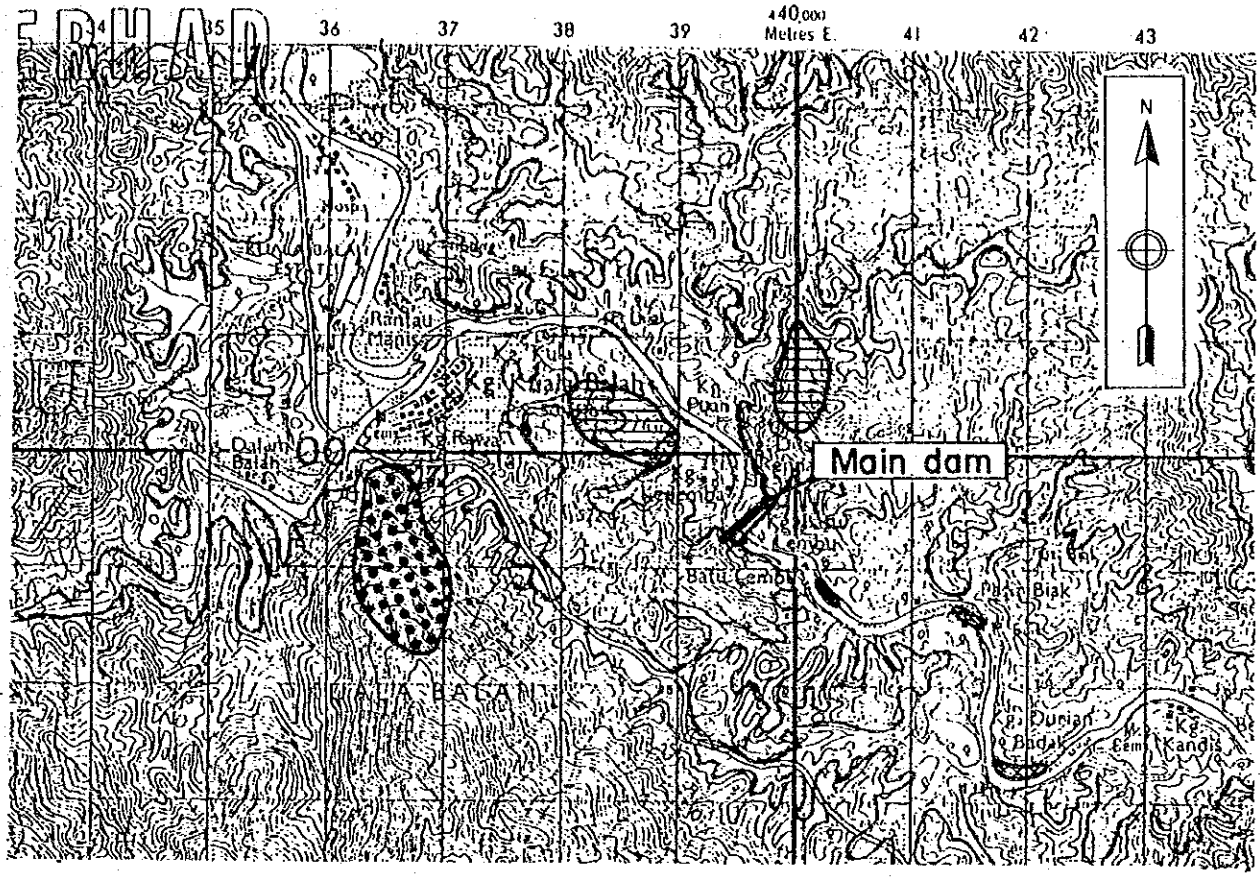

LEGEND

- Damsite
- Borrow Site (Core material)
- Borrow Site (filter, Sand material)
- Quarry Site (rock material, concrete aggregate)

SCALE

0 1 2 3 4 Km

Fig. 3.21

Location Map of Lower Pergau Dam

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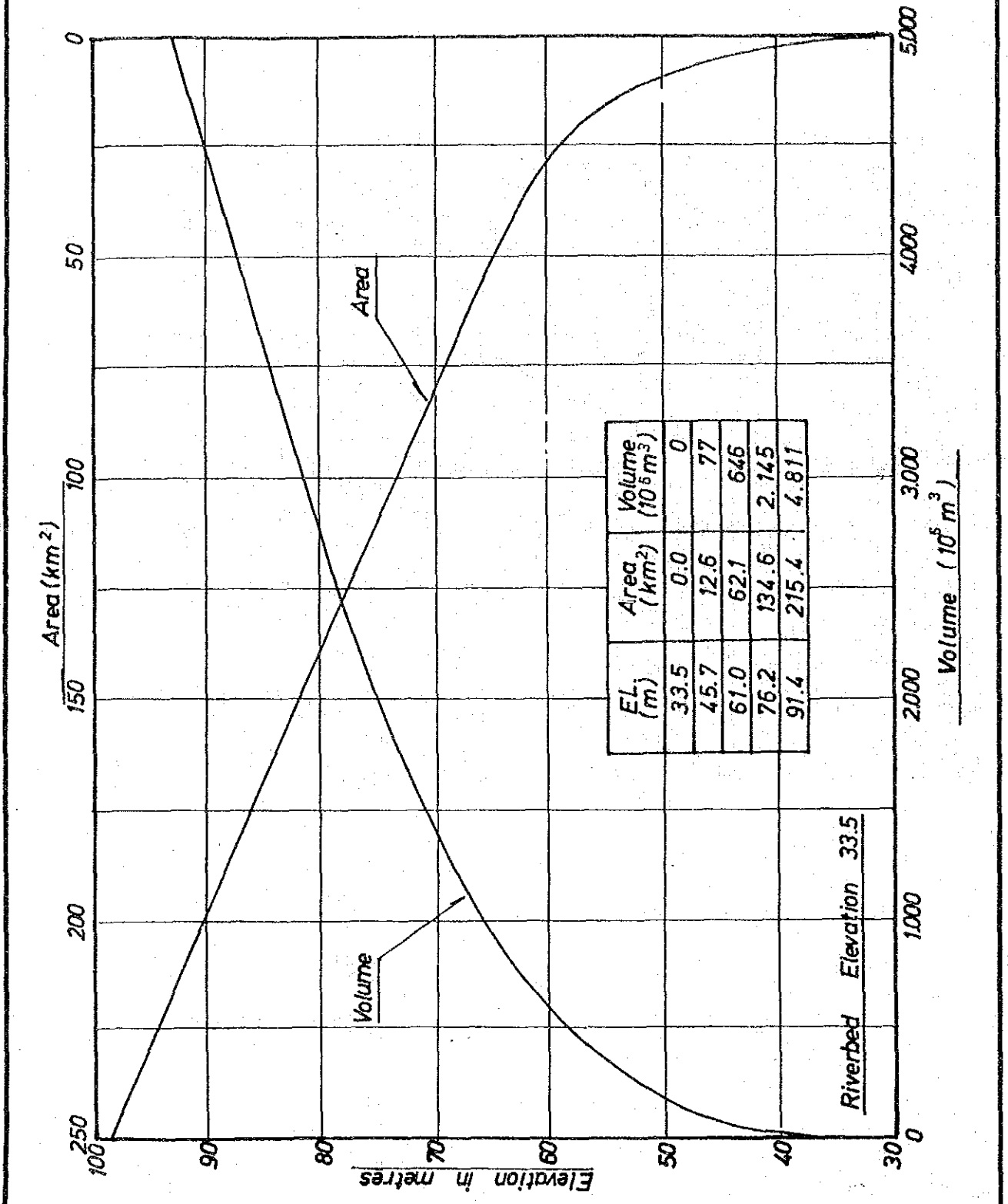

Fig. 3.22

Storage Capacity, Lower Pergau Dam

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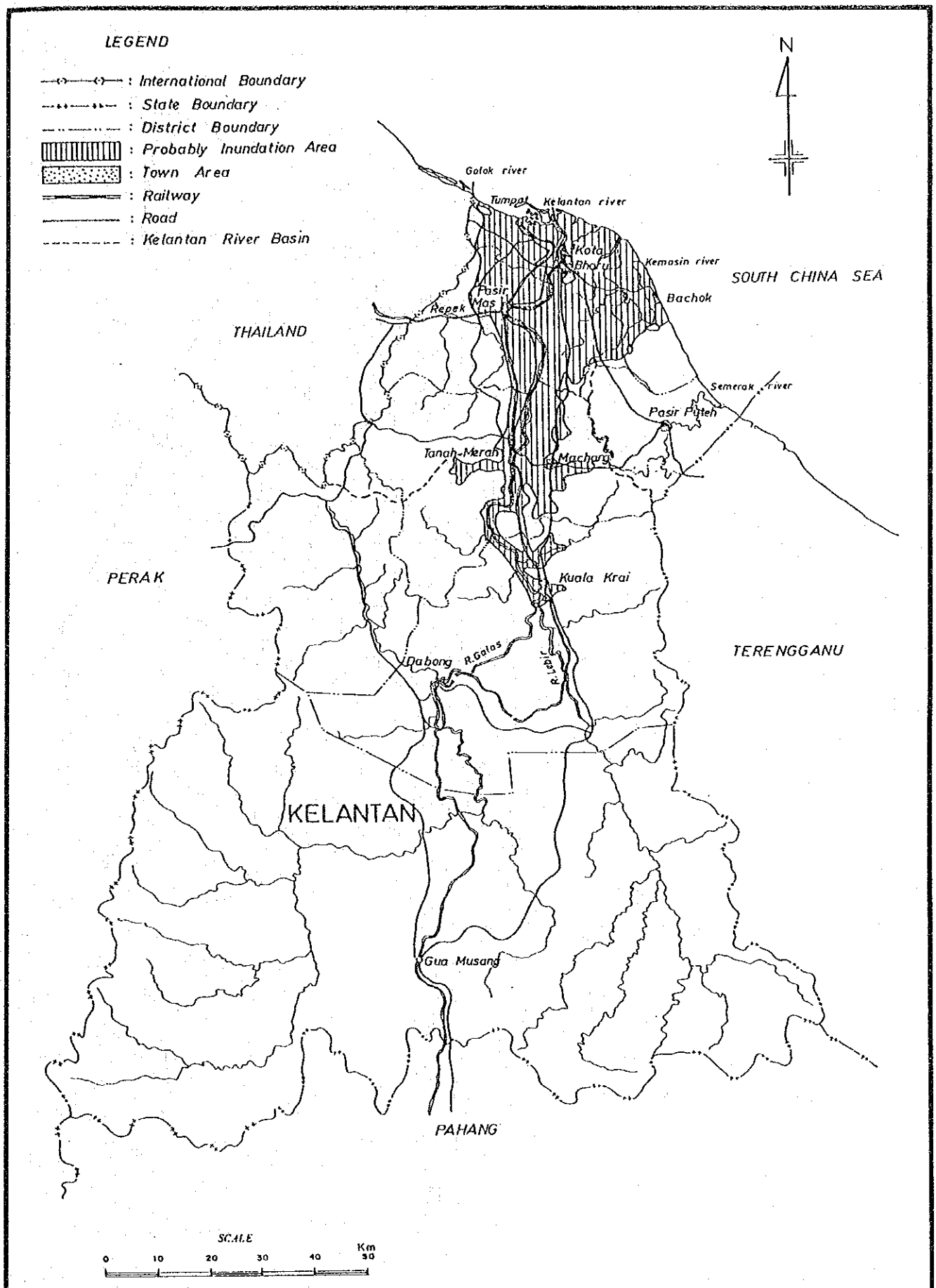

Fig.4.1

Protection Areas from Floods

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JAPAN INTERNATIONAL COOPERATION AGENCY

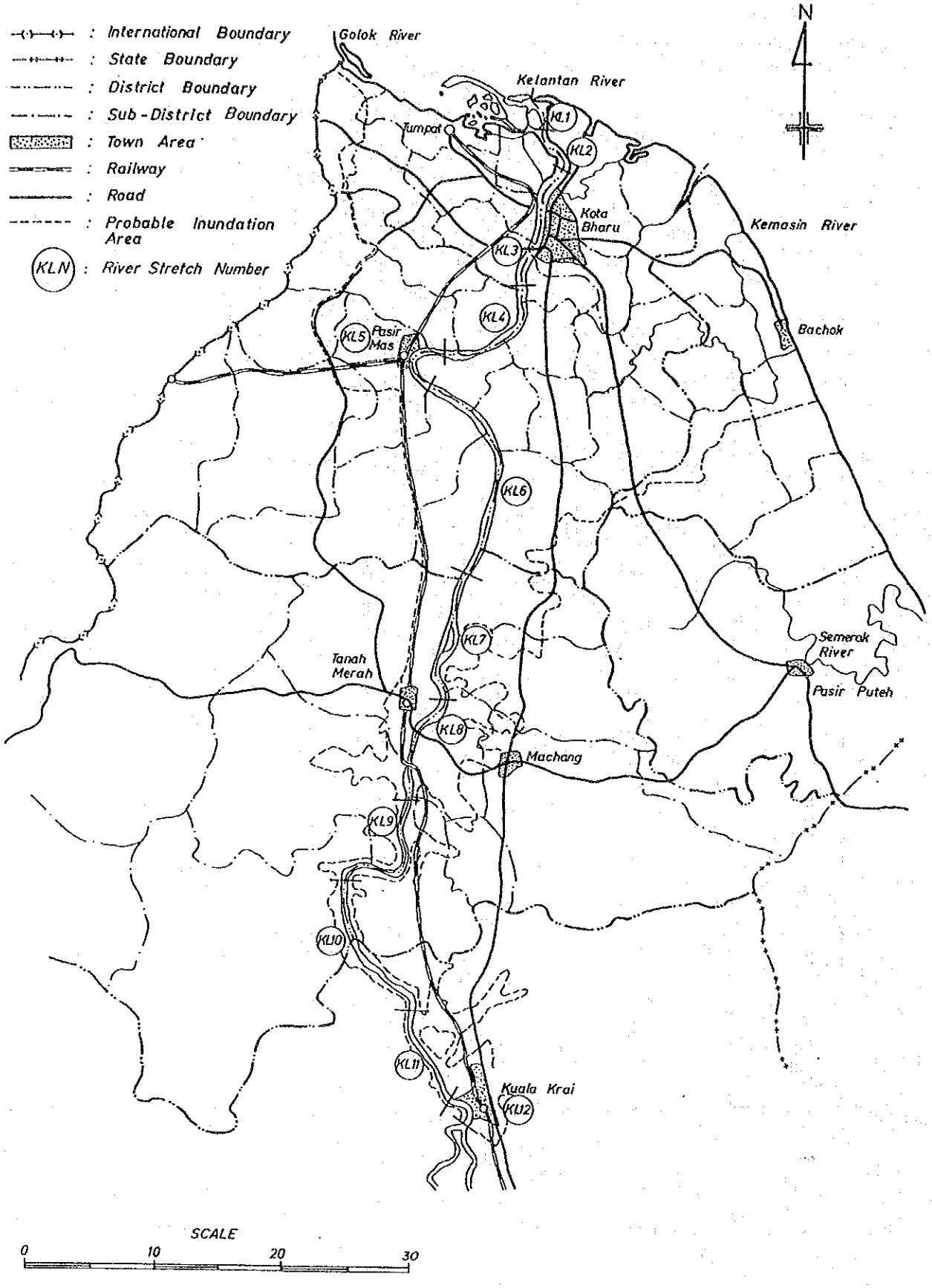

Fig.4.2

Division of River Stretches for Flood Analysis

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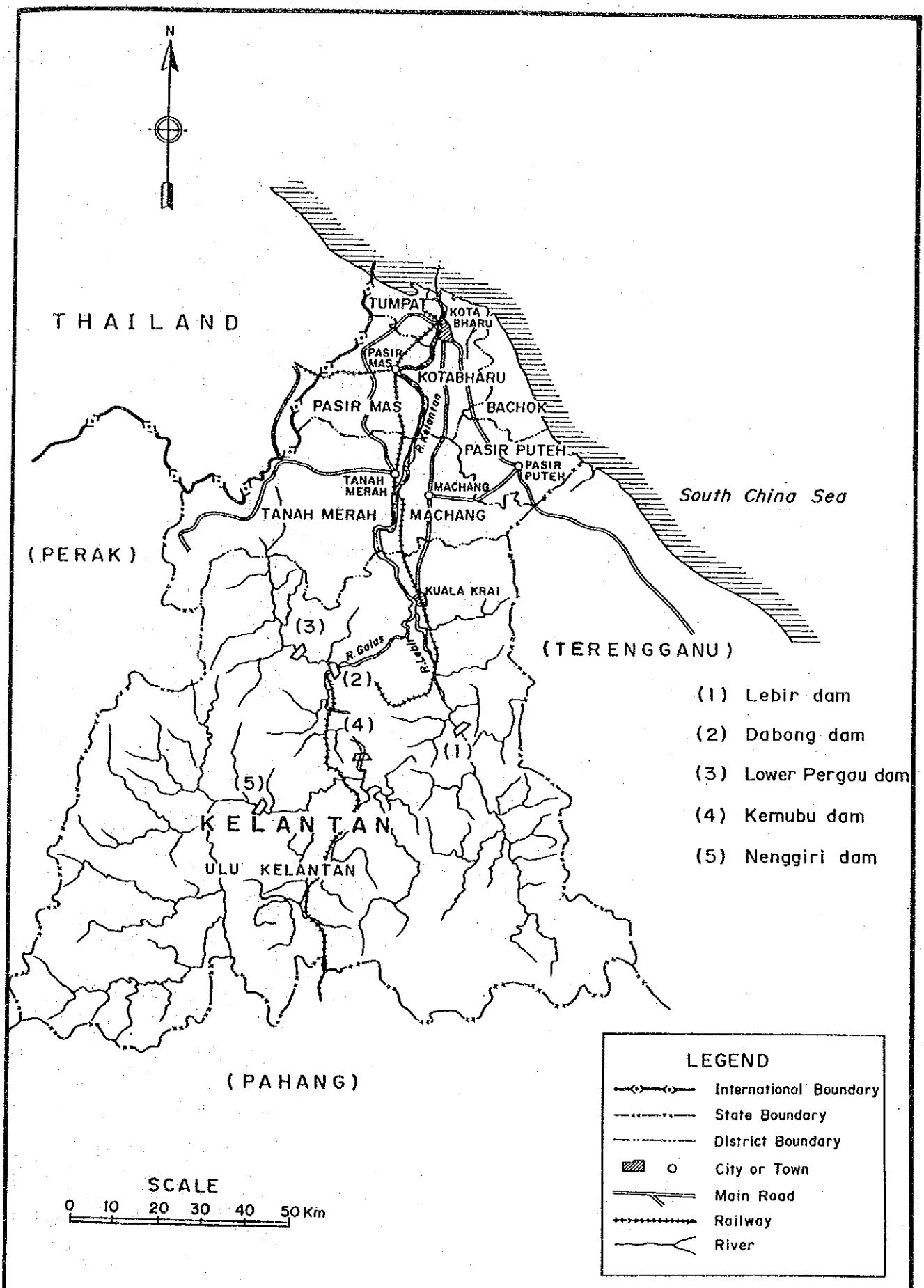

Fig.4.3

Location of Five Proposed Dam Schemes

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JAPAN INTERNATIONAL COOPERATION AGENCY

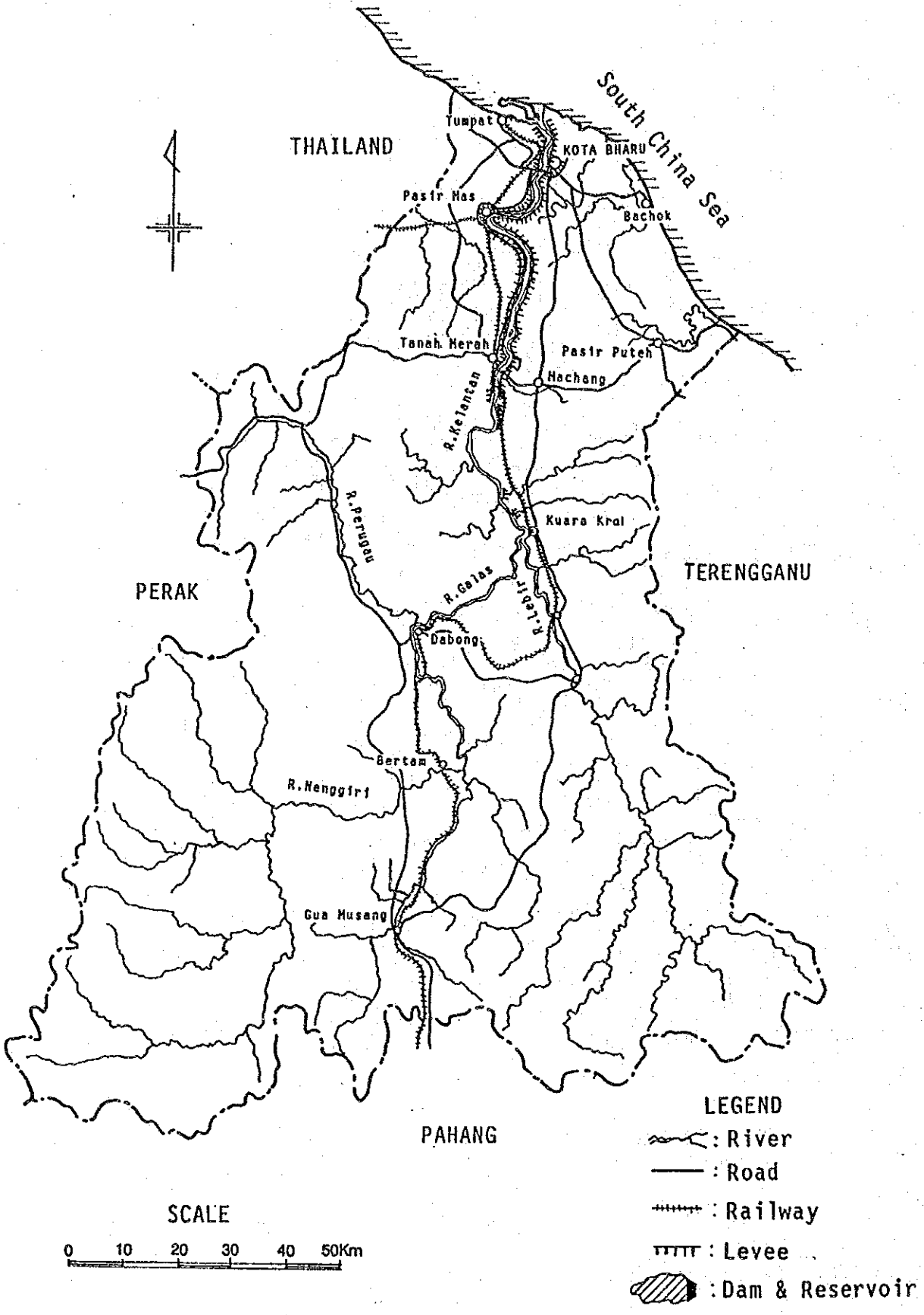

Fig.5.1

River Improvement Only

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JAPAN INTERNATIONAL COOPERATION AGENCY

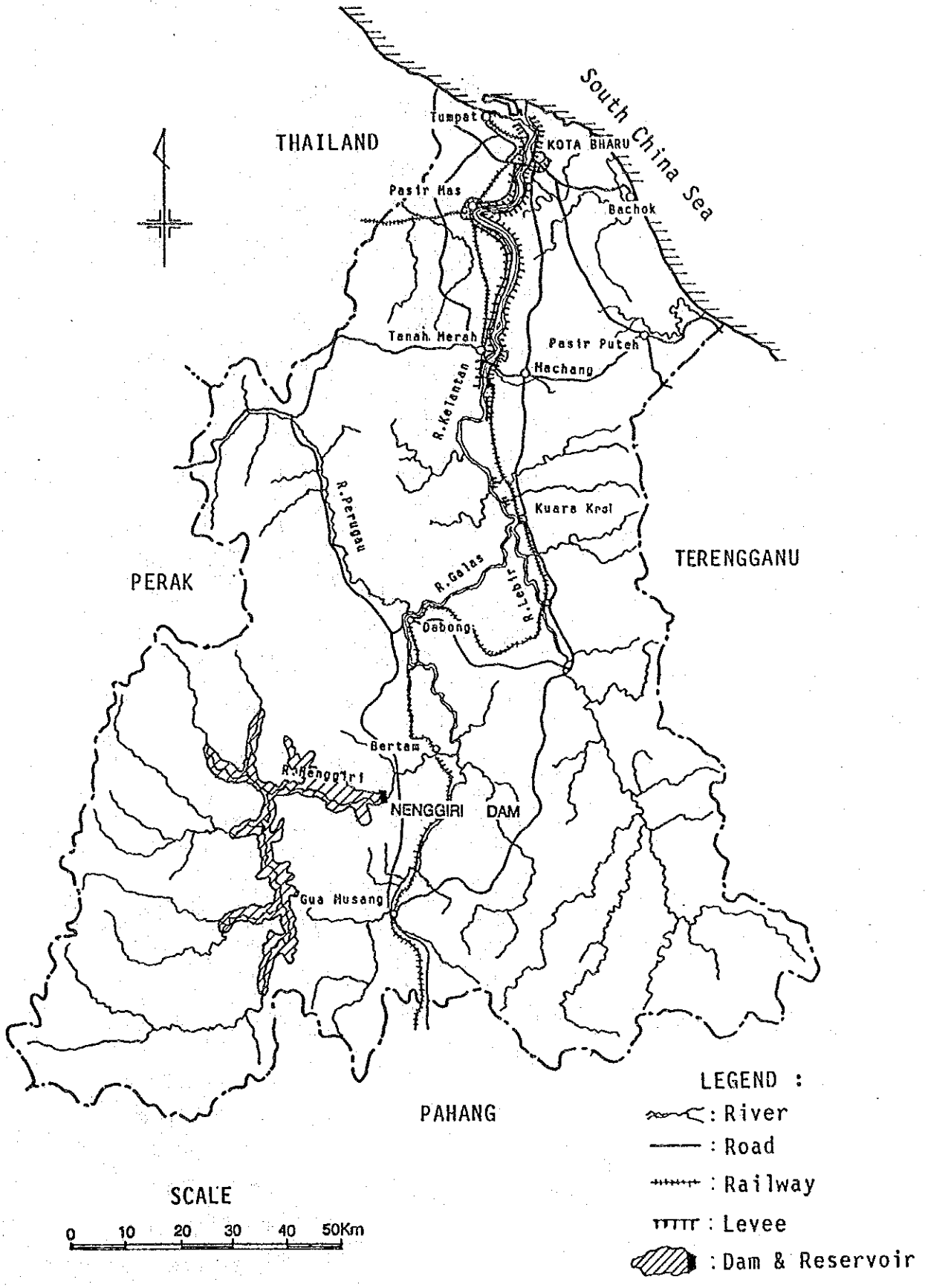

Fig.5.2

Nenggiri Dam + River Improvement

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JAPAN INTERNATIONAL COOPERATION AGENCY

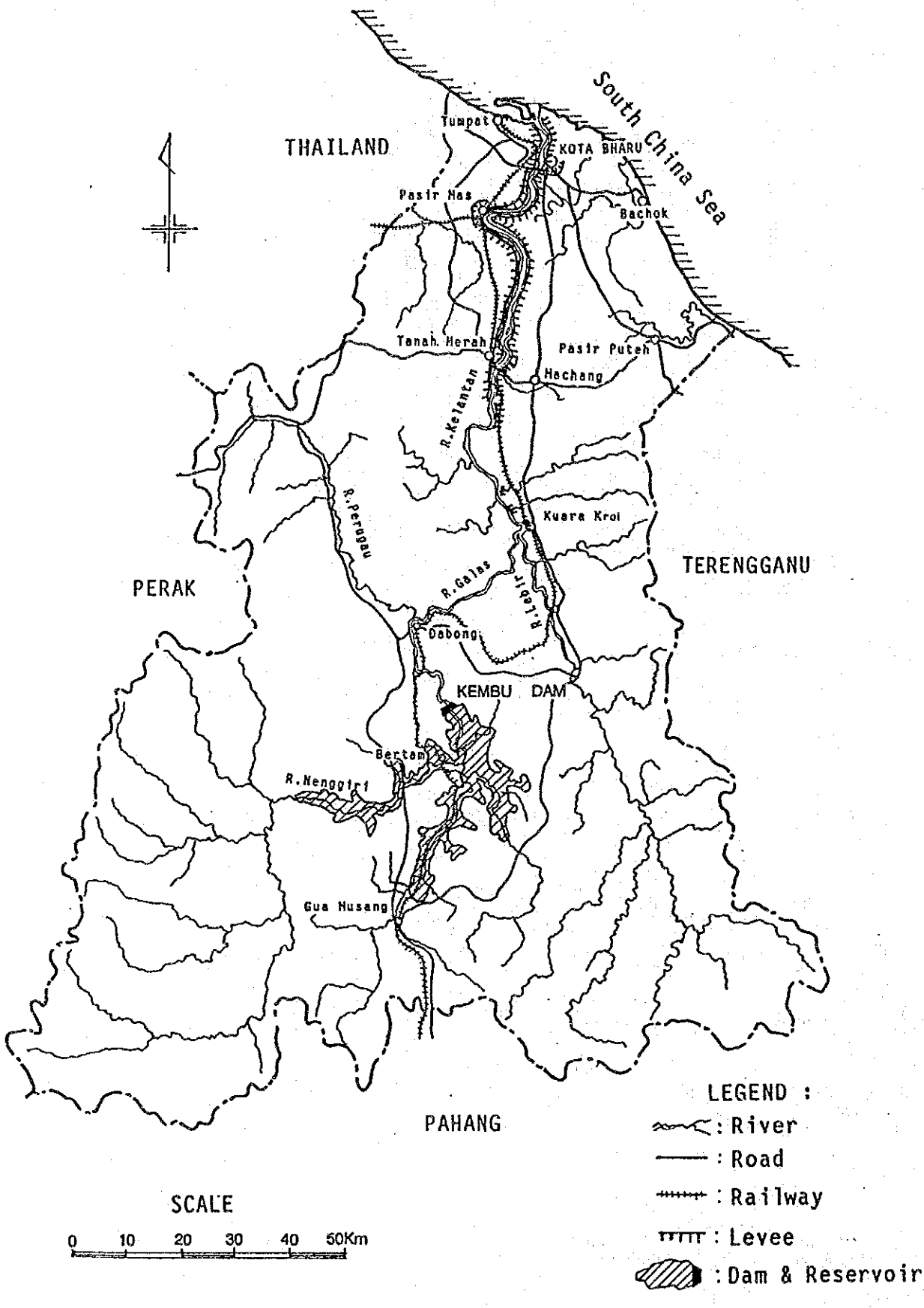

Fig.5.3

Kemubu Dam + River Improvement

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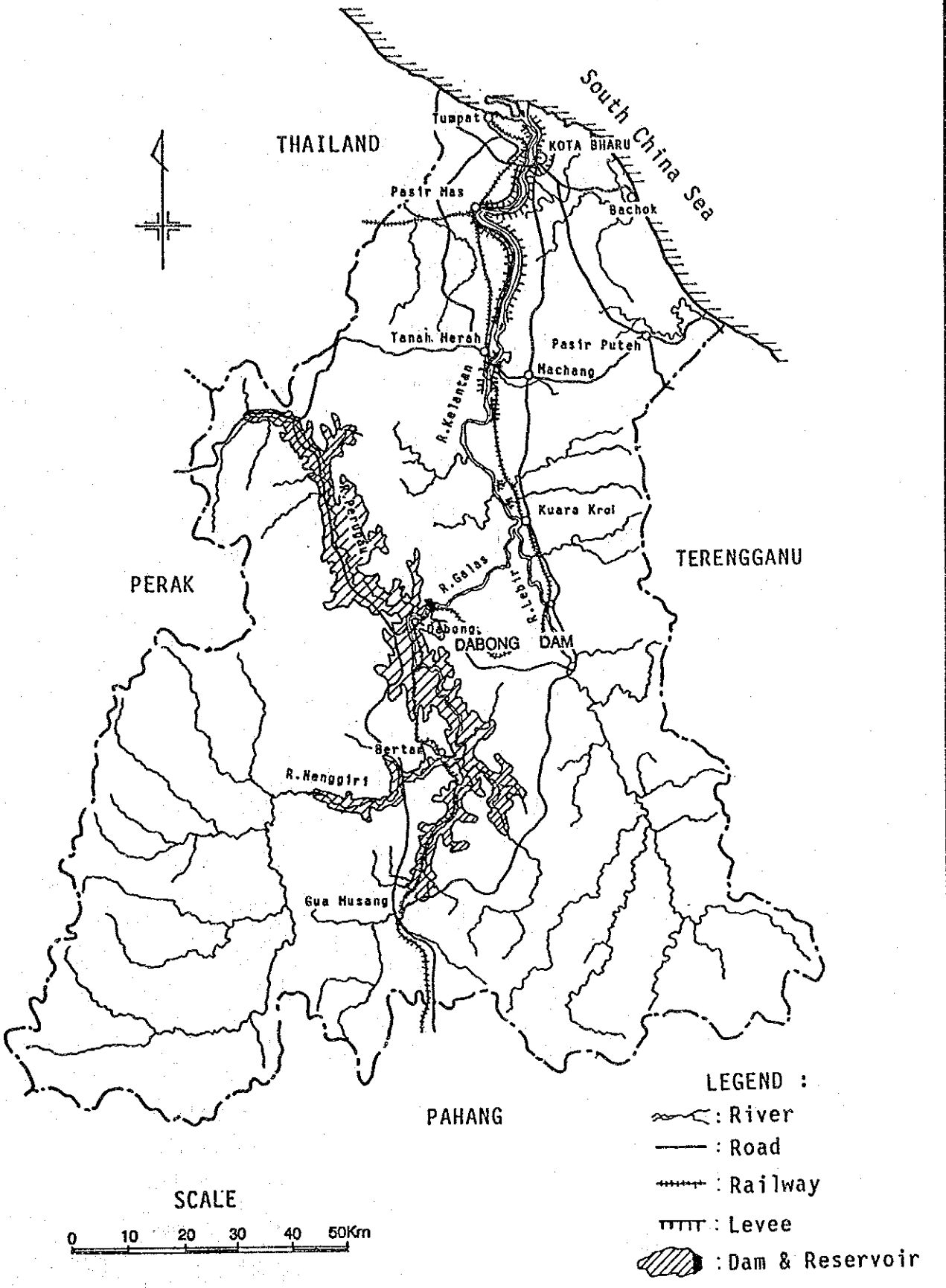

Fig.5.4

Dabong Dam + River Improvement

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JAPAN INTERNATIONAL COOPERATION AGENCY

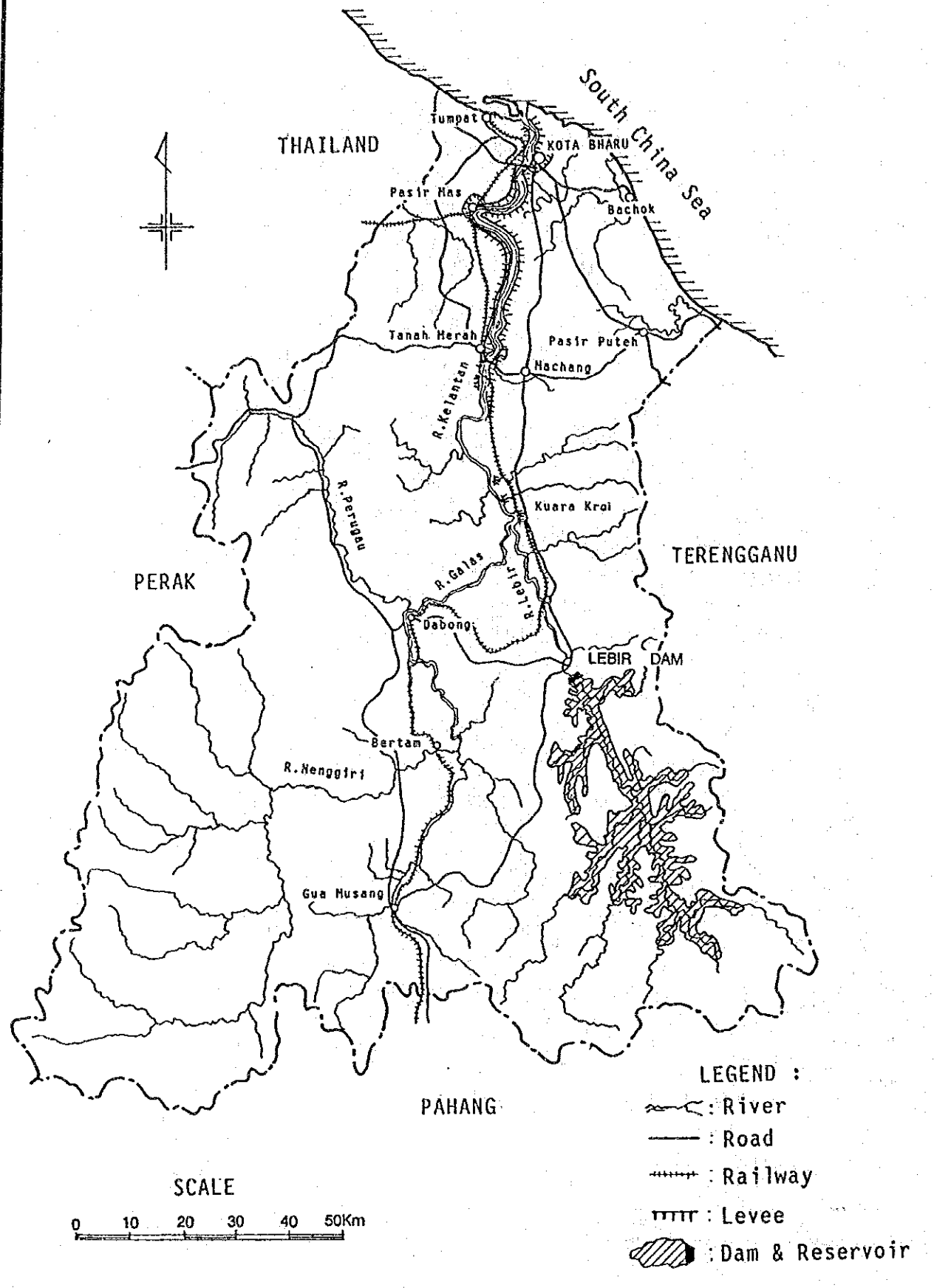

Fig.5.5

Lebir Dam + River Improvement

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ON
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JAPAN INTERNATIONAL COOPERATION AGENCY

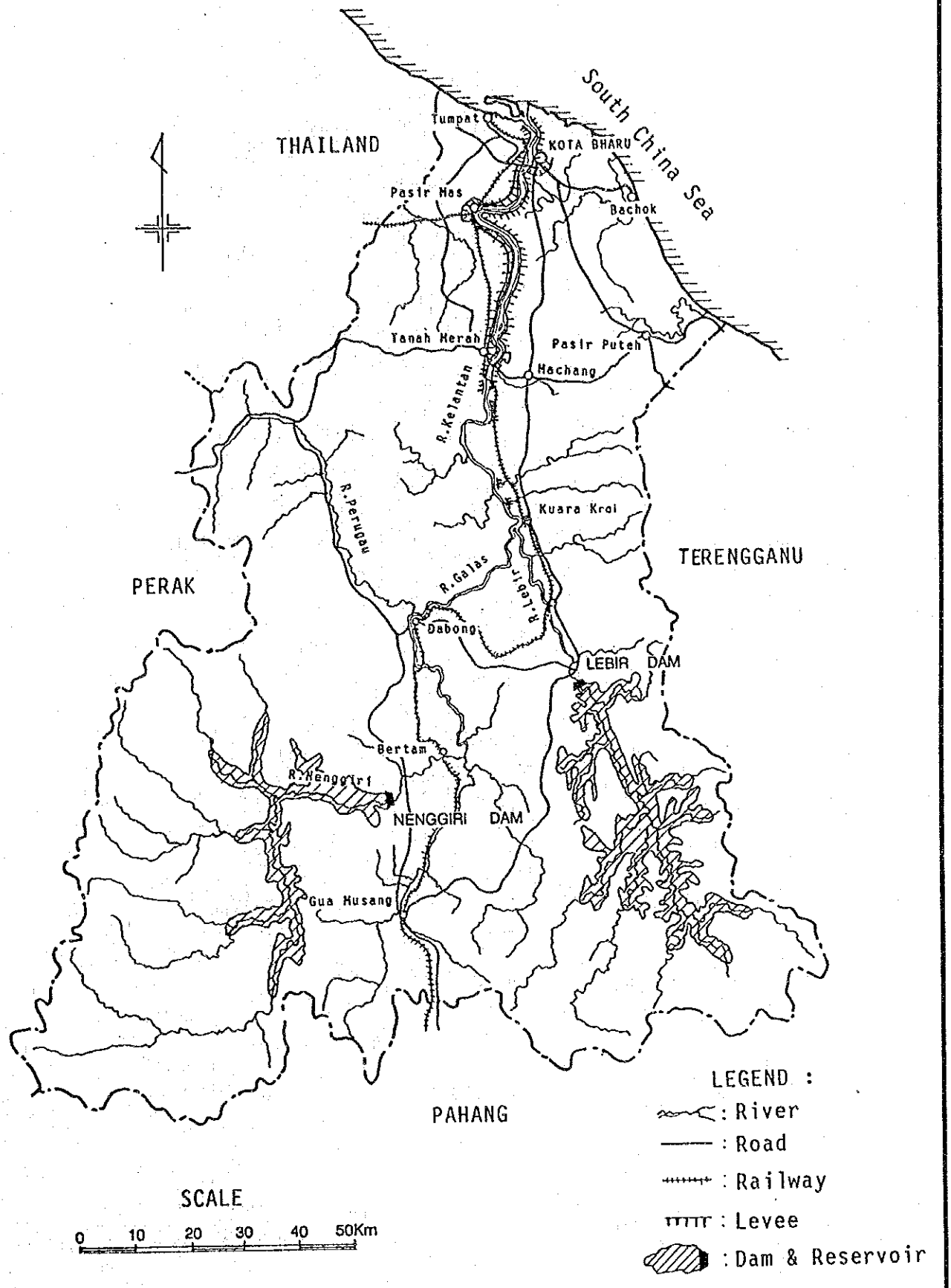

Fig.5.6

Lebir Dam + Nenggiri Dam + River Improvement

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JAPAN INTERNATIONAL COOPERATION AGENCY

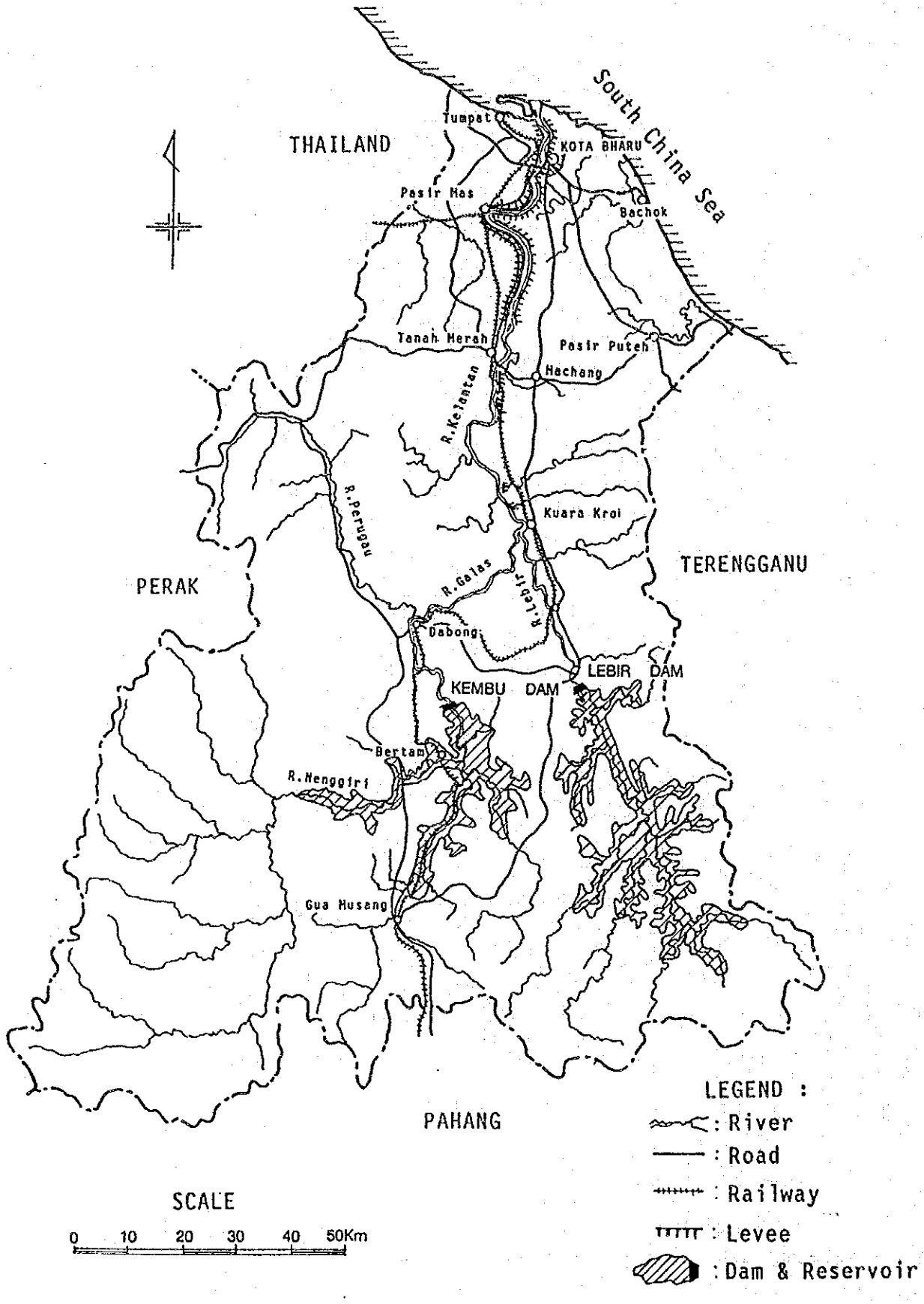

Fig.5.7

Lebir Dam + Kemubu Dam + River Improvement

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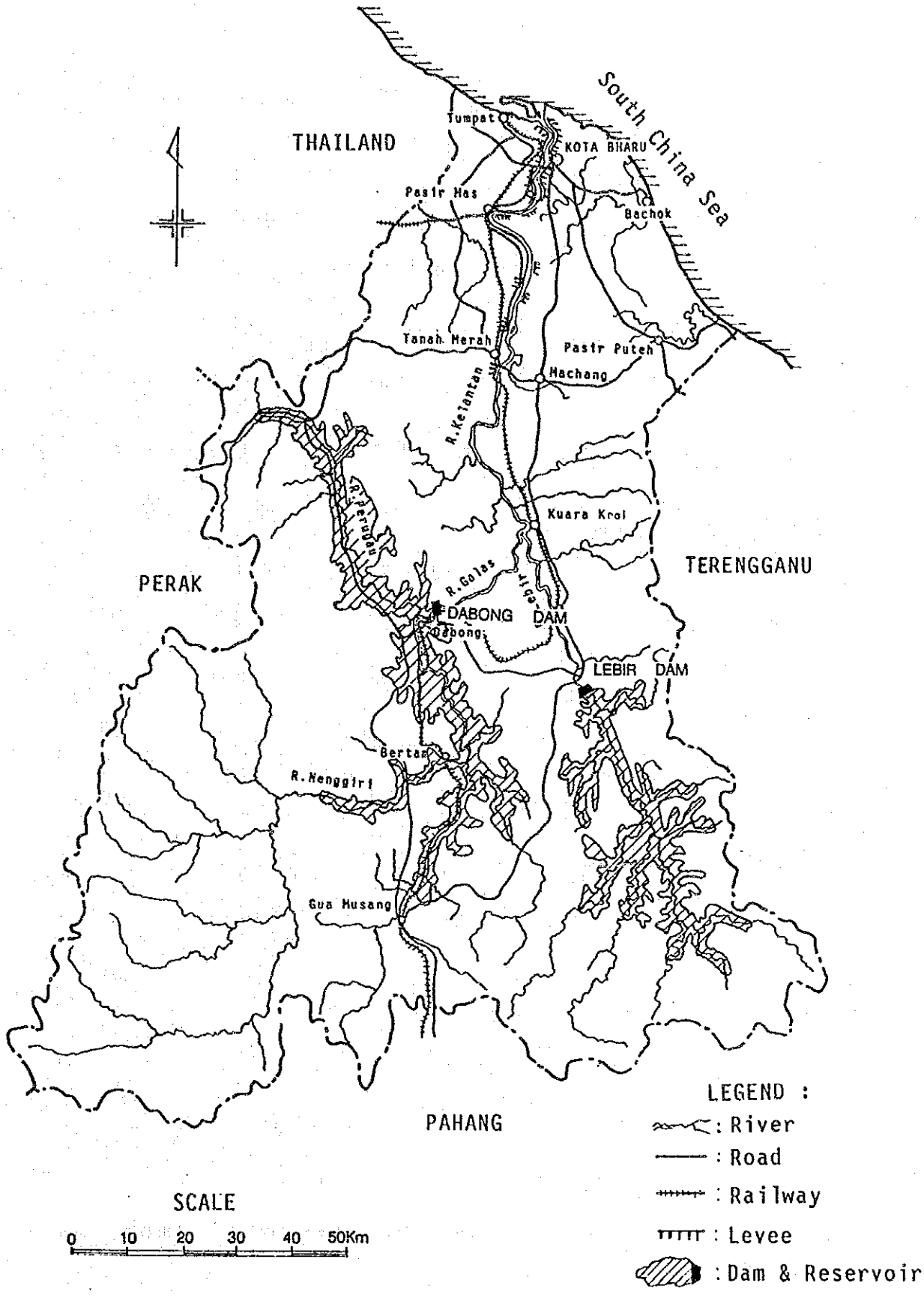

Fig.5.8

Lebir Dam + Dabong Dam + River Improvement

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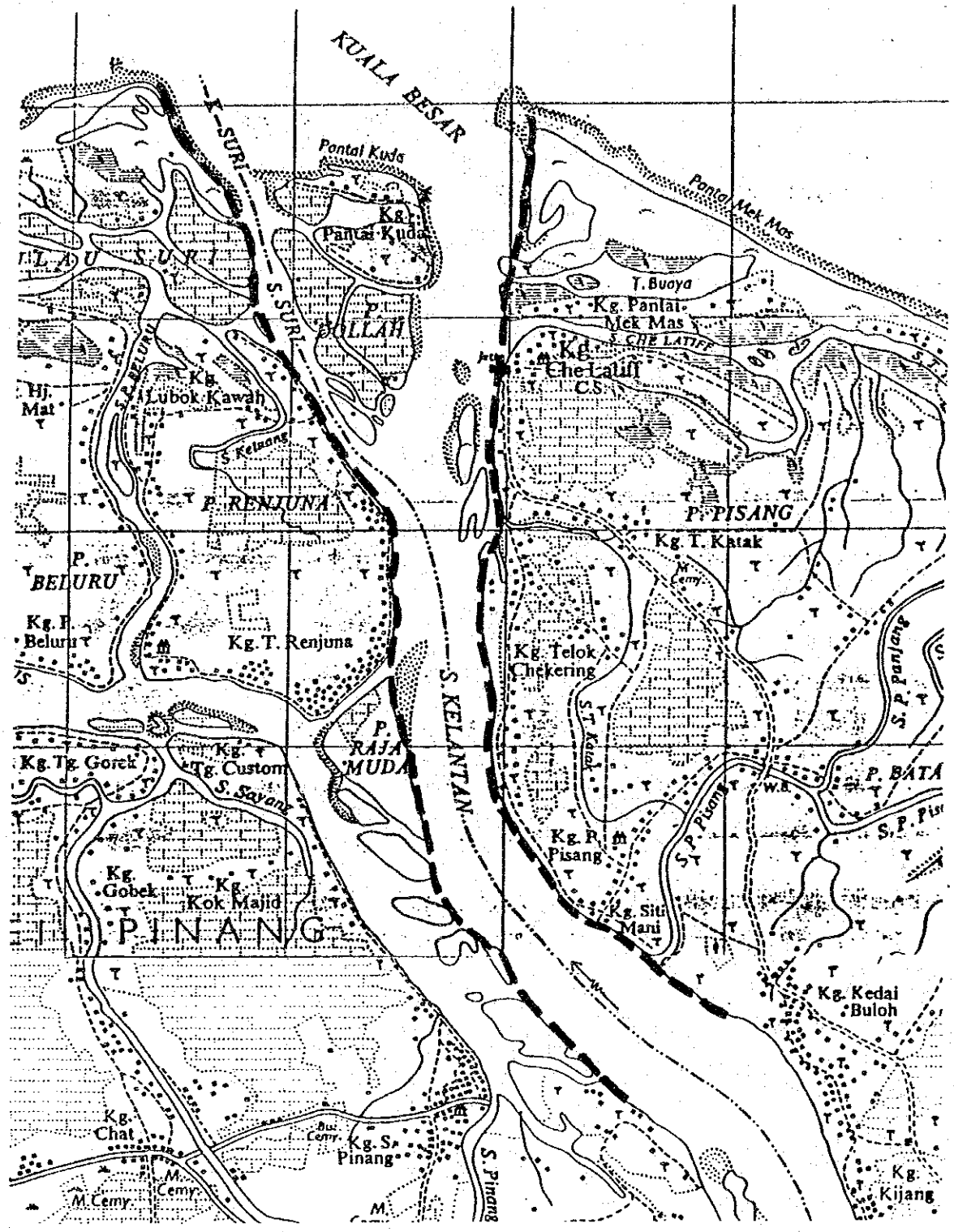

— — — — :BOUNDARY OF PREDOMINANT FLOW AT THE FLOOD TIME

Fig. 5.9

Predominant Flow Condition for the Flood Time

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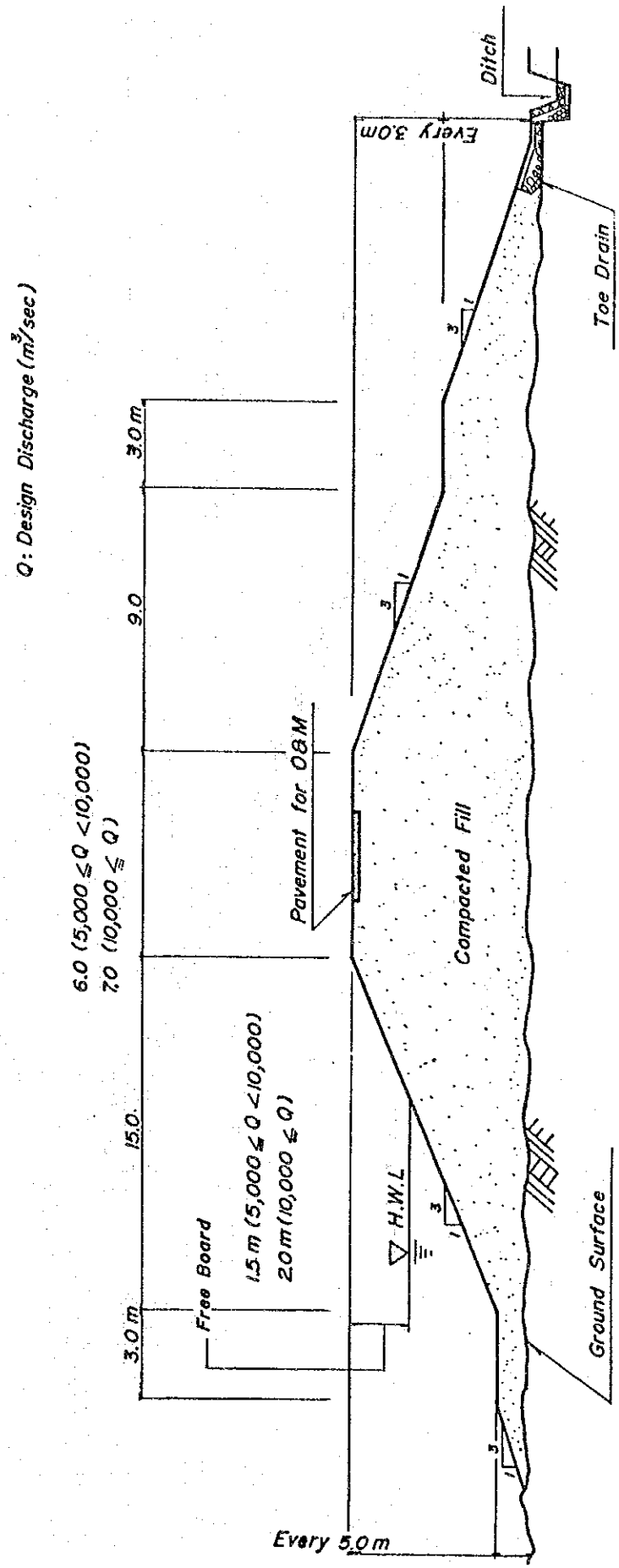

Fig.5.10

Typical Levee (Earth Embankment)

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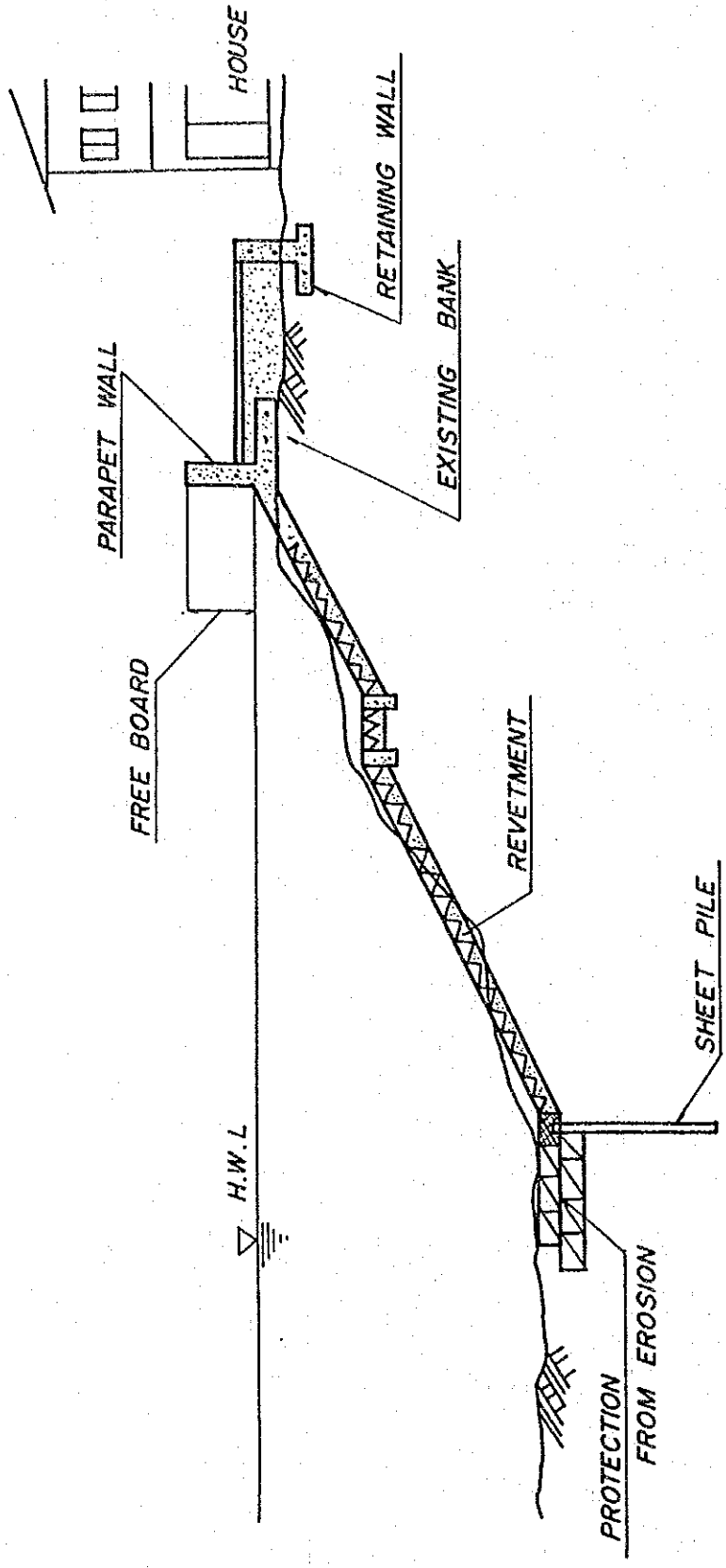

Fig. 5.11

Special Levee

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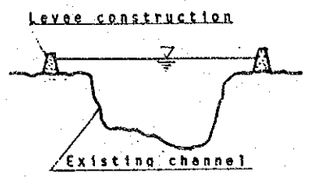
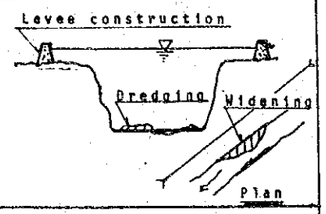
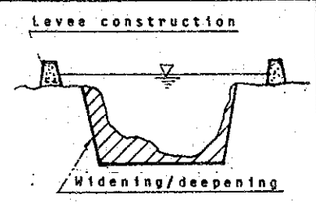
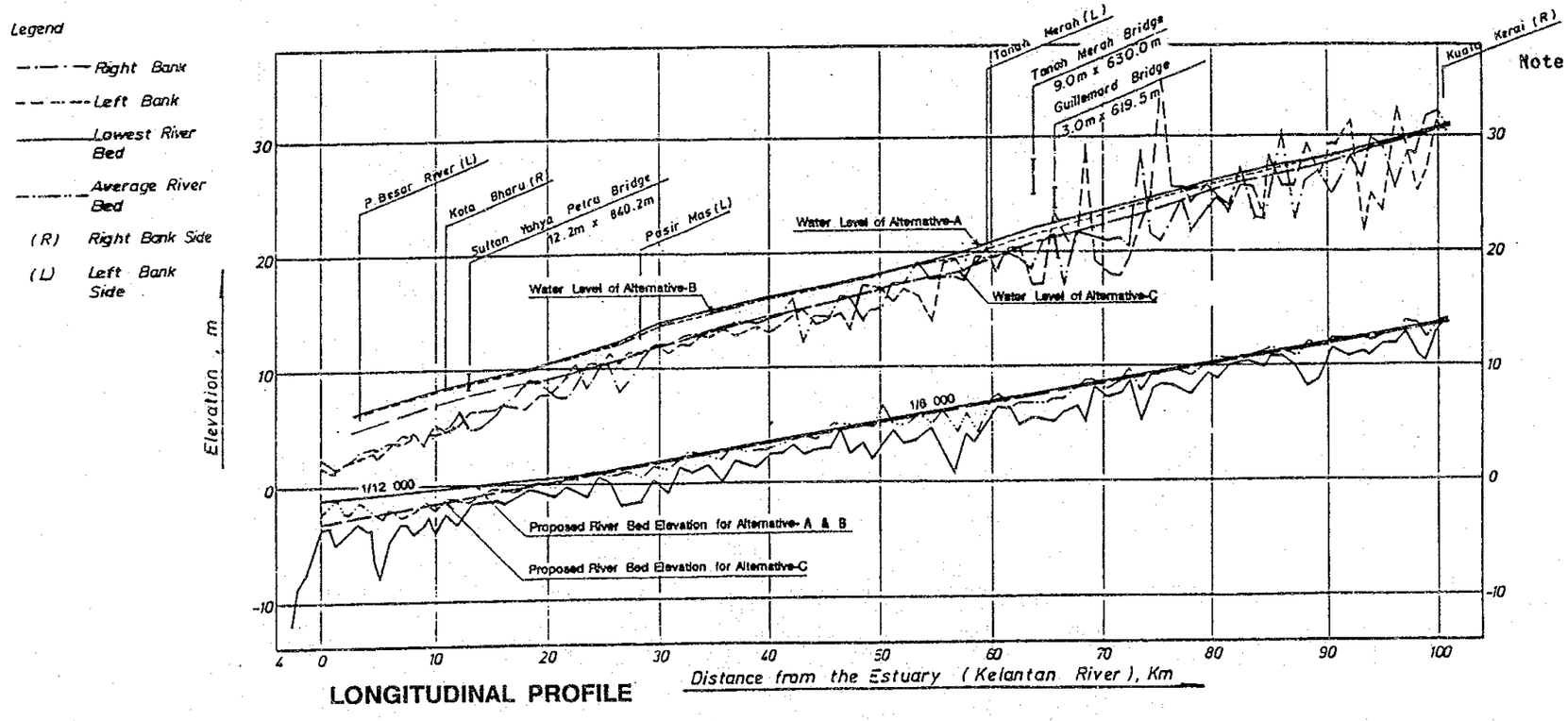
Alternative	Structural Measure	Explanation	Sketch of Measure	Water Level	Earthwork Volume & their Cost	Remarks
A	Levee construction only.	To confine the flood within the certain width.		. Water level in Alt-A is almost same as that of Alt-B, but is several ten centimetres lower at narrow places due to dredging. . Water level in Alt-C is several ten centimetres to 1.5 metres lower than that of Alt-A and B.	(1) Embankment volume for levee = 17 million m^3 (2) Cost = 138 million M$	
B	Levee construction + Widening of the existing channel at the remarkable narrow places + Dredging for arrangement of the channel cross-section.	To confine the flood within the certain width and to lower the flood water level by the excavation of narrow channel portions.			(1) Excavation volume = 2 million m^3 (2) Embankment volume for levee = 14 million m^3 (3) Cost = 118 million M$	(1) Low water level compared with Alternative-A (2) Lowest cost among three Alternatives
C	Levee construction + Widening and deepening of existing channel on a large scale (especially deepening of channel downstream of Kota Bharu).	To lower flood water level remarkably and to confine the flood within the certain width.			(1) Excavation volume = 58 million m^3 (2) Embankment volume for levee = 9 million m^3 (3) Cost = 400 million M$	(1) Lowest water level among three Alternatives (2) Highest cost among three Alternatives (3) Difficulty of maintenance of proposed cross-section of channel at river mouth (4) Problem of moving-upward of salty water



Note : Alternative-C was studied on the following conditions ;

- Proposed riverbed slope of 1/6,000 from rivermouth to Kuala Krai
- Channel widening of 600 m (rivermouth to 24 km), 500 m (24 km to 55 km) and 300 m (55km to 72 km).

Fig.5.12

River Improvement Plans, A to C

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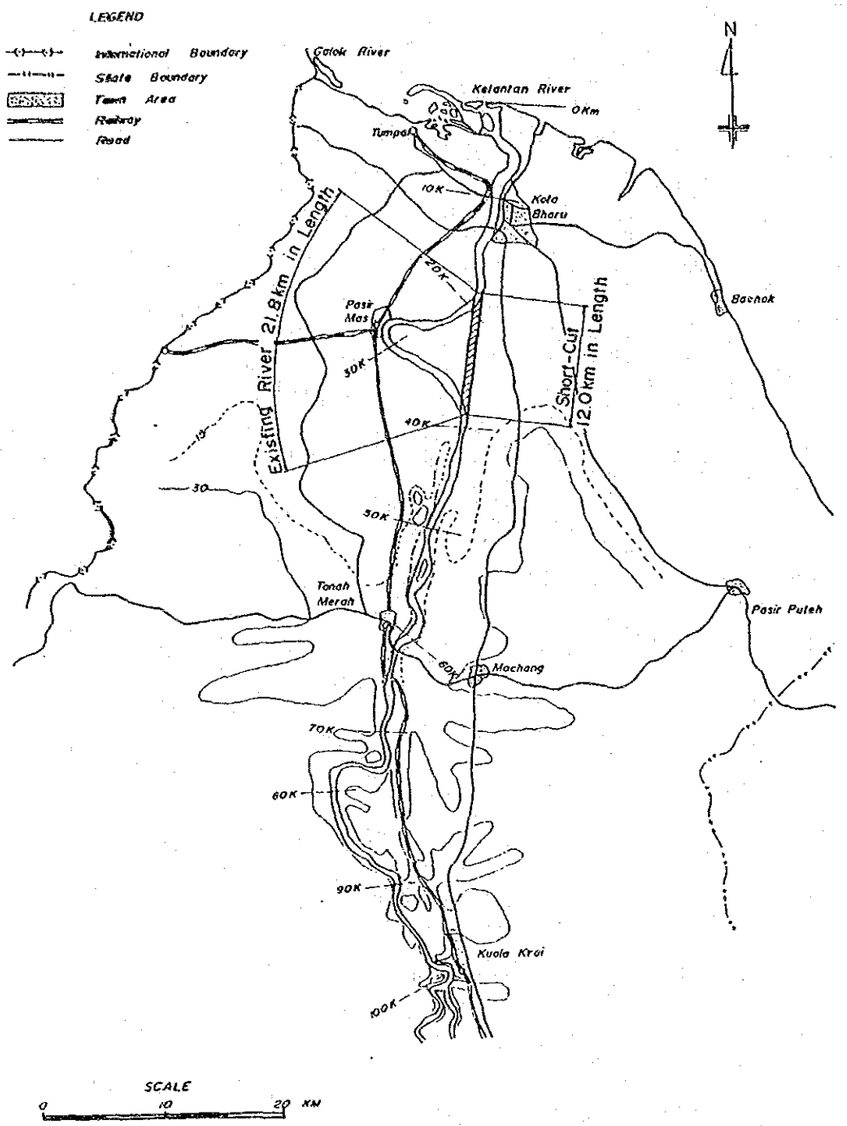
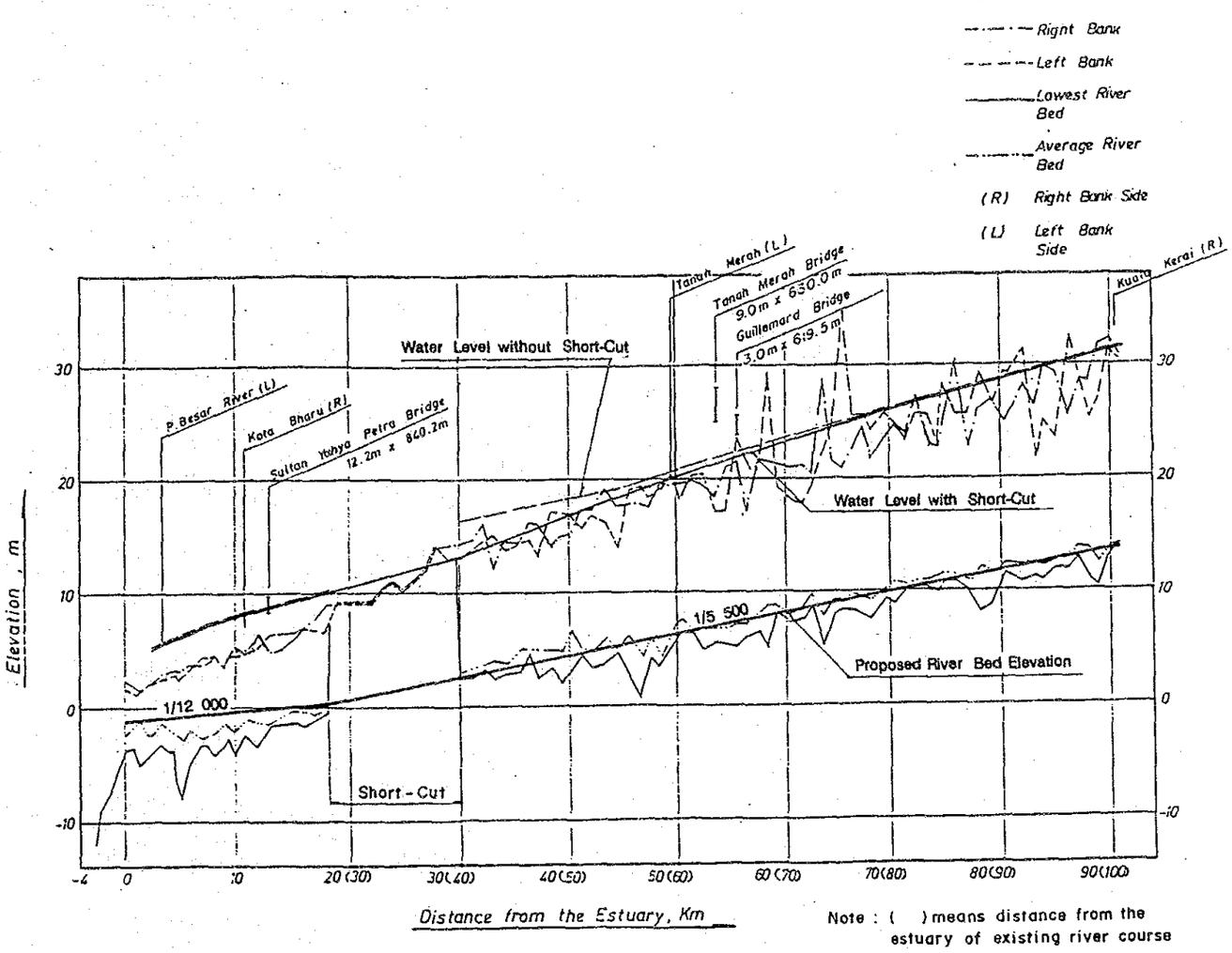


LOCATION OF SHORT-CUT



LONGITUDINAL PROFILE

Fig. 5.13

River Improvement Plan D
(short-cut)

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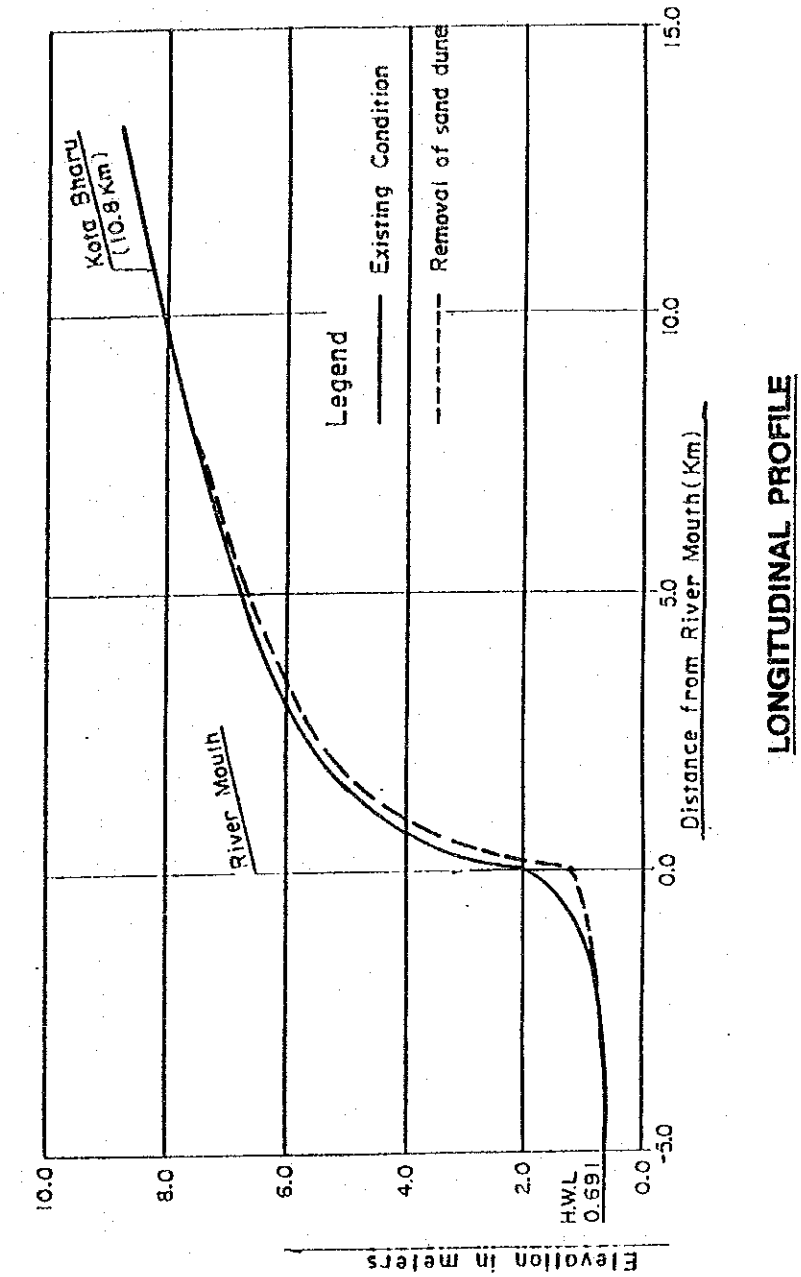
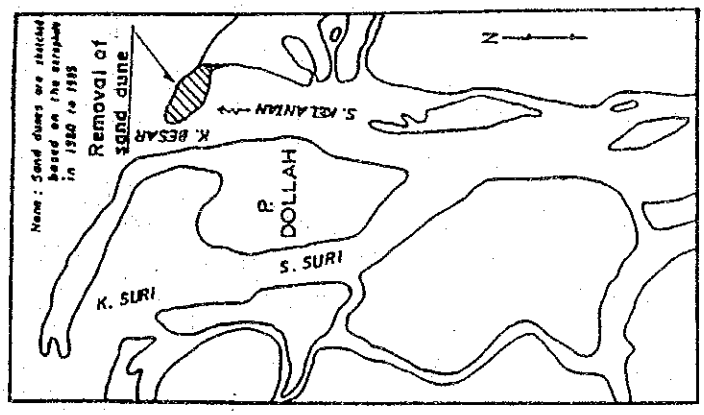


LONGITUDINAL PROFILE



PLAN

Fig. 5.14

Longitudinal Profile of Water Level for the Treatment of River Mouth

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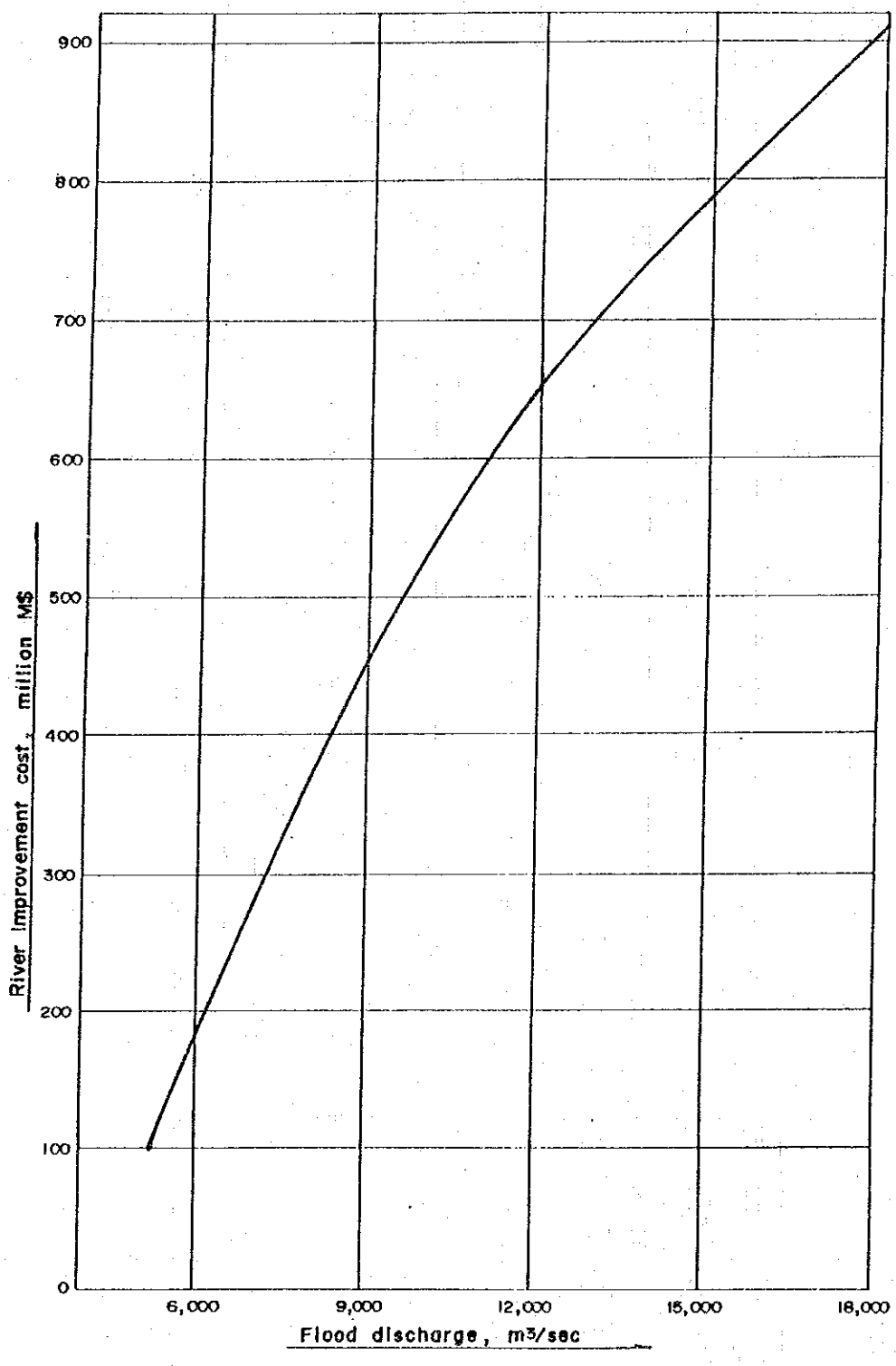

Fig.5.15

Relationship between Discharge and River Improvement Cost

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Implementation Programme of Combination Plans

Combination plans	Malaysia plan				
	5th	6th	7th	8th	9th
	'89 '90	'91 '95	'96 2000	'01 '05	'06 '10
1. R/I	F/S F/T D/D		Const.		
2. Nenggiri + R/I					
2.1 Nenggiri dam	F/T D/D	Const.			
2.2 R/I	F/S F/T D/D		Const.		
3. Kemubu + R/I					
3.1 Kemubu dam	F/S F/T D/D	Const.			
3.2 R/I	F/S F/T D/D		Const.		
4. Dabong + R/I					
4.1 Dabong dam	F/S F/T D/D		Const.		
4.2 R/I	F/S F/T D/D		Const.		
5. Lebir + R/I					
5.1 Lebir dam	F/T D/D	Const.			
5.2 R/I	R/S F/T D/D		Const.		
6. Lebir + Nenggiri + R/I					
6.1 Lebir dam	F/T D/D	Const.			
6.2 Nenggiri dam			F/T D/D	Const.	
6.3 R/I	F/S F/T D/D		Const.		
7. Lebir + Kumubu + R/I					
7.1 Lebir dam	F/T D/D	Const.			
7.2 Kumubu dam	F/S		F/T D/D	Const.	
7.3 R/I	F/S F/T D/D		Const.		
8. Lebir + Dabong + R/I					
8.1 Lebir	F/T D/D	Const.			
8.2 Dabong	F/S		F/T D/D	Const.	
8.3 R/I	F/S F/T D/D		Const.		

Notes : F/S; feasibility study, F/T; financing and tendering, D/D ; detailed design, Const.; construction

Fig.5.16

Implementation Programme of Combination Plans

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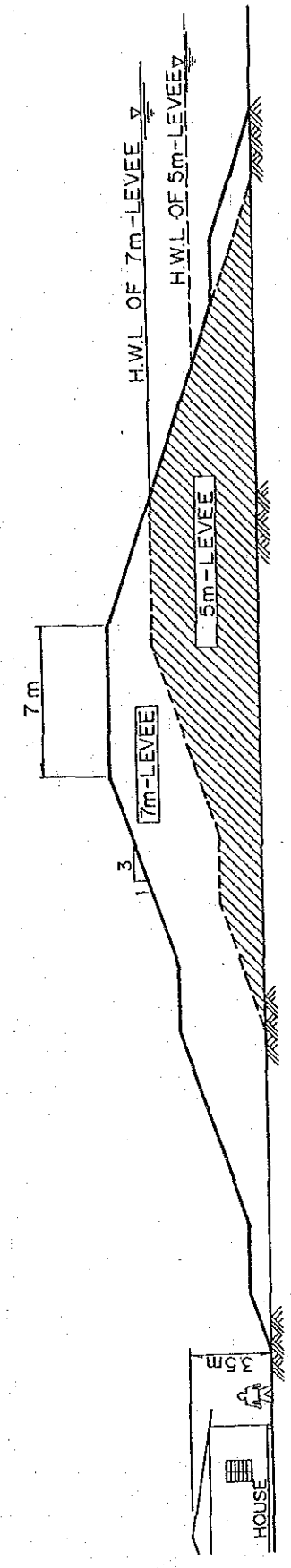

Fig. 6.1
Comparison between 5m and 7m High Levee

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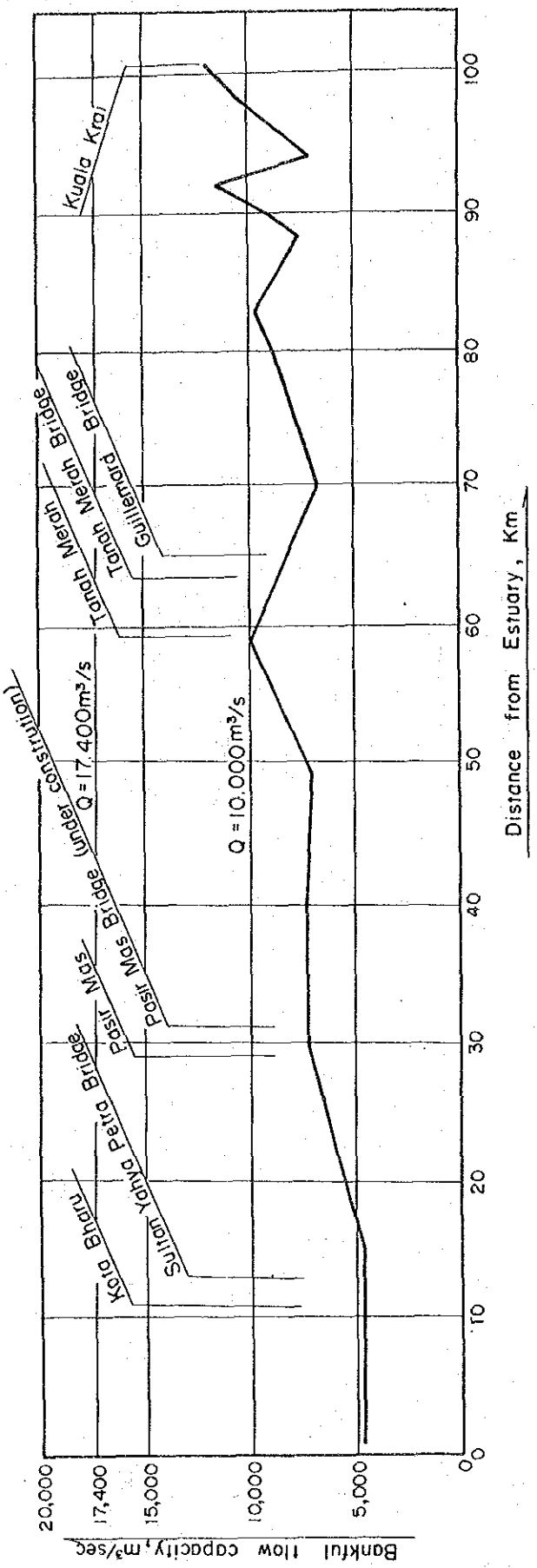

Fig. 6.2
Flow Capacity of the Kelantan River

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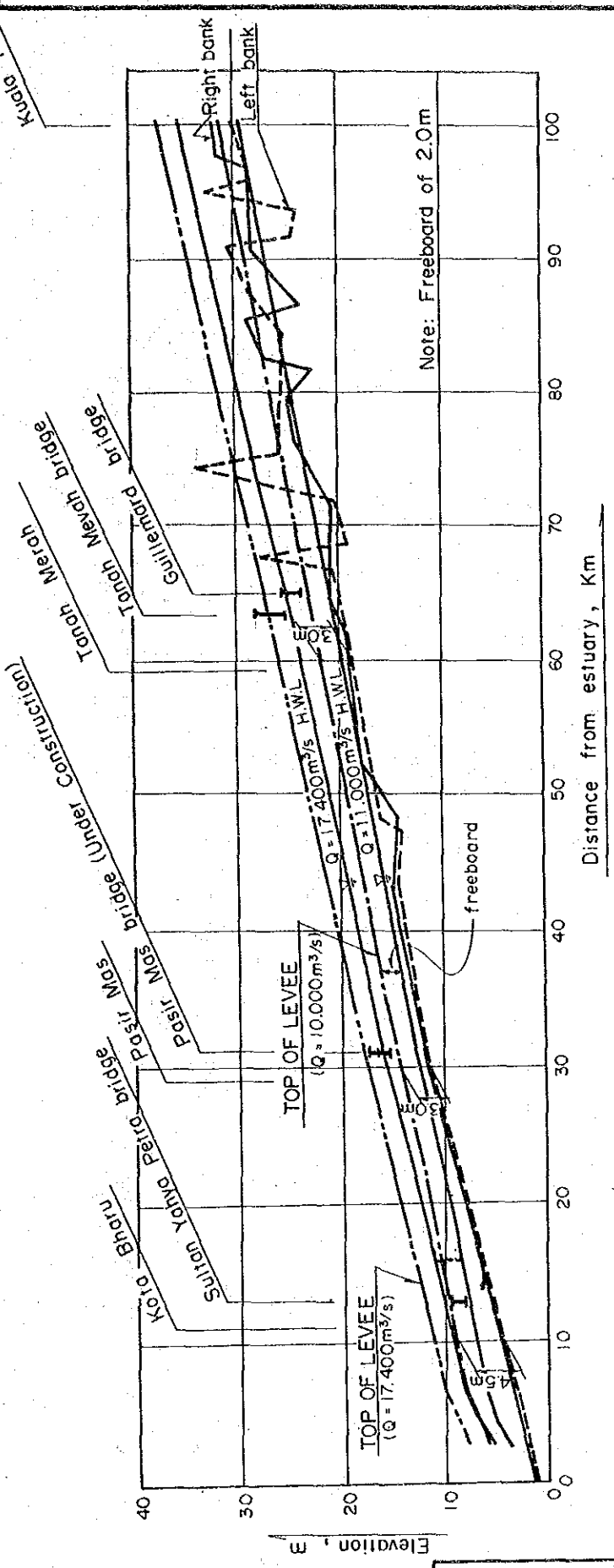

Fig. 6.3
Relationship between High water Level and Levee Height

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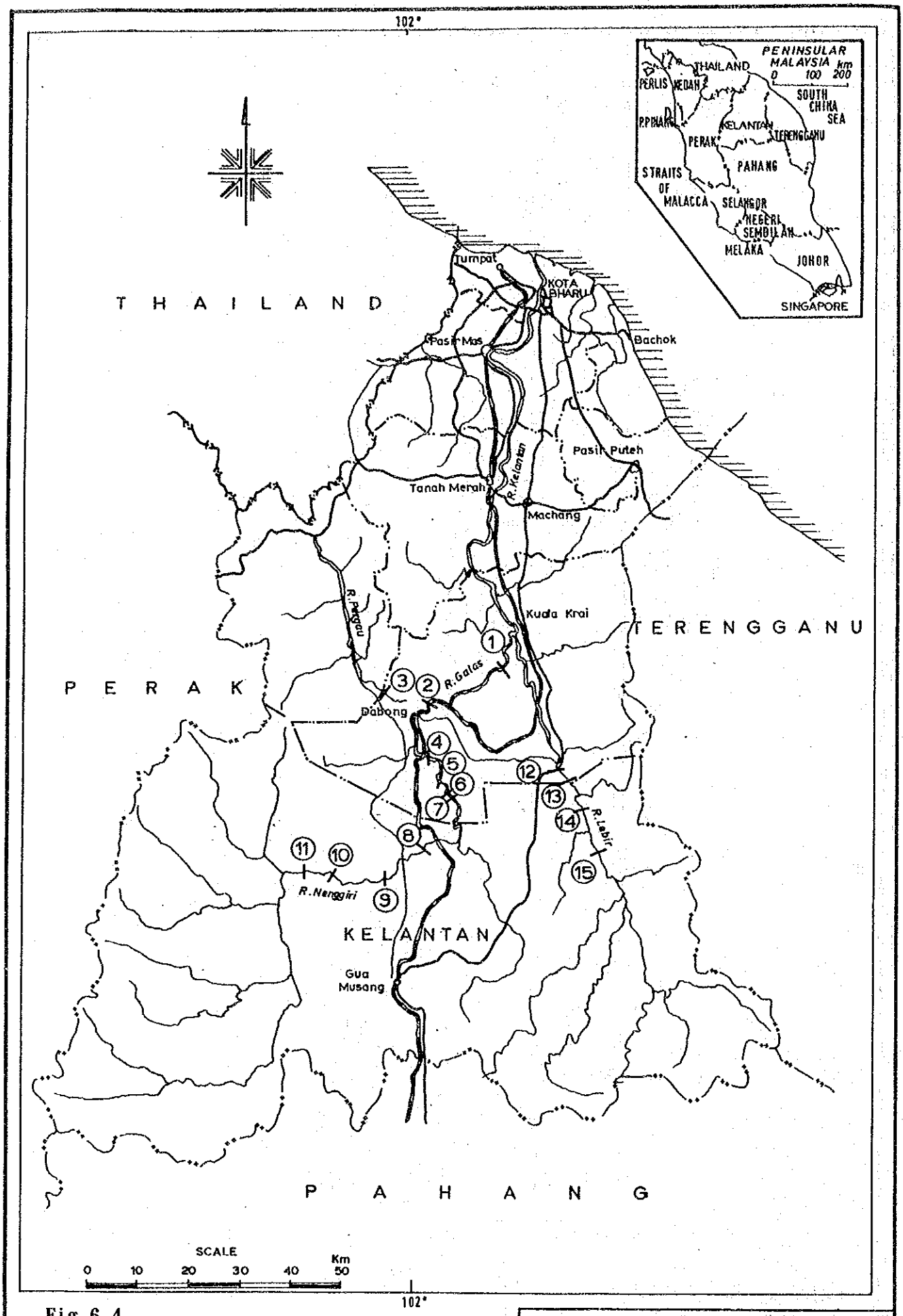

Fig. 6.4
Potential Damsites in the Kelantan River Basin

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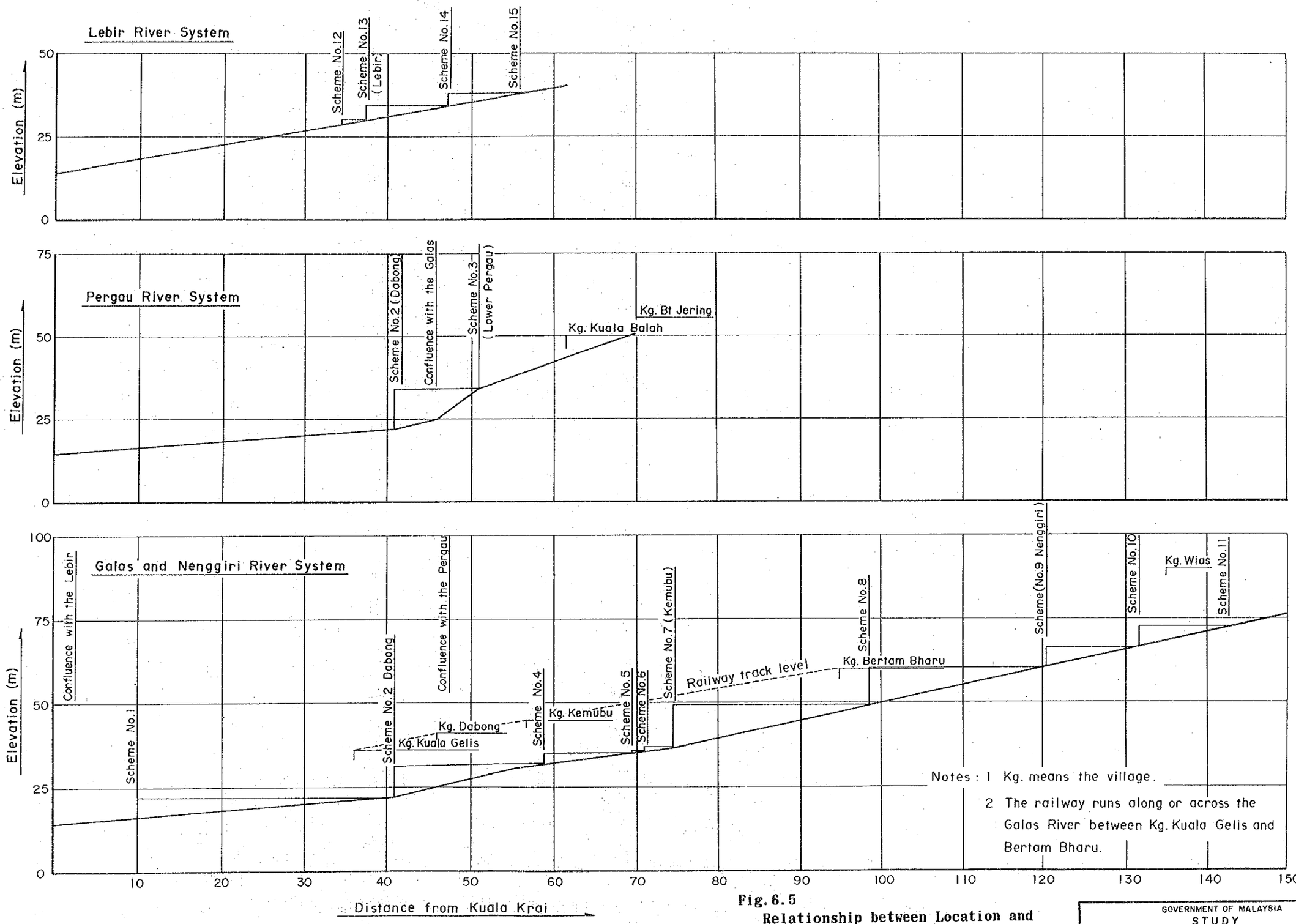

Fig. 6.5
Relationship between Location and Elevation for the Schemes Identified in the Kelantan River System

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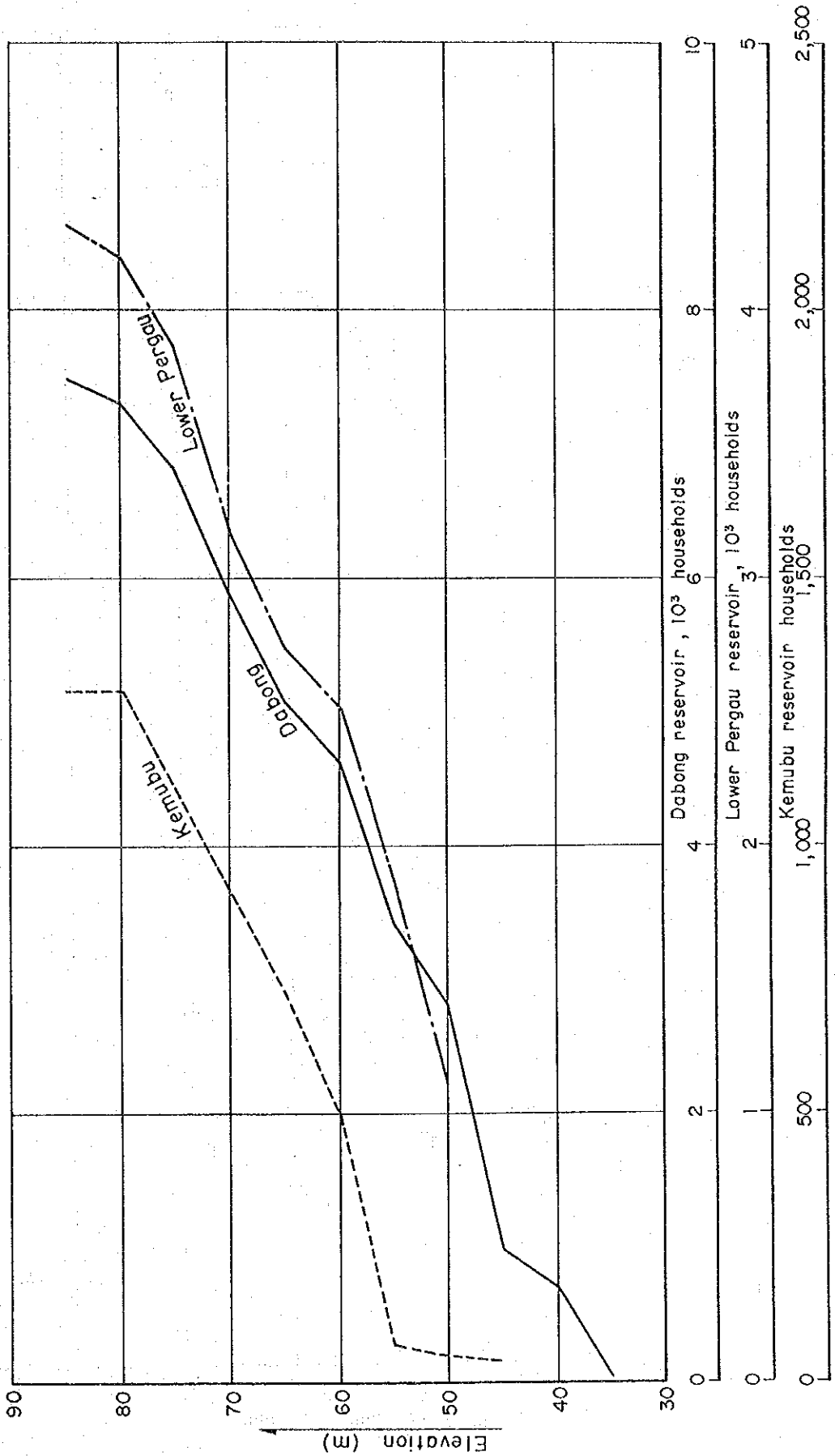

Fig. 6.6
Relationship between Elevation and Households to be Submerged for Dabong, Lower Pergau and Kemubu Reserviors

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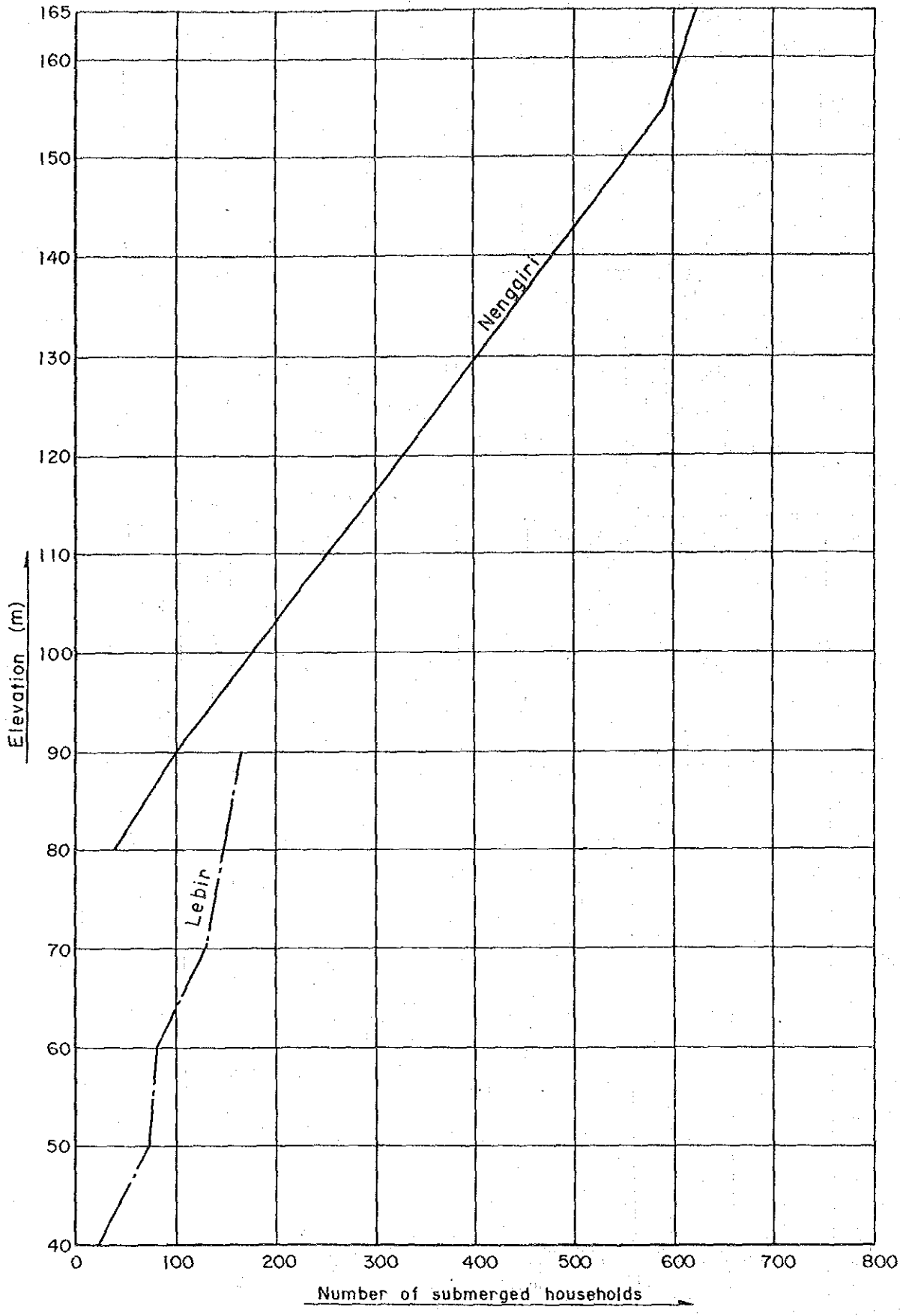

Fig. 6.7
Relationship between Elevation and Households to be Submerged for Nenggiri and Lebir Reservoirs

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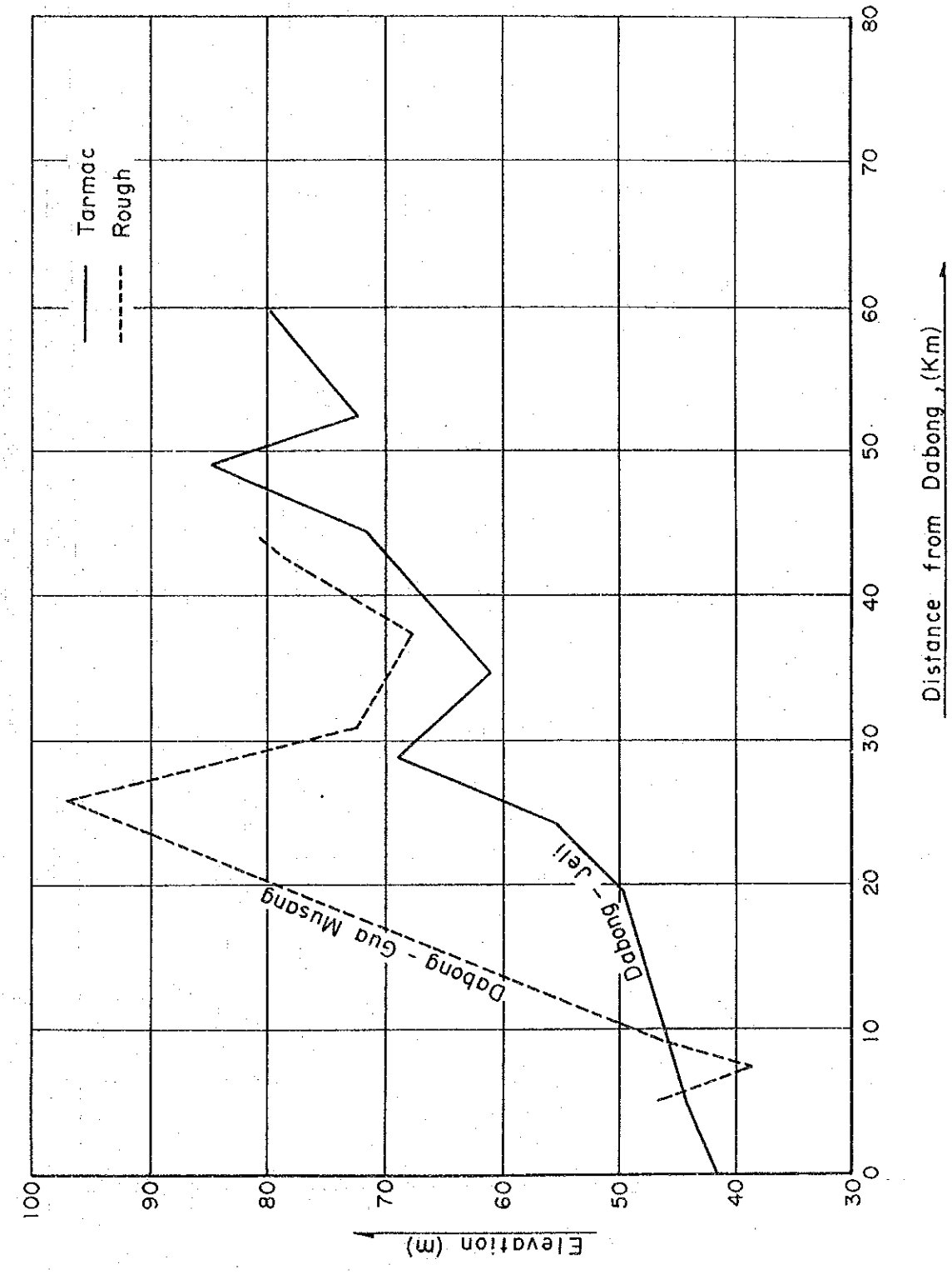

Fig. 6.8
Relationship between Distance and Elevation for Public Roads

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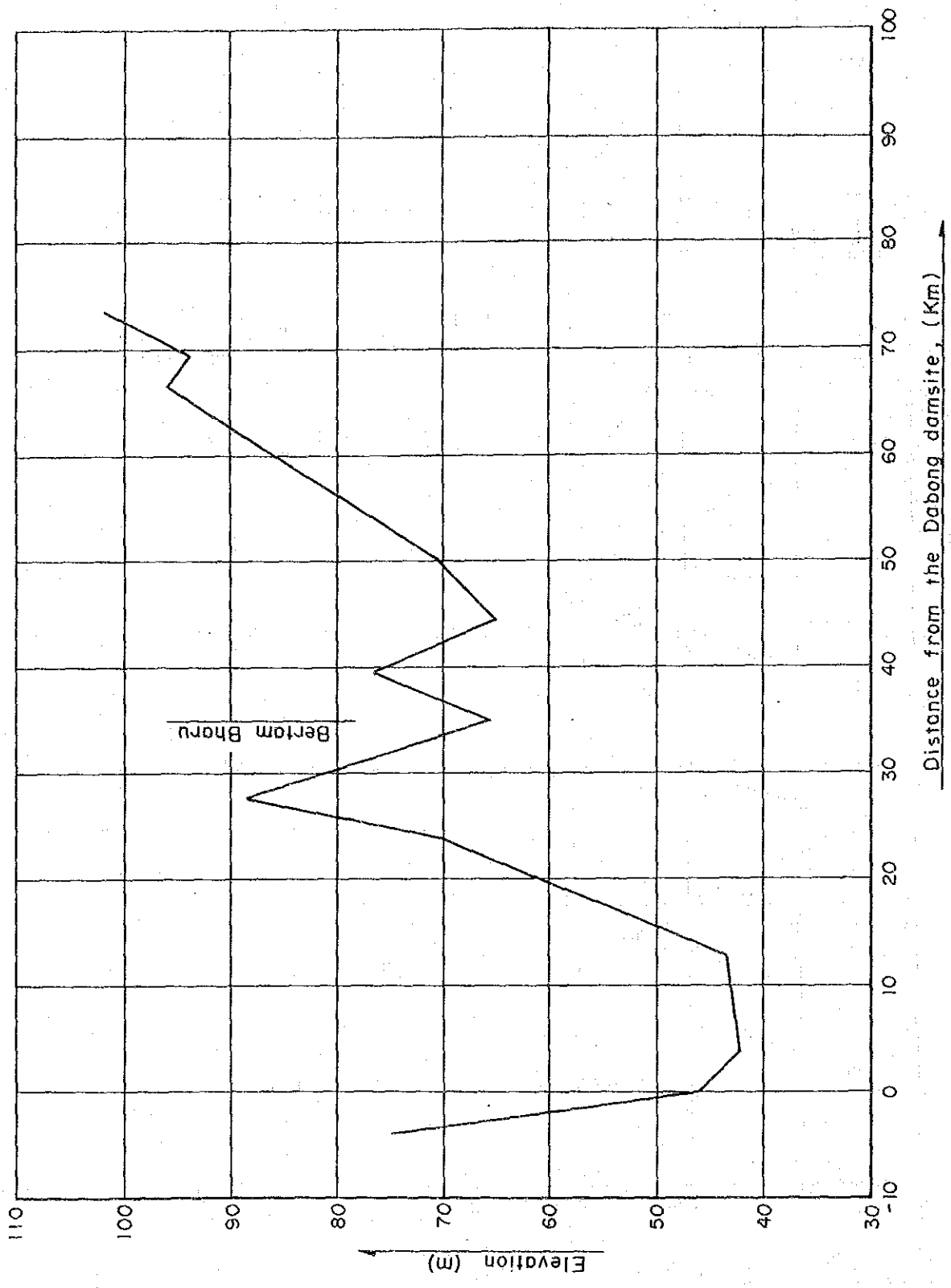

Fig. 6.9
Relationship between Distance and Elevation for Railway

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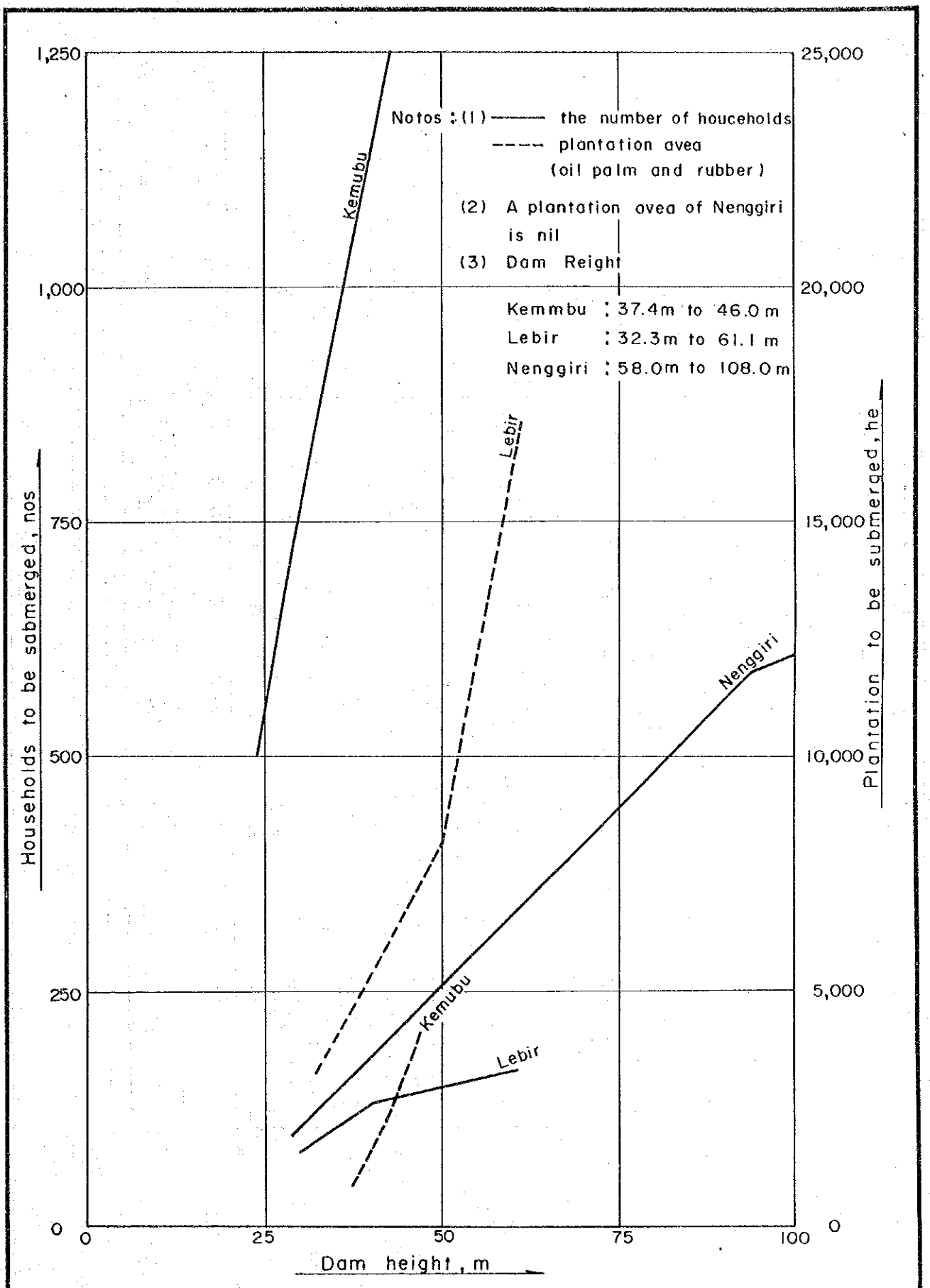

Fig. 6.10
Comparison of Social Impact among the Kemubu, Nenggiri and Lebir Dam schemes

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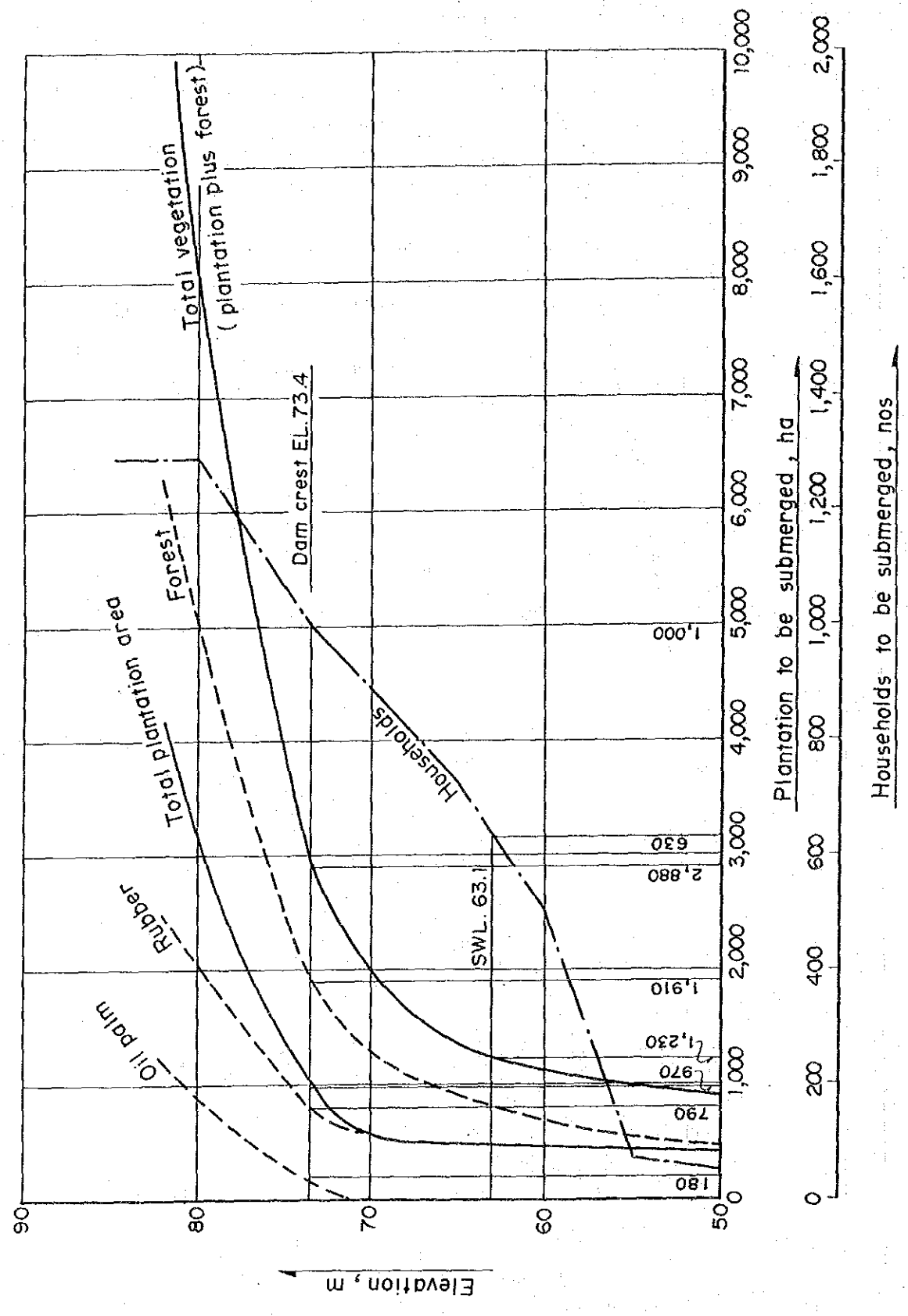

Fig. 6.11
Rel+ationshinp between Elevation and Social Impactd

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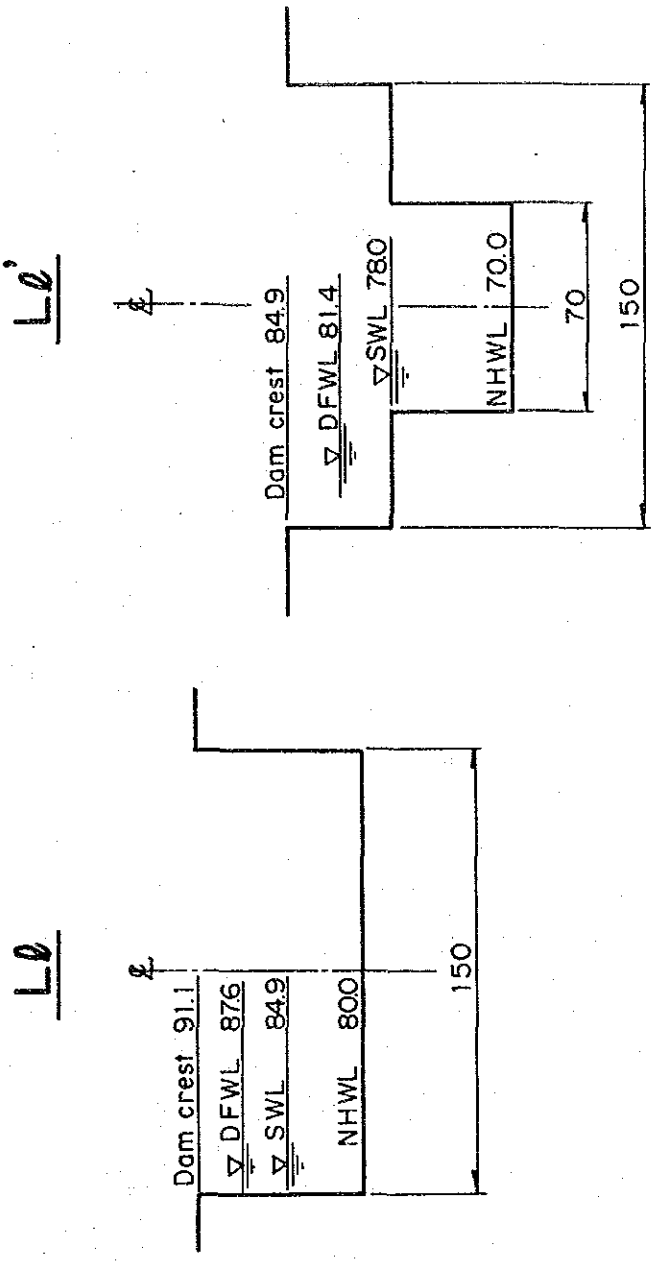

Fig.6.12
Dimensional Comparison of Spillway between Lℓ and Lℓ'

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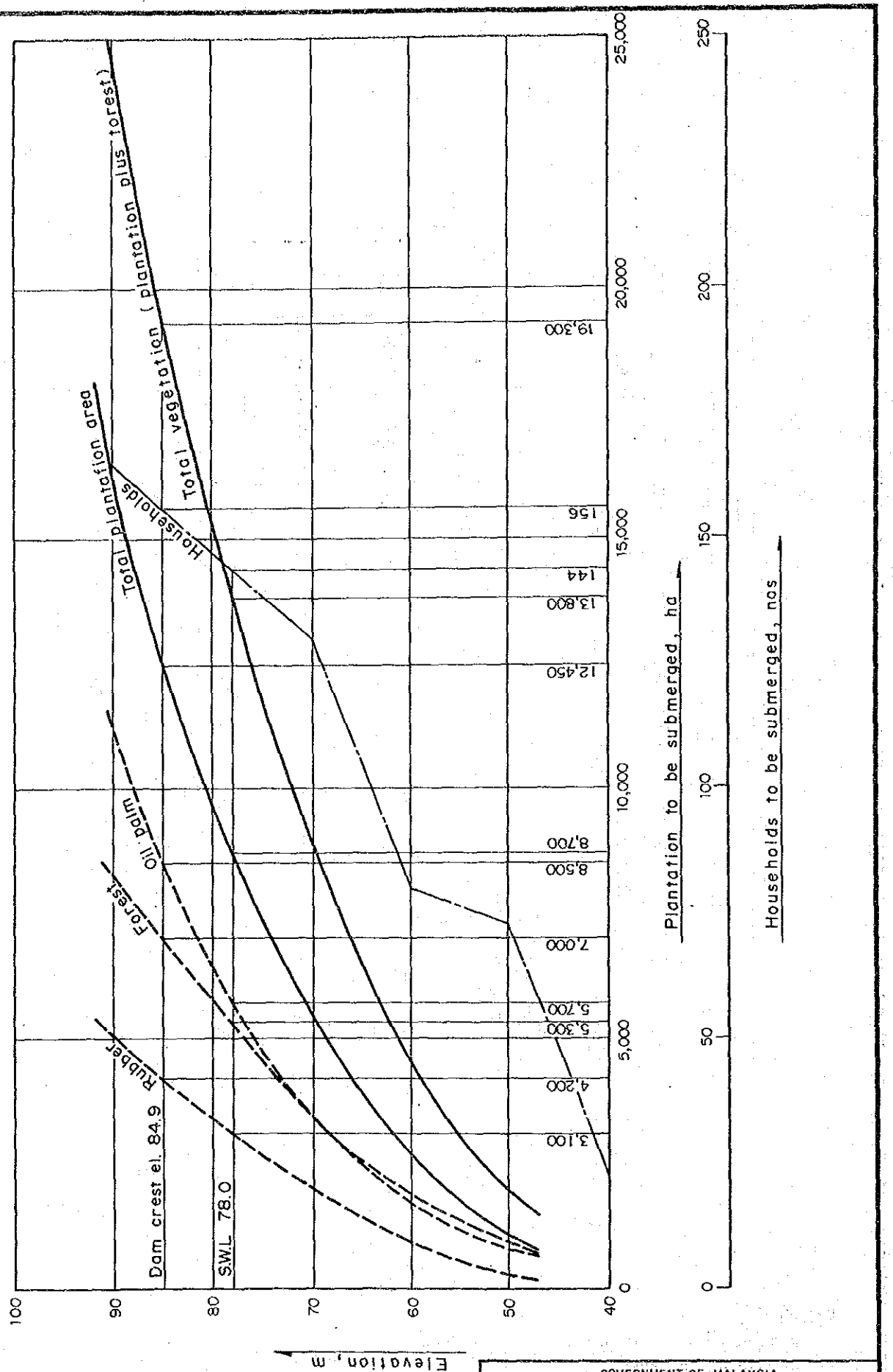

Fig. 6.13
Relationship between Elevation and Social Impact (Lebir)

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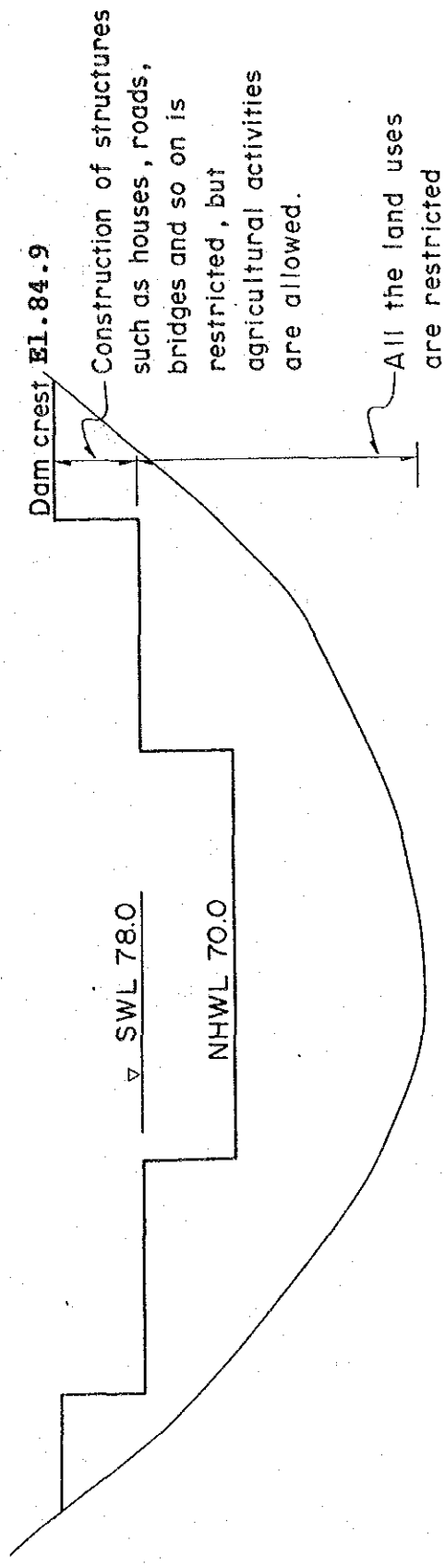

Fig. 6.14
Concept of Land Compensation

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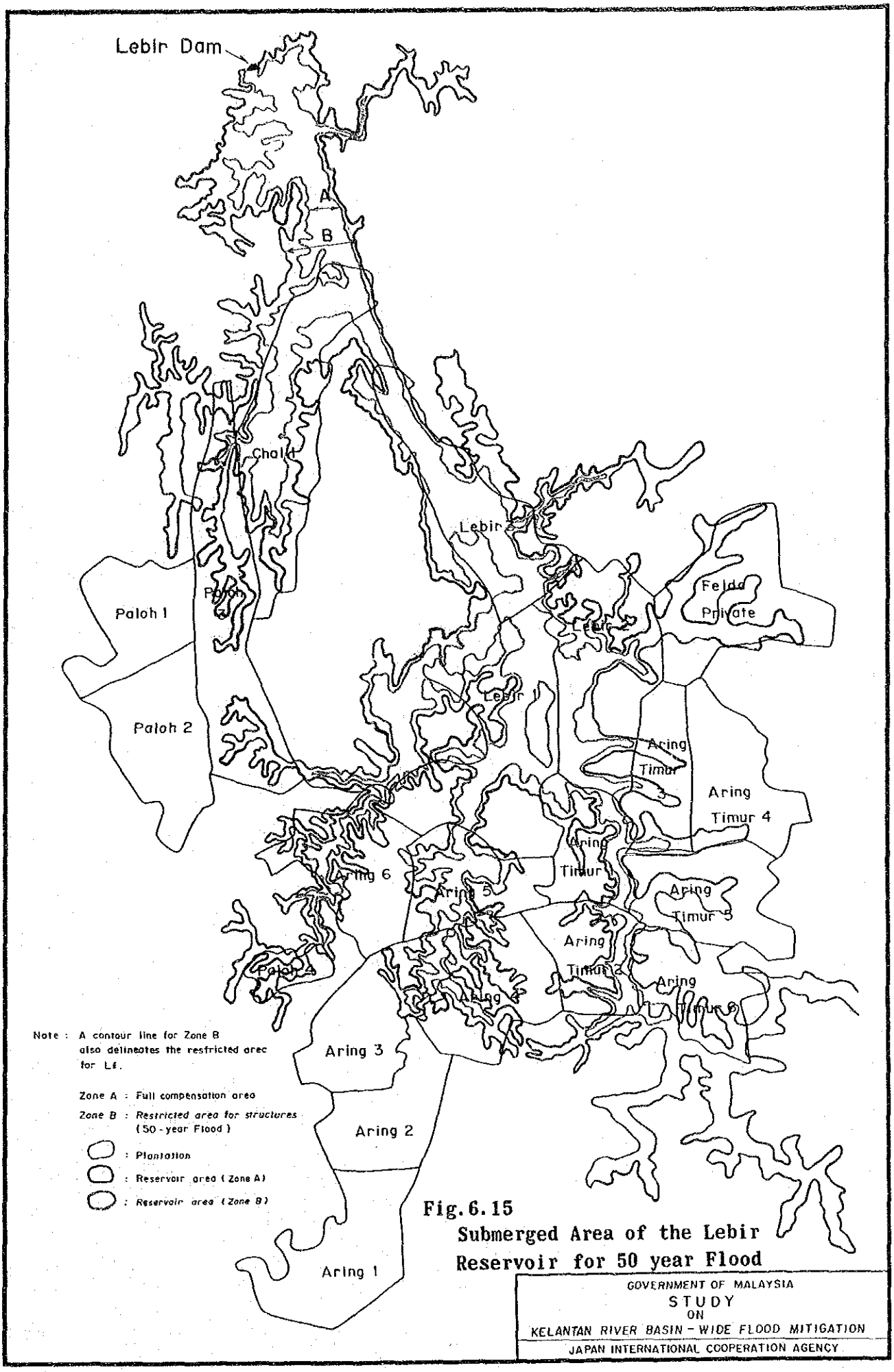

Fig. 6.15
Submerged Area of the Lebir Reservoir for 50 year Flood

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