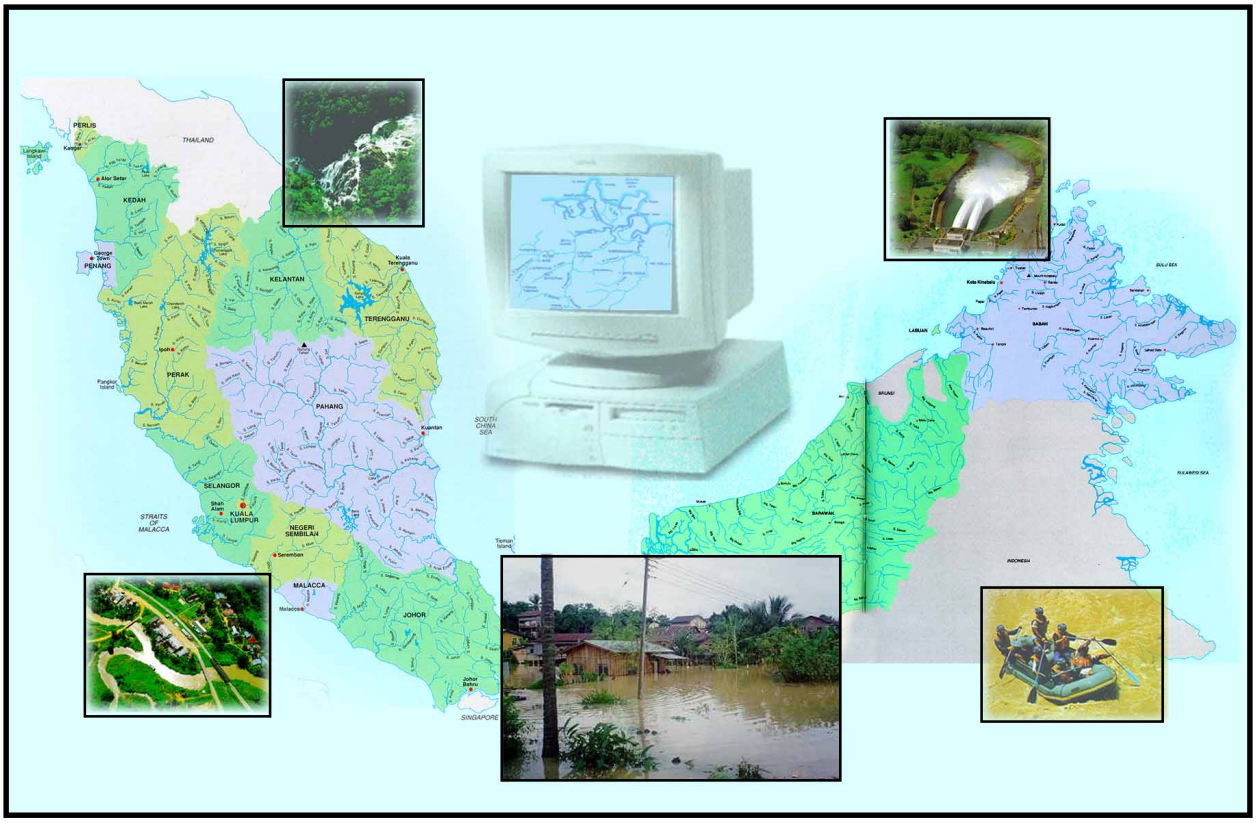
JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

NATIONAL REGISTER OF RIVER BASINS



FINAL REPORT

Volume 2

Updating of Condition of Flooding in Malaysia

MAIN REPORT

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Vol. 1 : Register of River Basins

Vol. 2 : Updating of Condition of Flooding in Malaysia - Main Report

Vol. 2.1 : State Report for Perlis, Kedah & Pulau Pinang

Vol. 2.2 : State Report for Perak

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Vol. 2.4 : State Report for Negeri Sembilan & Melaka

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NATIONAL REGISTER OF RIVER BASINS

VOLUME 2: UPDATING OF CONDITION OF FLOODING IN MALAYSIA - MAIN REPORT

Final Report

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

1.1 STUDY BACKGROUND

The Japan International Co-operation Agency (JICA), on the request of the Malaysian Government, completed a National Water Resources Study (NWRS) for Malaysia in 1982. As part of the Study, a compilation and an assessment of the conditions of flooding up to 1979 for Peninsular Malaysia, and up to 1981 for Sabah and Sarawak, were carried out. The Study has provided the following information on floods in the affected river basins in the country.

- Area of flooding
- Estimated annual average damage due to floods
- Number of people affected by the floods

Since the completion of the study in 1982, the Government has implemented numerous flood mitigation and drainage projects. The implemented projects have resulted in a reduction in the extent of flooding in various places. Also, the implementation of a number of water resources projects with flood control measures, would also have reduced the magnitude and therefore the extent of flooding downstream of their related river systems. Thus, the overall flood-affected areas in the country would have been reduced significantly.

However, over the last two decades, as a result of economic growth, there has been a rapid growth in urban centres and expansion in the development of land, property and infrastructure in the suburban areas. This has resulted in the potential for greater flood damage as well as increased incidences of occurrence of flash flood, which result in a lot of disruption to socio-economic activities.

In view of the above situation, there is a need to update the flood information, for all the flood-affected river basins in the country. The updated information on flooding will enable the Government, and its agencies, including the Jabatan Pengairan dan Saliran (JPS), which is responsible for flood mitigation, to prioritise and plan its flood mitigation works.

1.2 STUDY OBJECTIVES

The objectives of the study are as follows:

(a) to update information on the conditions of flooding in the country presented by JICA in the National Water Resources Study (1982) so as to present information on the conditions of flooding as at year 2000
(b) to prepare updated flood maps by river basin as at year 2000
(c) to derive information on the conditions of flooding if the flood mitigation projects proposed under Rancangan Malaysia Ke-8 are implemented

1.3 STUDY AREA

The study area encompasses the reported flood-affected areas in the whole country (i.e. Peninsular Malaysia, Sabah and Sarawak).

The reported flood-affected areas are to be grouped under their respective river basins.

1.4 SCOPE OF WORK

The Terms of Reference for this Study is given in **Appendix 1**. The scope of work is as follows:

1. Establish the baseline data and information on flood condition in Malaysia using the 1982 JICA Study. (NRWS)
2. Obtain, compile, organize and document an up-to-date information on flood mitigation and drainage works undertaken by Jabatan Pengairan dan Saliran at the Federal, State, District and Project levels.
3. Obtain, compile, organise and document an up-to-date information of urban drainage works undertaken by the Kuala Lumpur City Hall and other Local Authorities that undertake major urban drainage projects.
4. Obtain, compile, organise and document an up-to-date information on water resources projects that have an effect on flood mitigation, such as hydropower and water supply dams.

5. Assess the impacts of the flood mitigation, urban drainage as well as of other relevant projects that have modified the extent of flooding. The assessment should result in:

   (i) Areas organised by river basin that are still prone to flooding, as at year 2000, for the reported flood events.

   (ii) Flood maps showing flood-affected areas, as at the year 2000, for the reported flood events.

   (iii) Assessment and update on the Annual average flood damage and number of people affected by floods

   (iv) Number of people and areas still prone to flooding, organised by river basins, if all flood mitigation projects proposed under the Eighth Malaysia Plan are implemented.

Note: On the request of the Government the Consultant has also included in this study the floods that occurred in the year 2001, in the East Coast States of Peninsular Malaysia and also Johor.

CHAPTER 2

ORGANISATION OF REPORT AND METHODOLOGY

2.0 ORGANISATION OF REPORT AND METHODOLOGY

2.1 ORGANISATION OF REPORT

The outputs from this Study are organised and presented in 11 separate Volumes and 10 sets of Drawings. The 11 Volumes comprises this Main Report and 10 State Reports. Each State Report will be accompanied by a set of Drawings showing the maps of the flood-prone areas in each State.

The Main Report shall describe the details of the methodology used in the Study, the assumptions made and all pertinent outputs from the Study that are generic or national in nature.

The State Report shall contain all outputs from the Study that are specific to each State. This will facilitate the use of the results from this Study by the respective State JPS Offices, as only two Reports (the Main and pertinent State reports) and one set of drawings, need to be given to each State.

2.2 METHODOLOGY

The methodology adopted by the Consultant to carry out the scope of works described in Section 1.4 for the updating of the conditions of flooding in the country are summarised as follows:

1. Review of the JICA (1982) report to extract the pertinent baseline flood information.

2. Compilation of pertinent information on all reported flood events that have occurred in the country, from 1980 to 2000. The information for each flood event is extracted from the annual flood reports prepared by JPS offices at Federal and State levels. The outputs from this step are tables with pertinent flood information for each flood event, organised according to location – by States, River Basin Management Units (RBMU) and Rivers. This is reported in Chapter 3.

   Note: The Consultant has adopted JICA's definition of RBMU to ensure meaningful comparison of results from this study with JICA's study

3. Compilation and listing of flood mitigation and drainage projects carried out by JPS at Federal, State and District levels. The outputs from this step are lists showing pertinent details on Federal or State funded flood mitigation and drainage projects. This is reported in Chapter 4.

4. Compilation and listing of flood mitigation and drainage projects carried out by Local Authorities. The outputs from this step are lists showing the pertinent details on the significant flood mitigation and drainage projects carried out by Local Authorities, wherever provided to the Consultant. This is reported in Chapter 4.

5. Compilation and listing of water resources projects, such as hydropower and water supply dams, that have flood mitigation component, implemented by the JKR and TNB. The output from this step is a list of pertinent hydropower and water supply dam projects carried out by the TNB and JKR. This is reported in Chapter 4.

6. Based on the information compiled in Steps 2 to 5 above, and on the baseline flood information extracted from the JICA 1982 report, the conditions of flooding for each RBMU in the country are then updated to the year 2001. *The details on the procedures and assumptions used to derive the updated conditions of flooding are given in Section 2.3 below*. The outputs from this step are tables giving information on the conditions of flooding in each RBMU, as of the year 2001, compared to that reported by JICA in 1982. They are reported in Chapter 5.

7. Systematic analysis of the tabulated results from step 6 are then carried out to identify the RBMUs, in each state, that have significant changes in the conditions of flooding in the year 2001 compared to those reported by JICA in 1982. Discussions on the reasons for the changes are then given. They are reported in Chapter 5.

8. Finally, a list showing the flood mitigation projects proposed under the Eighth Malaysia Plan, and their reported expected benefits in terms of reduced flood-affected area and people affected by floods, is compiled in Chapter 6.

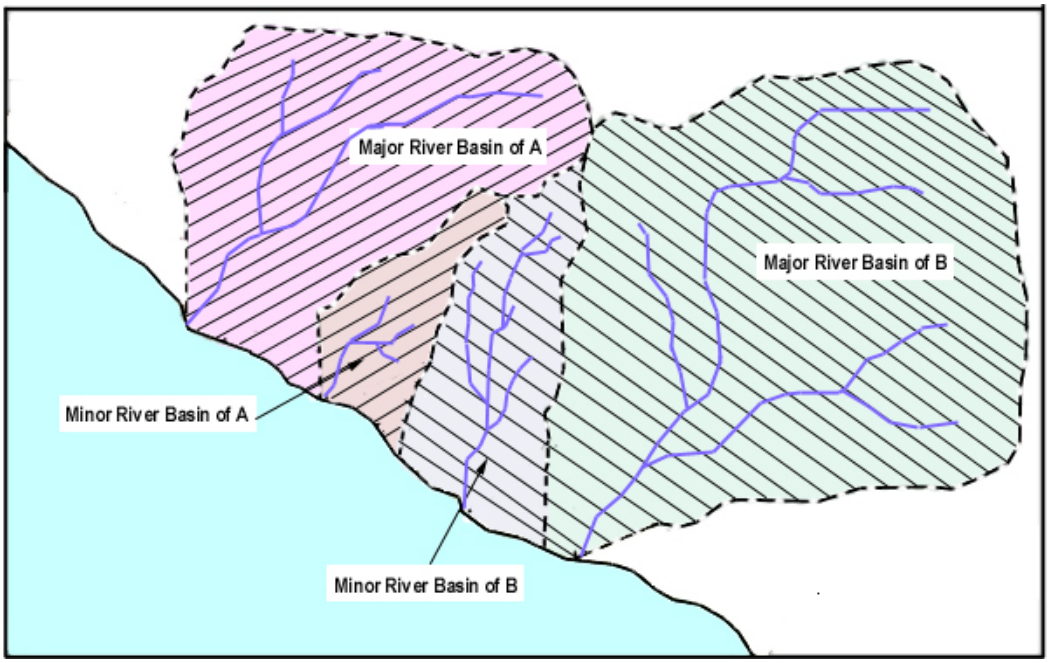
2.3 PROCEDURES AND ASSUMPTIONS USED TO UPDATE THE CONDITIONS OF FLOODING

2.3.1 Clarifications

The indicators for the conditions of flooding in a RBMU are:

(a) River Basin Management Unit (RBMU)

A "River Basin Management Unit (RBMU)" is the land area that has been delineated for the administrative purpose of defining a common global river basin management policy, planning and implementation of programs for the sustainable use of the land and the natural resources within it.



RBMU A
RBMU B

It shall comprise of the following:

- A major river basin (Major River Basin of A or B), which can dominate the RBMU
- Minor river basin (Minor River Basin of A or B), which can be logically grouped together with the major river basin for administrative purposes, based on a consideration of their common institutional, cultural and physical characteristics, as shown above.

(b) Flood-Affected Areas in a RBMU

There are some differences in the definition of flooded areas in this Study and those by JICA (1982), for RBMU where major flood mitigation projects have been implemented since 1979.

The flood areas in the JICA report is associated with the flooded areas of the largest recorded or worst flood event in a RBMU, between the years 1963 to 1979. However, in this Study the "flood-affected areas" can refer to either:

(i) For RBMU, where no major flood mitigation projects have been implemented since 1979, the "flood-affected areas" will be those associated with the largest recorded or worst flood event in the river basin between 1963 and 2001. This, for almost all the pertinent RBMU, will be the flood event reported in the JICA report.

(ii) For RBMU, where major flood mitigation projects have been implemented since 1979, the "flood-affected areas" will be defined by the envelope of flooded areas in the RBMU, associated with selected significant flood events that occurred after the implementation of the flood mitigation projects.

(c) Annual Average Damage (AAD) due to flood in a RBMU

The above definition for "flood-affected areas" in this Study has implications on the computation of the Annual Average Damage (AAD) due to flood in a RBMU, where major flood mitigation projects have been implemented since 1979. Since the AAD can only be computed from a given flood event it is not possible to use the envelope of the flood-affected areas to compute the AAD. Thus, for RBMU, where major flood mitigation projects have been implemented since 1979, the flood event that will be used to compute the AAD will be the worst of the selected flood event that occurred after the implementation of the flood mitigation projects.

2.3.2 Procedure for Delineating the Flood-Affected Areas in a RBMU

The following are the procedural steps used to delineate the total flood-affected areas in a RBMU.

1. The pertinent details related to each reported flood event in the Annual Flood Reports, from 1980 to 2001, prepared by all the JPS State Offices

are extracted and organised in tables according to the major rivers where the flood events occurred. The tables are further grouped by RBMU and are then compiled and presented in the respective State Reports.

2. The lists of flood mitigation, drainage and water resources projects compiled in Steps 2 to 5 in Section 2.2 above are then organised in tables, according to their river locations in each RBMU.

3. The list of projects in the tables derived in Step 2 are then reviewed to identify and compile a list of RBMU, where major flood mitigation projects have been implemented since 1979.

4. For the list of RBMU compiled in Step 3 above the significant flood events that occurred in each RBMU, after the implementation of the major flood mitigation projects after 1979, are then selected. The flood-affected area in the RBMU is then the envelope of the flooded areas associated with the selected significant flood events.

5. For the RBMU, where no major flood mitigation projects have been implemented since 1979, the flood-affected area will be the flooded area associated with the worst reported flood event in the RBMU from 1963-2001. The worst reported flood event, for almost all the pertinent RBMU, is the worst flood event reported in the JICA 1982 report.

6. Based on the information in Steps 4 and 5 the flood maps, showing the total flood-affected areas in each RBMU are then updated to the year 2001.

2.3.3 Procedure for Updating the Annual Average Damage (AAD)

The Annual Average Damage (AAD) due to flood in a RBMU is a statistically-averaged measure of the annual flood damage in a RBMU. It is the area under the Flood-damage – Frequency curve for a RBMU. The Flood damage – Frequency curve is the X-Y plot of the points, defined by the flood-damage (Y) associated with each flood event in a RBMU and the return period (X) in years of the flood event.

The procedure to compute the AAD for each RBMU is as follows:

1. The worst reported flood event in each RBMU is first identified, as described in Section 2.3.3.1 below.
2. The flood-damage associated with the worst reported flood event is then computed, using the procedure described in Section 2.3.4 below.
3. Estimates of the return periods of the river discharges, associated with zero flood-damage and for the worst reported flood event, are carried out as described in Section 2.3.5 below.
4. The Flood damage – Frequency curve is then plotted and the AAD for the RBMU is then computed, as described in Section 2.3.3.2 below.

2.3.3.1 Identification of the worst reported flood event in a RBMU

The worst reported flood event in a RBMU is required to define the top-point of the Flood-damage – Frequency curve. It is identified as follows:

(a) The worst reported flood event for the RBMU, where major flood mitigation projects have been implemented since 1979, will be the worst of the selected flood events after the implementation of the flood mitigation projects in the RBMU.
(b) For the RBMU, where no major flood mitigation projects have been implemented since 1979, the worst reported flood event from 1963-2001 is selected.

2.3.3.2 Flood-damage – Frequency curve and AAD Computation

The Flood-damage – Frequency curves in this study have been derived based on the following assumptions:

(a) The Flood-damage – Frequency curves developed by JICA in 1982 are not used in this study.
(b) In the absence of detailed documentation on flood damages and return periods, for each reported flood events in the JPS Annual Flood Reports, the Consultant has followed JICA in assuming a "linear relationship" for the Flood-damage – Frequency curves for all the RBMU. The linear relationship is defined by two points plotted on semi-logarithm paper.
(c) The bottom point is associated with the river discharge where zero flood damage occurs. This river discharge is normally associated with the danger flood levels at various JPS flood-monitoring stations. Thus, based on the information on the danger flood levels at the stations and through

frequency analysis it is possible to estimate the return period for the zero flood damage point. For the RBMU in this study it was found that no flood damage occurs for river discharges associated with return periods of one to four years.

(d) The top point is defined by the total flood damage of the worst reported flood event in a RBMU and its return period.

(e) The area under the Flood-damage – Frequency curve between the bottom and top point represents the statistical annual average flood damage. The area under the curve can be computed by the equation:

$$\mathbf{AAD=SUM\ [(D_{i-1} + D_i)/2\ x\ (P_{i-1} - P_i)]}$$

Where AAD = Annual (Statistical) Average Flood-damage

D_i = Probable flood damage value of i-year return period

P_i = Occurrence probability of i-year return period

Appendix 2 gives an example on how the AAD for the Sungai Perai/ Sungai Juru RBMU in Pulau Pinang is computed for the worst reported flood event in the RBMU.

2.3.4 Procedure for Estimating the Flood Damage of the Worst Flood Event

Due to the limited available data on flood damages due to the worst reported flood events the Consultant has adopted the "proxy method" used by JICA in the 1982 study, to estimate the flood damages due to the worst reported flood events. The steps in the procedure are shown in Figure 2.1 and are described as follows:

1. The worst reported flood event in a RBMU is first identified (see section 2.3.3.1 above).
2. The flood map associated with the worst reported flood event is then prepared. The delineation of the flooded areas in the flood map involves judgement, taking into account the information reported in the JPS Annual Flood Report for the flood event, the peak flood levels recorded at river gauging stations in the RBMU and interpolation of the contours on the flood maps.
3. The flood map is then overlaid on the latest available land-use map.
4. From the overlaid maps the flood area statistics due to the flood event are then derived. The flood area statistics comprises of 12 classified land-use

categories (see Section 2.3.4.1 below) and lengths of roads and railways that are flooded. Also, from the flood area statistics on urban and rural flooded areas the number of people and number of houses affected by the flood event can be estimated (see Section 2.3.4.2 below) from the population and housing data.

5. An estimate of the monetary flood damage due to the flood event can be computed from the latest unit values of crops and properties for each land-use category, inclusive of livestock (see Section 2.3.4.3 below), and appropriate choices of flood damage factors (see Section 2.3.4.4 below). The flood damage factors are weighting factors used to quantify the severity of flood damages for the various crops, live stocks and properties, due to the depth and duration of flooding of a flood event.
6. The flood damage for each land-use category is then computed from the information derived in steps 4 and 5 above, and the total estimated flood damage (see Section 2.3.4.5 below) for the flood event can then be computed. The total flood damage can be divided into 3 categories – agricultural damage, structural and properties damage and indirect damages arising from disruption to economic activities.

Appendix 2 gives an example on how the flood damage for the Sungai Perai/ Sungai Juru RBMU in Pulau Pinang is computed for the worst reported flood event in the RBMU.

2.3.4.1 The 12 Classified Land-use Categories

By overlaying the flood map on the Department of Agriculture (DOA) land-use map, the flooded areas for 12 classified land-use categories can be derived. The 12 classified land-use categories are:

1. Urban Area
2. Mixed Horticulture
3. Paddy
4. Rubber
5. Oil Palm
6. Coconuts
7. Other Tree Crops
8. Forest
9. Mining
10. Swamp
11. Pasture/Grassland

12. Unused Land

2.3.4.2 Estimating the number of People and Houses Affected by a Flood

The number of people and houses affected by a flood event can be estimated from the flood statistics for the urban and rural flooded areas and the population and housing data. The population density in the urban and rural areas is obtained by applying the relevant population growth rate for each state/district to the figures given in the JICA 1982 Study. The number of people per family/household, can be derived from the year 2000 Population and Housing Census for Malaysia. The Census figures give the population density (people/ha) and average family size per household (people/house) for both the urban and rural areas. The number of houses affected by a flood event in the urban and rural areas are derived by dividing the number of people affected by the flood in the urban and rural areas by their respective family size data.

Appendix 3 gives the pertinent population and housing census data used in this Study.

2.3.4.3 Unit Values of Livestock, Crops and Properties

(a) Livestock

There are no reliable statistics on the value of the losses of livestock due to a flood. However, it is normally related to the number of rural households affected by a flood. Thus, in this study the value of the loss of livestock is assumed to be RM25 per rural household.

(b) Crops and Properties

To derive the unit values of crops and properties for this Study the Consultant has reviewed two pertinent recent studies conducted by JICA in Malaysia. They are:

(a) Comprehensive Management Plan for Muda River Basin (Muda Study, 1995)
(b) Perak River Basin Information Systems Study (RBIS Study, 1999)

In the Muda 1995 Study, JICA conducted a survey to determine the values of damages to buildings and household effects due to floods.

In the RBIS 1999 Study JICA has estimated the average production value of paddy in Perak to be RM465 per ton. Also, JICA has estimated the crop values for rubber, oil palm, coconut, cocoa and other tree crops.

Based on the latest information on unit crop and property values compiled by JICA in the two recent studies, and those in the 1982 study, the Consultant has derived or adopted the appropriate unit values for the crops and properties to be used in this study. They are given in Table 2.1. The following are descriptions on how they are derived.

1. The unit values for the urban and rural house/household articles are adopted from the Muda 1995 Study.
2. The unit values for the public buildings were derived from the JICA 1982 Study, based on an inflation rate of 3.6% applied over an 18-year period.
3. The unit values of paddy for each state were derived by pro-rating the average production value of paddy in Perak (RM465/ton derived from the RBIS 1999 Study) with the average paddy yield figures for each state published by the Department of Agriculture.
4. The unit values for rubber, oil palm, coconut and other crops were derived from the mortality rate and production loss figures from the JICA 1982 Study and the unit cost figures in the RBIS 1999 Study.

Table A4.1 in **Appendix 4** shows the comparison of the Unit Values of Crops and Properties used in the JICA 1982 Study and the KTAT 2002 Study.

2.3.4.4 Flood Damage Factors

Since the amount of flood damage is also dependent on the depth and duration of a flood event there is a need to define flood damage factors to quantify the severity of flood damages for the various crops, live stocks and properties, due to the depth and duration of flooding. If the depth and duration of flooding is very severe the flood damage factor can be 100%, which implies total loss for a given category of flood damage. For each category of flood damage, the amount of damage sustained is estimated by multiplying the unit value of the damageable assets (houses and crops) by an appropriate damage factor.

The flood damage factors adopted for this study were derived from the 2000 JICA Study on the Integrated Urban Drainage Improvement for Melaka & Sg Petani, and also from the 1999 JICA Study. They are given in Table 2.2 and the descriptions on how they are derived are given below.

1. The flood damage factors for crops were adopted from the 1999 JICA Study. They were derived by JICA from consultation with the Department of Agriculture as well as MARDI, and thus can be considered reliable.
2. The flood damage factors for properties were adopted from the 2000 JICA Study. This is because JICA conducted a survey in the Study to derive the latest flood damage factors to be used for properties. The Study also categorises the damage factors for buildings and household effects.

Table A4.2 in **Appendix 4** shows the comparison of the flood damage factors and unit damage values for the buildings and household articles used in the JICA 1982 Study and the KTAT 2002 Study.

2.3.4.5 Total Estimated Flood Damage for a Flood Event

The total estimated flood damage for a flood event in a RBMU is the total of the following items:

1. Crop Damage: Unit value of production loss x Damage factor x Flooded area
2. Livestock Loss: RM25 x No. of rural households affected
3. Damage to houses: Unit value x Damage factor x No. of houses affected
4. Damage to Public Buildings: Unit value x No. of people affected per 10,000 x Damage factor
5. Public Utilities: 30% of damages to Houses and Public Buildings
6. Industrial Facilities: 10% of damages to Urban Houses
7. Indirect Damages: 30% of total direct damages (total of items 1 to 6)

To facilitate comparison of the assumptions used to derive the total estimated flood damage for a flood event, between the JICA 1982 and KTAT 2002 Study, Table A4.3 in **Appendix 4** gives the assumptions used in the two studies.

2.3.5 Estimating the Return Period of the Worst Reported Flood Event

Two methods were used to estimate the return period or average recurrence interval (ARI) of the worst reported flood event, depending on the availability of data. They are:

(a) Frequency analysis of observed peak flood discharges (see Section 2.3.5.1 below)
(b) Comparison of Intensity Duration Frequency (IDF) curve of the rainstorm associated with the worst reported flood event, against published IDF curves (see Section 2.3.5.2 below)

Where flood discharge data are available, flood frequency analysis were carried out to determine the ARI of the worst reported flood event. However, in the absence of flood discharge data the method of plotting and comparison of the IDF curve of the rainstorm associated with the worst reported flood event, with published IDF curves is used. However, in situations where no flood or rainfall data are available, or the computed ARI is too low, then the ARIs of the worst reported flood event will be assigned according to the ranking of the severity of the flood event based on the judgement of the pertinent JPS state officers.

For example, if a selected flood event is considered by the JPS officer to be the worst ever experienced in the last 20 years, then it will be assigned a 20-year ARI. If it is considered to be the second most severe flood over the last 20 years than it can be considered to be a 20/2 = 10-year ARI flood.

2.3.5.1 Flood Frequency Analysis

The JPS Hydrology Branch at Ampang maintains a network of principal river stations where stage and discharge data are collected, processed and stored in its Hydrological Database. For Peninsular Malaysia flood frequency analysis have been carried out by the JPS, for each of the stations, using Hydrological Procedure No. 4 (1987). The frequency analysis has also been carried out and reported in the recently completed National Water Resources Study (SMHB et. al. 2000).

Appendix 5 gives the results of the flood frequency analysis for the various JPS Streamflow stations in Peninsular Malaysia. The results were used to determine the ARI of the worst reported flood events in the RBMU in Peninsular Malaysia.

For the worst reported flood events in the RBMU in Sabah and Sarawak the Consultant has obtained the flood discharge data, where available, from the JPS database and has conducted the necessary frequency analysis. For overbank flow floods located near to the hydrological gauging station the peak flood discharge can be obtained from either the JPS's hydrological publications or through direct retrieval from the JPS hydrological database.

The results of some of the frequency analysis indicated that some values of the ARI obtained from the flood records at JPS river gauging stations are very low, even though the flood event (after consulting JPS state officers) is considered a major flood over a 20-year period. The reason for the above are discussed below.

Flood flow data are usually available at major river gauging stations, which may not cover all the flooded areas and thus the data at the gauging station may not be representative of the situation in the other areas. For some flood events, the flooding may not be from the river in which the JPS river gauging station is located. It may be localised flooding from a small tributary, drain or it may be a localised flash flood.

For example in Kelantan for the year 2000, as far as basin-wide flood for the Kelantan River basin is concerned, the computed ARI is very low. However, if we consider localised flooding then the ARI is high. The same situation was also observed in the Besut River basin, where the maximum peak flow recorded in the year 2000 at the river gauging station (Jambatan Jerteh) shows that the river flows are normal and the selected flood event has a low ARI. In some cases the flood discharge at the river gauging station is not representative due to overflow from upstream of the river, which bypass the river gauging station - for example, Sg. Kurau at Selama for the 1999 flood.

2.3.5.2 Rainfall IDF Curve Analysis

Many floods occur in smaller ungauged rivers, where flash floods often occur. For these floods, rainfall data were used to estimate the ARI of the flood. In

this case, the temporal rainfall pattern attributed to the flood event was compared with those shown in the Intensity-Duration-Frequency (IDF) curves derived by JPS for the major towns in the country to determine the flood ARI.

For most cases the rainfall data recorded in the flood reports are insufficient. Thus, the rainfall data for the date or period of the flood event was retrieved from the JPS's hydrological database for analysis.

In determining the ARI of a rainstorm, the duration of a rainfall has also been considered. Thus, the ARI of the rainstorms were also analyzed to determine whether they are short or long duration rainfall. Where there are enough rain gauge records in a RBMU the basin aerial rainfall was computed and used to determine the ARI of the flood event. Where there are not enough recording rain gauges in a river sub-basin, the nearest rain gauge within the vicinity of the sub-basin was used for the analysis.

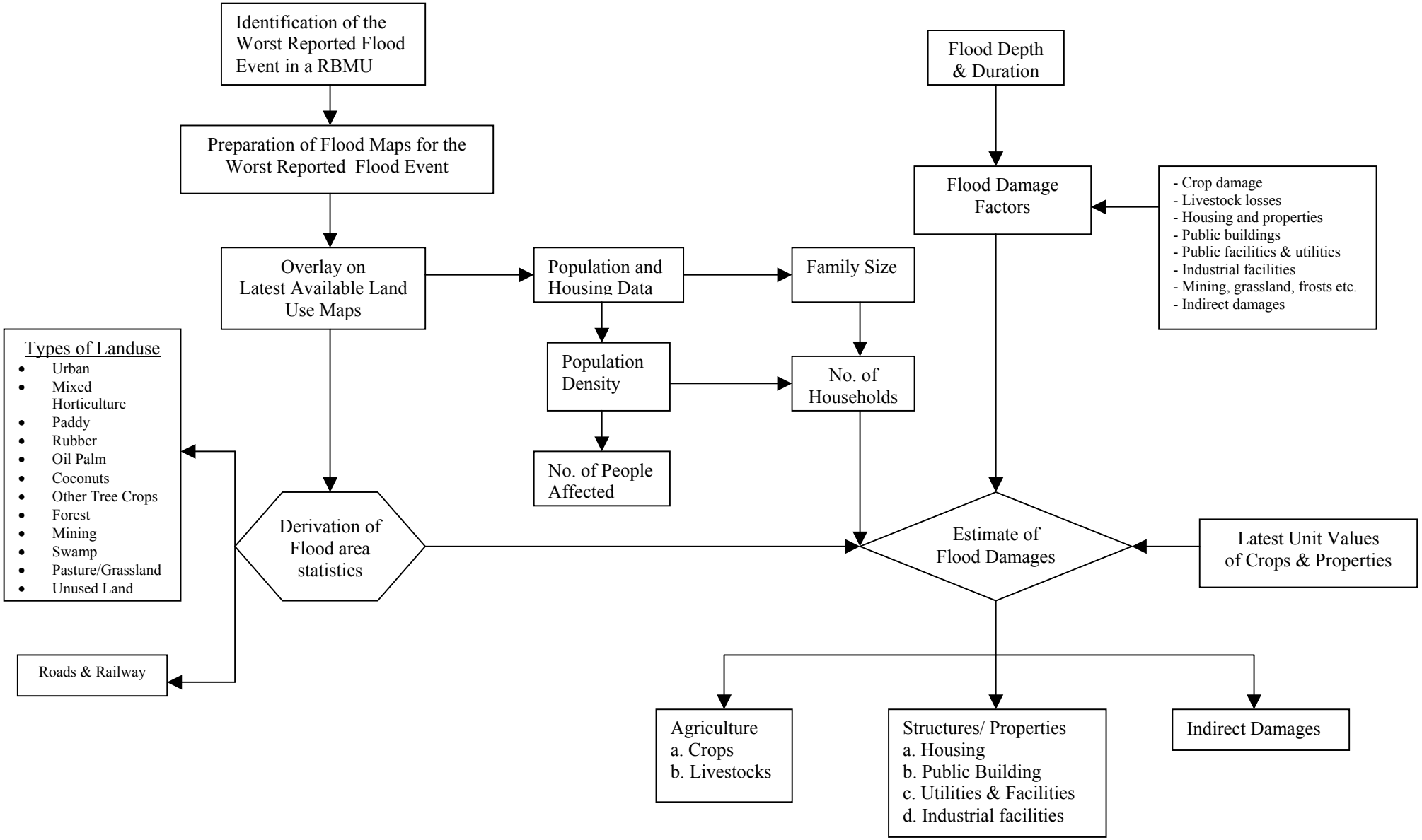


Figure 2.1: Flow Chart for Flood Damage Computation

TABLE 2.1 : UNIT VALUES OF PROPERTIES AND CROPS

Property/crop		Unit	Value (RM)	Remarks
Urban house		household	22,000	Adopted from JICA 1995 study
Household articles		household	18,000	
Rural houses		household	15,500	
Household articles		household	16,600	
Public buildings		per 10,000 population	3,780,000	Derived from JICA 1982 study figure with inflation rate of 3.6% applied over 20 years
Paddy (Average production and replacement loss)				i. *Source : Paddy Statistics of Malaysia 1995, Department of Agriculture Peninsular Malaysia ii. Production cost of RM465.00/ton in Perak is adopted. Source : RBIS, 1999.
State	Yield* (ton/ha)			
Perlis	4.029	ha	1872	
Kedah	3.997	ha	1857	
Pinang	3.165	ha	1471	
Perak	3.228	ha	1500	
Selangor	4.113	ha	1911	
N. Sembilan	2.924	ha	1359	
Melaka	3.038	ha	1412	
Johor	2.575	ha	1197	
Pahang	2.081	ha	967	
Trengganu	3.537	ha	1644	
Kelantan	3.268	ha	1519	
Sabah	3.033	ha	1409	
Sarawak	1.74	ha	809	
Rubber (mortality of young trees) –assume young trees account for 9% of all the trees		ha	5,200	The per hectare mortality rate and production loss figures (for rubber, oil palm, coconut and other crops) were obtained from JICA's 1982 study. The unit costs of rubber, oil palm, coconut, cocoa and others are adopted from figures presented in the River Basin Information System (RBIS) report, carried out by JICA in 1999. The values are current and are therefore applicable
Rubber trees –production loss = production loss x flood duration production loss = 4.7kg/ha/day x RM 5/kg		/ha/day	23.5	
Oil palm (mortality of young trees) – assume young trees account for 9% of all the trees		ha	3,500	
Coconut tree (mortality of young trees) – assume young trees account for 9% of all the trees		ha	6,200	
Other tree crops (mortality of young trees). E.g. cocoa - assume 10% of area with young trees which are susceptible to flooding		ha	6,400	
Mixed horticulture		ha	4,700	

TABLE 2.2: FLOOD DAMAGE FACTORS

Item	Flood Depth	Flood Duration	Damage Factor (%)		Remarks
Paddy (Production loss)	less than 0.5m	less than 2 days	30		
		3 to 4 days	37		
		5 to 6 days	40		
		more than 7 days	45		
	0.5 to 1.0m	less than 2 days	33		
		3 to 4 days	40		
		5 to 6 days	43		
		more than 7 days	49		
	more than 1m	less than 2 days	60		
		3 to 4 days	80		
		5 to 6 days	86		
		more than 7 days	96		
Rubber (Mortality of young tree)	more than 0.25m	less than 7 days	5		Assume 9% of total planted area to be subject to mortality
		8 to 14 days	15		
		15 to 21 days	60		
		more than 22 days	100		
Oil Palm/Coconuts Palm (Mortality of young tree)	more than 0.25m	less than 7 days	10		Assume 9% of total planted area to be subject to mortality
		8 to 14 days	20		
		15 to 21 days	70		
		more than 22 days	100		
Other Tree Crops (Mortality of young tree)	more than 0.25m	less than 4 days	10		Assume 10% of total planted area to be subject to mortality
		5 to 8 days	25		
		9 to 12 days	60		
		more than 13 days	70		
House/Building			*Urban*	*Rural*	
	less than 0.5m		3.5	3.5	
	0.5 to 1.0m		4.5	4.5	
	1.0 to 1.5m		6.1	6.1	
	1.5 to 2.0m		6.8	6.8	
	2.0 to 3.0m		11.2	11.2	
	more than 3.0m		17	17	
Household Effects	less than 0.5m		5.7	5.7	
	0.5 to 1.0m		9.6	9.6	
	1.0 to 1.5m		11.9	11.9	
	1.5 to 2.0m		13.5	13.5	
	2.0 to 3.0m		33.6	33.6	
	more than 3.0m		68.7	68.7	
Industrial Facilities	10% of damage to urban houses				
Public Facilities and Utilities	30% of damages to public buildings and private houses				
Indirect Losses	30% of direct losses				
Mining, Grasslands, Forests and Swamps	Minor damages and not estimated				

CHAPTER 3

COMPILATION OF INFORMATION ON FLOOD EVENTS

3.0 COMPILATION OF INFORMATION ON FLOOD EVENTS

3.1 INFORMATION ON FLOOD EVENTS

Information on flood events in the country can be found in the flood reports prepared by the JPS State offices, Bahagian Keselamatan Offices and some local government agencies. However, as the government agency responsible for river management and flood mitigation the JPS has implemented a system of annual flood reporting by the various JPS State Offices. As a result of this the JPS State Annual Flood Reports are the most comprehensive and was thus systematically reviewed by the Consultant to extract the pertinent flood event information for this Study.

For each reported flood event that occurs in the country from 1980 to 2000/01, the following information have been extracted and organised in a table under the river where it occurs.

(a) Date of flood event
(b) Location of flood event
(c) Area, Depth, Duration of flood event
(d) Level at flood warning station, where pertinent
(e) Rainfall or Flood Discharge ARI, where available
(f) Number of family and people evacuated
(g) Number of deaths
(h) Reported flood damages, where available
(i) Length of roads and railways flooded
(j) Flood maps, where available
(k) Pertinent Remarks

Table 3.1 shows an example of a river-based flood-event table for Sg. Perlis in Perlis RBMU.

Each of the river-based, flood-event tables is grouped under the RBMU of the respective rivers, where the rivers are located. The tables in the RBMU are then grouped under their respective State Reports. In this way, information on any flood event can be made easily accessible to any reader. For details on the flood events compiled in this Study please refer to the respective State Reports of this Study.

3.2 RIVER BASIN MANAGEMENT UNITS (RBMU) IN MALAYSIA

JICA has organised the flood event information in its 1982 Study according to River Basin Management Units (RBMU). For that purpose it has grouped the Peninsular river systems into 41 RBMU, while the river systems in Sabah and Sarawak in East Malaysia are grouped into 26 and 21 RBMU, respectively. Each of JICA's RBMU usually consists of a major river system and one or more smaller adjacent river systems.

Table 3.2 gives the details of the eighty eight RBMU in the country, together with the RBMU name and number, the major river/s within the RBMU, the RBMU total area and the state/s where a RBMU is located.

3.3 NUMBER OF FLOOD EVENTS BY RBMU IN EACH STATE

Tables in **Appendix 6** provide an overview of the number of flood events that occur in each RBMU, for each year between 1980 and 2000/01, and for each state.

3.4 SUMMARY OF FLOOD EVENTS BY RIVERS IN EACH STATE

To provide an overview of the number of flood events that occur in a river within an RBMU, for each year between 1980 and 2000/01, summary tables giving the dates of the flood events that occur in each river within an RBMU for each state have been compiled.

Table 3.3 shows an example of such a summary table for the state of Pulau Pinang.

TABLE 3.1: FLOOD EVENTS FROM 1980 TO 2000

RBMU 1: PERLIS, STATE: PERLIS (SHEET 1/1)

River	Date of Flood	Flood Location	Flood				Rainfall/ Flood Recurrence Interval (yrs)	Evacuees		Death	Damages Reported (RM)	Road / Railway Flooded (km)	Flood Maps (Y/N)	Remarks
			Area (ha)	Depth (m)	Duration (day)	Level at Flood Warning Station (m)		Family	People					
Sg. Perlis	Aug. 91	-Batu Pahat -Kurung Batang	173.2	0.3-0.8	1/2-3								Y	
	16,17, 19-09-91	-Bintong -Kubang Badak -Padang Melangit -Repoh	190	0.3-0.8	1-3		110.0mm at Kaki Bukit on 17/9/91 & 150.0mm at Ulu Pauh on 19/9/91					-Jln Bintong Batu 1.5 2 days 0.2m -Jln Padang Melangit Bt 5 1.5 days 0.3m	Y	
	08-10-92	- Titi Tinggi Hilir - Tasoh	-	0.5-1.0	1							- Jln Sahabat 1/2 day 0.3 - 0.4 m	Y	
	12-11-92	-Titi Tinggi Hilir -Tasoh -Kubang Badak -Kg Belukar -Padang Malau -Kg Darat -Padang Melangit	7430	0.25-1.0	1-6	34.0m at Wang Mu on 12-11-92 & 31.40m at Titi Jln Sahabat on 12-11-92			137		Rm 0.58 mil	-Jln Padang Besar 1 day 0.3m -Jln Sahabat 1.5 days 0.4m -Jln Guar Jentik 1 day 0.1m	Y	
	22-08-97 to 23-08-97	-Kg Titi Tinggi -Lembah Biak -Kg Rambai -Kuala Tunggang -Alor Melaka -Banggol Sena			1-2	27.36m at Arau (Felda) on 25/8/97 & 38.13m at Sg Pelarit on 24/8/97	171.0mm at Pdg Besar on 23/8/97 & 220.0mm at Kaki Bukit on 22/8/97 & 230.0mm at Arau (Felda) on 23/8/97		152				Y	
	01-10-98	-Kg Paya Burma -Kg Banggol Sena -Kg Rambai -Kg Padang Siding -Simpang Klinik Gial -Sekitar SMDA Arau				38.64mm at Sg Pelarit on 2-11-98 & 26.92m at Arau (Felda) on 1-11-98	147.5mm at Arau (Felda) on 27/10/98 & 90.0mm at Ulu Pauh on 27/10/98	37					Y	
	22/11/00 to 25/11/00	-Kg Lembah Biak -Kg Pdg Malau -Kg Paya -Padang Pauh -Kg Gial -Kg Rambai -Kg Perawah	5200	0.4-1.7	2-4	29.985m at Epgn T.Tasoh 0n 23/11/00	170mm at Pdg Besar on 22/11/00 & 126.5mm at Wang Kelian on 22/11/00 &		199			-Jln Panggas (Kg Panggas) 0.2m 2 days -Jln Padang Besar (Jambatan Sg Jarum) 0.5m 4 days -Jln Pauh (Spg Tiga Arau)	Y	

TABLE 3.2 : LIST OF RIVER BASIN MANAGEMENT UNITS (RBMU) (Sheet 1/3)

RBMU		RIVER(S)	BASIN AREA (km^2)	STATE (S)
NO.	NAME			
A. PENINSULAR MALAYSIA				
01	Perlis	Perlis	790	Perlis / Kedah
02	P. Langkawi	Small River	475	Kedah
03	Kedah	Kedah, etc.	3,695	Kedah / Perlis
04	Merbok	Merbok, etc	520	Kedah
05	Muda	Muda Tembus	4,300	Kedah / P.Pinang
06	Perai	Perai Juru Jawi	895	P.Pinang / Kedah
07	P.Pinang	Pinang, etc	300	P.Pinang
08	Kerian	Kerian	1,420	Kedah / P.Pinang / Perak
09	Kurau	Kurau Beruas, etc	3,255	Perak
10	Perak	Perak	15,180	Perak
11	Bernam	Bernam, etc	3,335	Perak / Selangor
12	Tengi	Tengi, etc	565	Selangor
13	Selangor	Selangor	1,820	Selangor
14	Buloh	Buloh, etc	560	Selangor
15	Klang	Klang	1,425	Selangor
16	Langat	Langat	1,815	Selangor / N. Sembilan
17	Sepang	Sepang, etc	640	Selangor /N. Sembilan
18	Linggi	Linggi Bharu, etc	1,420	N. Sembilan/Melaka
19	Melaka	Melaka Duyong, etc	1,010	Melaka / N. Sembilan
20	Kesang	Kesang	705	Melaka /N. Sembilan / Johor
21	Muar	Muar, etc	6,595	Johor /N. Sembilan/ Melaka / Pahang
22	Batu Pahat	Batu Pahat Senggarang	2,600	Johor
23	South-West Johor Rivers	Benut, etc Pulai Scudai Tebrau	2,660	Johor
24	Johor	Johor, etc	3,250	Johor
25	Sedili Besar	Sedili Besar Sedili Kechil, etc	1,820	Johor
26	Mersing	Mersing Teriang Besar Tenglu, etc	880	Johor
27	Endau	Endau	4,740	Johor / Pahang
28	Rompin	Rompin Pontian	4,285	Pahang / Johor
29	Bebar	Merchong Bebar	1,895	Pahang

TABLE 3.2 : LIST OF RIVER BASIN MANAGEMENT UNITS (RBMU) (Sheet 2/3)

RBMU		RIVER(S)	BASIN AREA	STATE (S)
NO.	NAME		(km^2)	
30	Pahang	Pahang	29,300	Pahang /N. Sembilan
31	Kuantan	Kuantan, etc	2,025	Pahang
32	Kemaman	Kemaman Kemasik Kerteh	2,570	Terengganu
33	Paka	Paka	850	Terengganu
34	Dungun	Dungun	1,875	Terengganu
35	Merchang	Merchang Marang	760	Terengganu
36	Terengganu	Terengganu Ibai, etc	4,650	Terengganu
37	Setiu	Setiu Merang, etc	1,035	Terengganu
38	Besut	Besut	1,230	Terengganu / Kelantan
39	Kemasin / Semerak	Kemasin Semerak, etc	1,020	Kelantan / Terengganu
40	Kelantan	Kelantan	13,100	Kelantan
41	Golok	Golok,	895	Kelantan / (Thailand)
		Total :	**132,160**	
B. SABAH				
201	Pensiangan	Pensiangan, Talankai, Sabutan, etc.	5,971	Sabah
202	Serudong	Serudong	1,308	Sabah
203	Kalabakan	Kalabakan, etc.	1,371	Sabah
204	Brantian	Brantian	741	Sabah
205	Umas Umas	Umas-umas	553	Sabah
206	Merutai Besar	Merutai Besar, etc.	558	Sabah
207	Tawau	Tawau, etc.	888	Sabah
208	Kalumpang	Salumpang, Tingkayu, etc.	2,792	Sabah
209	Silibukan	Sahabat, Matamba, etc.	2,714	Sabah
210	Segama	Segama	5,558	Sabah
211	Kinabatangan	Kinabatangan, etc.	16,581	Sabah
212	Segalid	Segalid	2,335	Sabah
213	Labuk	Labuk, Sepagaya, etc.	6,829	Sabah
214	Sugut	Sugut, etc.	3,094	Sabah
215	Paitan	Paitan, etc.	1,474	Sabah
216	Bengkoka	Bengkoka, Kanibonggan	1,943	Sabah
217	Bongan	Bongan, etc.	2,191	Sabah
218	Kadamaian	Kedamaian, Wariul, etc.	1,386	Sabah
219	Tuaran	Turan, Mulay	1,219	Sabah
220	Putatan	Putatan, Moyog	629	Sabah
221	Papar	Papar	805	Sabah
222	Kimanis	Kimanis, Puas	572	Sabah
223	Membakut	Membakut	736	Sabah
224	Padas	Padas, Sook, etc.	9,180	Sabah
225	Labuan	Labuan	91	Sabah
226	Lakutan	Lakutan, Mengalong	1,291	Sabah
		Total :	**72,810**	

TABLE 3.2 : LIST OF RIVER BASIN MANAGEMENT UNITS (RBMU) (Sheet 3/3)

RBMU		RIVER(S)	BASIN AREA (km^2)	STATE (S)
NO.	NAME			
C. SARAWAK				
227	Lawas	Lawas	1,050	Sarawak
228	Trusan	Trusan	2,615	Sarawak
229	Limbang	Limbang	3,950	Sarawak
230	Baram	Baram, Miri	22,930	Sarawak
231	Sibuti	Sibuti	1020	Sarawak
232	Niah	Niah	1,280	Sarawak
233	Suai	Suai	1,540	Sarawak
234	Similajau	Similajau	660	Sarawak
235	Kemena	Kemena	6,100	Sarawak
236	Tatau	Tatau	5,260	Sarawak
237	Balingian	Balingian	2,510	Sarawak
238	Mukah	Mukah	2,275	Sarawak
239	Oya	Oya	2,195	Sarawak
240	Rajang	Rajang	47,880	Sarawak
241	Krian	Krian	1,500	Sarawak
242	Saribas	Saribas	2,200	Sarawak
243	Lupar	Lupar	6,510	Sarawak
244	Sadong	Sadong	3,550	Sarawak
245	Samarahan	Samarahan	1,090	Sarawak
246	Sarawak	Sarawak	2,375	Sarawak
247	Kayan	Kayan	1,645	Sarawak
		Total:	**124,448**	
		GRAND TOTAL :	**329,418**	

TABLE 3.3 : SUMMARY OF FLOOD EVENTS (1980 - 2000) BY RIVERS (SHEET 1 OF 1)

STATE : **PULAU PINANG**

Year of Flood	RBMU	No. of Flood Events	River	Date of Flood Event
1990	Perai	2	Sg Macang Bubuk	30-10-90
			Sg Junjung	22-09-90
			Sg Junjung	30-10-90
	Pulau Pinang	1	Sg Pinang/Air Hitam	23-09-90
1991	Perai	1	Sg Jarak	06-04-91
			Sg Kulim	06-04-91
	Pulau Pinang	1	Sg Pinang/Air Hitam	06-02-91
1992	Perai	1	Sg Mengkuang	29-10-92
			Sg Pertama/Kubang Semang	29-10-92
			Sg Derhaka	29-10-92
			Sg Rambai	29-10-92
			Sg Kelang Ubi	28-10-92
			Sg Permatang Rawa	29-10-92
			Parit No 5	28-10-92
	Pulau Pinang	1	Sg Pinang/Air Hitam	04-10-92
1993	Perai	4	Sg Jarak	24-07-93
			Sg Kulim	24-07-93
			Sg Rambai	26-07-93
			Sg Kelang Ubi	26-07-93
			Sg Junjung	11-02-93
			Parit No 5	11-06-93
			Sg Bakap	11-02-93
	Pulau Pinang	1	Sg Pinang/Air Hitam	21-11-93
1995	Perai	1	Sg Kereh	20-09-95
			Sg Logan/Orang Puteh/Dua	20-09-95
			Sg Jarak	20-09-95
			Sg Kulim	20-09-95
	Pulau Pinang	1	Sg Pinang/Air Hitam	17-09-95
1996	Perai	4	Sg Kulim	12-05-96
			Sg Kulim	19-11-96
			Sg Rambai	21-10-96
			Sg Junjung	21-10-96
			Sg Jejawi/Tengah	21-10-96
			Sg Kerian	21-10-96
	Pulau Pinang	1	Sg Pinang/Air Hitam	10-11-96
1997	Perai	4	Sg Permatang Rawa	09-06-97
			Sg Macang Bubuk	20-07-97
			Sg Macang Bubuk	23-08-97
			Sg Macang Bubuk	21-11-97
	Pulau Pinang	1	Sg Pinang/Air Hitam	03-09-97
1998	Perai	1	Sg Kereh	16-11-98
			Sg Logan/Orang Puteh/Dua	16-11-98
			Sg Jarak	16-11-98
			Sg Kulim	16-11-98
			Sg Pertama/Kubang Semang	16-11-98
			Sg Juru	15-11-98
			Sg Rambai	15-11-98
			Sg Kelang Ubi	15-11-98
			Sg Junjung	16-11-98
			Sg Jejawi/Tengah	15-11-98
			Sg Kerian	15-11-98
			Sg Kecil	15-11-98

CHAPTER 4

PROJECTS THAT HAVE IMPACT ON FLOODS

4.0 PROJECTS THAT HAVE IMPACTS ON FLOODS

4.1 FLOOD MITIGATION AND DRAINAGE PROJECTS BY JPS

The Federal and State JPS have implemented numerous flood mitigation and drainage projects since 1979, under Rancangan Malaysia Ke-4 to Ke-7. The projects can be classified into major and minor projects based on their cost. For the purpose of this study, major projects are those that cost more than 5 million ringgit.

Tables 4.1 and 4.2 show the lists of major and minor flood mitigation and drainage projects, respectively, implemented by the JPS under Rancangan Malaysia Ke-4 to Ke-7. The projects are grouped under their respective river, which in turn are grouped under their respective RBMU and States. For each project the type of mitigation works carried out is also given.

In addition to the above, for the major projects given in Table 4.1, the year of project completion and nature of the flooding mitigated are also given.

4.2 FLOOD MITIGATION AND DRAINAGE PROJECTS BY LOCAL AUTHORITIES

Since 1979 a number of local authorities have also implemented flood mitigation and drainage projects in their respective areas. Table 4.3 (a), 4.3 (b), 4.3 (c) and 4.3 (d) gives the list of flood mitigation and drainage projects implemented by the following local authorities, respectively.

(a) Dewan Bandaraya Kuala Lumpur
(b) Majlis Perbandaran Melaka
(c) Majlis Bandaraya Johor Bahru
(d) Majlis Perbandaran Seberang Perai

The tables also give information on the cost of each project, their date of commencement and completion.

4.3 WATER RESOURCES PROJECTS BY JKR AND TNB

Since 1979, the JKR and TNB have also implemented a number of water resources projects that have flood mitigation components. Table 4.4 gives the list of projects with flood mitigation components implemented by the JKR and TNB. The projects are grouped under their respective river system and RBMU and the year of project completion is also given.

TABLE 4.1: MAJOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 1 OF 7)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Project Completion	Nature of Flooding Mitigated		Remarks
	No.	Name					Localised	Widespread	
PERLIS	1	Perlis	Perlis	Timah Tasoh Dam	Irrigation, water Supply & Flood Control	1992		✓	
				RTB Kangar	River Rehabilitation	1995	✓		
				RTB Negeri Perlis	Urban Drainage Upgrading	on - going		✓	Continued to RM8
KEDAH	2	Langkawi	Chenang	Membina Parit Sepanjang Jln di Pantai Chenang dan Pantai Tengah, Langkawi	Drainage Improvement and Channelisation.	1996	✓		
	3	Kedah	Raja & Derga	RTB Alor Setar Fasa 1 (Sg Raja Drainage Catchment Improvement Works)	River Channelisation Drainage Improvement Pumping Station	1996	✓	✓	
			Alor Bemban	RTB Alor Setar Fasa II (Taman Intan Drainage Catchment Improvement Works)	Drainage Improvement Pumping Station.	2000	✓		Continued to RM8
PULAU PINANG	6	Perai	Perai	Ranc. Pencegahan Banjir Mak Mandin/ Bagan Serai Seberang Perai	Flood Protection & Drainage Improvement	1995	✓		
			Junjung, Jawi & Tengah	Ranc. Tebatan Banjir Sg. Junjung, Sg. Jawi & Sg. Tengah	Flood Protection & Drainage Improvement	Several components completed in RM7	✓		Continued to RM8
			Jawi	RTB Nibong Tebal	Flood Protection & Drainage Improvement	on - going	✓		Continued to RM8

TABLE 4.1: MAJOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 2 OF 7)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Project Completion	Nature of Flooding Mitigated		Remarks
	No.	Name					Localised	Widespread	
PULAU PINANG	7	P. Pinang	Tiram	Ranc. Tebatan Banjir Sg. Tiram	Flood Protection & Drainage Improvement	1997	✓		
				RTB Kawasan Perbandaran Pulau Pinang	Flood Protection & Drainage Improvement	Several components completed in RM7		✓	Continued to RM8
PERAK	10	Perak	Perak	Rancangan Saliran Teluk Tiga/Tanjung Kupang, Kayan	Drainage Improvement	On going	✓		Commenced in RM5 & continued to RM8
			Perak	Rancangan Membina Semula Bagan Datoh	Drainage Improvement	On going	✓		Commenced in RM5 & continued to RM8
			Bidor	Pengaloran Sungai Bidor, Batang Padang	River Improvement	Completed	✓		Commenced in RM5 & continued to RM7
			Siput	RMB Sg. Siput	River Improvement	On going	✓		Commenced in RM6 & continued to RM8
			Pari	RTB Sg. Pari	River Improvement	Completed	✓		Commenced in RM5 & continued to RM7
			Pari	RTB Sg. Pari Fasa II	River Improvement	On going	✓		Commenced in RM7 & continued to RM8
			Perak	RTB Taiping Fasa I	River Improvement	On going	✓		Commenced in RM7 & continued to RM8
			Perak	RTB Teluk Intan Fasa II	River Improvement/ Urban Drainage Upgrading	On going	✓		Commenced in RM7 & continued to RM8

TABLE 4.1: MAJOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 3 OF 7)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Project Completion	Nature of Flooding Mitigated		Remarks
	No.	Name					Localised	Widespread	
SELANGOR	11	Bernam	Bernam	RMB Sg. Benam/Kg. Sg. Selisek	River Improvement	On going	✓		Commenced in RM6 & continued to RM8
	15	Klang	Klang	RTB Bandar Klang dan Pelabuhan Klang	Drainage Improvement	On going	✓		Commenced in RM6 & continued to RM8
			Klang	Projek Buang Kelodak Sg. Batu dan Sg. Gombak	River Improvement	On going	✓		Commenced in RM6 & continued to RM8
			D'sara	RTB Sg. Damansara	River Improvement	On going	✓		Commenced in RM6 & continued to RM8
			Penchala	RTB Sg. Penchala	River Improvement	On going	✓		Commenced in RM6 & continued to RM8
	16	Langat	Langat	RTB Sg. Langat	River Improvement	On going	✓		Commenced in RM6 & continued to RM8
			Langat	Rancangan Membaiki Kuala Langat/Sepang	River Improvement	On going	✓		Commenced in RM6 & continued to RM8
			Semenyih	Rancangan Mengorek Sg. Semenyih	River Improvement	On going	✓		Commenced in RM6 & continued to RM8
WILAYAH PERSE-KUTUAN KUALA LUMPUR	15	Klang	Klang	RTB Kuala Lumpur/ Lembangan Sg. Klang					
				a) Dam Component	Enlargement of Klang Gates Dam	1980		✓	
				b) River Works Component	Canalisation & Revetment Works	On going		✓	

TABLE 4.1: MAJOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 4 OF 7)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Project Completion	Nature of Flooding Mitigated		Remarks
	No.	Name					Localised	Widespread	
WILAYAH PERSE-KUTUAN KUALA LUMPUR				c) Trunk Drainage Component	Drainage Improvement Works	On going	✓		
			Batu	d) Empangan Batu	Flood Control & Water Supply Dam	1986		✓	
NEGERI SEMBILAN	17	Sepang	Linggi	RTB Port Dickson	Flood Protection	on going	✓		Commenced in RM6 & continued to RM8
	18	Linggi	Linggi	RTB Bandar Seremban	Flood Protection	on going	✓		Commenced in RM5 & continued to RM8
MELAKA	18	Linggi	Baharu	Projek Tebatan Banjir Masjid Tanah (Phase 1), Daerah Alor Gajah	Urban Drainage Upgrading	1999	✓		Commenced in RM7 and Phase II continued in RM8
	19	Melaka	Melaka	Ranc. Mencegah Banjir Sg Melaka	Flood Bypass River Rehabilitation Bund Protection	1991		✓	Commenced in RM5
JOHOR	20	Kesang	Kesang	Ranc. Saliran Sg Kesang Peringkat II	River Channelisation	RM7			
	21	Muar	Muar	Projek Perparitan Bandar Maharani, Muar	Urban Drainage Upgrading River Channelisation River Rehabilitation	On-going	✓		Commenced in RM6 and continued to RM8
	22	Batu Pahat	Batu Pahat	RTB Bandar Batu Pahat	Urban Drainage Upgrading	On-going	✓		Commenced in RM7 and continued to RM8
				IADP Johor Barat	Dams				
				- Machap Dam	River Improvement	1982		✓	Commenced in RM2
				- Semberong Dam		1984		✓	Commenced in RM5
				- Bekok Dam		1990		✓	Commenced in RM5

TABLE 4.1: MAJOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 5 OF 7)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Project Completion	Nature of Flooding Mitigated		Remarks
	No.	Name					Localised	Widespread	
JOHOR	23	South West Johor Rivers	Skudai	Rancangan Pengaluran Sg.Skudai, Fasa IV	River Channelisation	On-going		✓	Continued from Phase III. Phase IV commenced in RM7 and continued to RM8
PAHANG	30	Pahang	Pahang	RTB Pekan	River Channelisation River Rehabilitation Bund Protection	On-going	✓		Commenced in RM3 and continued to RM8
	31	Kuantan	Kuantan	RTB Kuantan	River Channelisation River Rehabilitation Bund Protection	On-going	✓		Commenced in RM4 and continued to RM8
TERENG-GANU	32	Kemaman	Kemaman	Ranc. Tebatan Banjir Bandar Chukai	Urban Drainage Upgrading	On-going	✓		Continue to RM8
			Kemaman	Penempatan semula nelayan Kampung Paya Berenjut	Resettlement	On-going	✓		Continue to RM8
	34	Dungun	Dungun	Pengaluran Sg. Pimpin	River Channelisation	On-going	✓		Continue to RM8
	36	Terengganu	Terengganu	Ranc. Tebatan Banjir Bandar Terengganu	Urban Drainage Upgrading	On-going	✓		Continue to RM8
	37	Setiu	Setiu	Pengaluran Sg. Setiu	River Channelisation	On-going	✓		Continue to RM8
KELANTAN	39	Kemasin / Semerak		Program Mencegah Banjir Kemasin/Semerak	Flood Mitigation Agricultural Upgrading			✓	
			Kemasin	Phase 1:		1991			Commenced in 1982
			Semerak	Phase 2:		On - going			Flood Mitigation Component Completed in RM7

TABLE 4.1: MAJOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 6 OF 7)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Project Completion	Nature of Flooding Mitigated		Remarks
	No.	Name					Localised	Widespread	
KELANTAN	40	Kelantan	Kelantan	RTB Kota Bharu	Urban Drainage Upgrading	On - going	✓		Continued to RM8
					Bund Protection				
			Kelantan	Mengorek Sungai Jajahan	River Improvement	RM7	✓		
				Machang					
			Kelantan	Rancangan Menstabil	River Rehabilitation	RM7	✓		
				Tebing Sg.Kelantan di					
				Kg.Kedai Buluh & Kg.Laut					
			Kelantan	Rancangan Menstabil	River Rehabilitation	RM7	✓		
				Tebing Sg.Kelantan di					
				Pasir Pekan					
	41	Golok	Golok	Rancangan Menstabil	River Rehabilitation		✓		
				Tebing Sg.Golok	Bund Protection				
				(KESBAN)					
				Phase 1:		1997			
				Phase 2:		1999			
SABAH	212	Segalid	Manila	RMB Sg. Manila	River improvement	On-going	✓		Catchment of Sg
		(Segaliud)							Gum-Gum/Sibuga
	217	Bongan	Bandau	RTB Dataran Bandau	River improvement	On-going		✓	
	219	Tuaran	Marabahai	RMB Marabahai /	Drainage system	On-going	✓		
				Berungis / Tagas	constructiobn				
	220	Putatan	Kota	RMB Kota Kinabalu	Flood mitigation	On-going	✓		State Funded
			Kinabalu						
	221	Papar	Kinarut	RMB Sg. Kinarut	River improvement/	On-going	✓		
					diversion				

TABLE 4.1: MAJOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 7 OF 7)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Project Completion	Nature of Flooding Mitigated		Remarks
	No.	Name					Localised	Widespread	
SABAH	221	Papar	Papar	RMB Sg. Papar	Prevention of river bank erosion	On-going		✓	
			Takis	RMB Sg. Takis	River improvement/ diversion		✓		Not implemented yet
	224	Padas	Pegalan	RMB Sg. Pegalan	Prevention of river bank	On-going	✓		
		Sg. Nabahab	Nabahab	RMB Sg. Nabahab	Dredging	Completed		✓	Not included in the final draft report
SARAWAK	245	Samarahan	Samarahan	Mencegah Banjir Samarahan	Flood Mitigation	1995	✓		Completed
	246	Sarawak	Sarawak	Rancangan Tebatan Banjir Sarawak - Memperelokkan saliran Bandaraya Kuching	Component for Drainage & Flood Mitigation Works		✓		Continued to RM8

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 1 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
KEDAH	2	Langkawi	Kuah	Membina Parit Utama A - B di Pekan Kuah,	Drainage Improvement and	
			(Parit A - B -	Langkawi	Channelisation.	
			tributary)			
	3	Kedah	Alor	Menaiktaraf Hilir Alor Tok Pasai, Kuala Kedah	Drainage Improvement	
			Tok Pasai			
	4	Merbok	Banggol	Ran Mencegah Banjir Banggol Lalang, Gurun	Drainage Improvement	
			Lalang	Kedah		
	5	Muda	Chepir	Mengorek Sungai Chepir	River Improvement	
	6	Perai	Keladi	Ran Saliran Bandar Kulim	Drainage Improvement and	Continued to RM8
				(Menaiktaraf Parit Monsun Kelang Sago)	Channelisation.	
			Seluang	Ran Saliran Bandar Kulim	Drainage Improvement and	Continued to RM8
			Bawah	(Membina Parit Utama kawasan Perindustrian	Channelisation.	
				Kulim)		
PULAU PINANG	6	Perai	Rambai	Rancangan Tebatan Banjir Sungai Rambai	River Improvement	
			Juru	Rancangan Mencegah Banjir Ceruk Tekun	River Improvement	
	7	P.Pinang	Pinang	Pemeliharaan Sungai Pulau Pinang	River Improvement	
				Rancangan Tebatan Banjir Sungai Pinang	River Improvement	
			Air Putih	Rancangan Mencegah Banjir Paya Bakung	River Improvement	
PERAK	8	Kerian	Kerian	Rancangan Saliran Lembah Beriah, Kerian	Urban Drainage Upgrading/	On-going in RM8
					River Channelisation	
			Kerian	Rancangan Pengorekan Bahagian Hilir	River Improvement	
				Sg. Kerian		

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 2 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
PERAK	9	Kurau	Kurau	Rancangan Mencegah Banjir Sg. Kurau	River Improvement	On-going in RM8
				Projek Pengaluran Sungai Kurau, Larut/Kerian (Daerah Larut, Matang dan Selama)	River Channelisation	
	10	Perak	Suli	Rancangan Sungai Suli	River Improvement	
			Jenderata	Rancangan Saliran Sungai Jenderata	River Channelisation	
			Perak	Rancangan Parit Memarit Teluk Bahru/Teluk Sireh	Urban Drainage Upgrading	
			Bangsi	Rancangan Memarit Sungai Bangsi	Urban Drainage Upgrading	
				Rancangan Saliran Pulau Pasir Hitam	Urban Drainage Upgrading	
			Trong	Rancangan Kg. Tebok/Kg. Temerloh/Kuala Trong	River Improvement	
			Durian	Rancangan Saliran Sungai Durian	River Channelisation	On-going in RM8
			Sungkai Mati	Rancangan Saliran Sungkai Mati	River Channelisation	
			Renggam	Rancangan Saliran Sg. Renggam	River Channelisation	On-going in RM8
			Langkap	Rancangan Saliran Sg. Langkap	River Channelisation	
			Manila	Rancangan Saliran Sg. Muda	River Channelisation	On-going in RM8
			Jebong	Rancangan Saliran Jebong	River Channelisation	
			Perak	Rancangan Mencegah Banjir Kg. Koh, Sitiawan	River Improvement	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 3 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
PERAK	10	Perak	Pahlawan	Pengaloran Sungai Pahlawan, Hilir Perak	River Improvement	On-going in RM8
			Nerok	Membaiki Sg. Nerok	River Improvement	
			Sungkai	Rancangan Mencegah Banjir Sg. Sungkai	River Improvement	On-going in RM8
			Kinta	Rancangan Mencegah Banjir Sg. Kinta	River Improvement	On-going in RM8
			Bukit Gantang	Rancangan Mencegah Banjir Sg. Bukit Gantang	River Improvement	On-going in RM8
			Plus	Rancangan Mencegah Banjir Sg. Plus, Sg. Siput	River Channelisation	On-going in RM8
			Ijok	Rancangan Mencegah Banjir Sg. Ijok Fasa II	River Channelisation	On-going in RM8
			Larut& Rantin	Rancangan Tebatan Banjir Sg. Larut & Sg. Rantin, Taiping	River Improvement	
			Hangai	Rancangan Tebatan Banjir Sg. Hangai di Grik, Hulu Perak	River Improvement	
			Ayer Tawar	Rancangan Tebatan Banjir Sg. Ayer Tawar, Manjung	River Improvement	
			Choh& Pinji	Rancangan Tebatan Banjir Sg. Choh/Sg.Pinji Kinta	River Improvement	On-going in RM8
			Perak	Rancangan Tebatan Banjir Padang Rengas, Kuala Kangsar	River Improvement	
			Perak	Rancangan Tebatan Banjir Kuala Sepetang	River Improvement	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 4 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
PERAK	10	Perak	Perak	Rancangan Tebatan Banjir dan Hakisan	River Improvement	
				Sungai Perak di Teluk Intan		
			Perak	Rancangan Tebatan Banjir Telok Intan Fasa 1	River Improvement	
			Tumboh	Rancangan Perparitan Tumboh Blok	Urban Drainage Upgrading	
			Bruas	Pemeliharaan Sg. Perak - Sg. Bruas	River Improvement	
			Perak	Rancangan-rancangan Parit, Perak		
				- Seberang Perak Peringkat III	Agricultural drainage	
				- Teluk Bahru/Teluk Sireh	Agricultural drainage	
				- Sg. Bangsi	Agricultural drainage	
				- Sg, Suli	Agricultural drainage	
				- Sg. Jenderata	Agricultural drainage	
				- SG. Bruas	Agricultural drainage	
			Perak	Rancangan -rancangan Taliair, Perak		
				- Parit		
				- Senin		
				- Bota/Lambor		
				- Kubang Haji		
				- Bota Kiri		
				- Lambor Kiri		
				- Projck Seberang Perak Pkt. IV		
SELANGOR	12	Tengi	Kg Kedah	Rancangan Mencegah Banjir Sungai Kg. Kedah /Tg. Siam	River Improvement	
			Tengi	Rancangan Mencegah Banjir Sg. Tengi	River Improvement	
	13	Selangor	Panjang	Rancangan Sungai Panjang	River Improvement	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 5 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
SELANGOR	14	Buluh	Buluh	Rancangan Tebatan Banjir Sg. Buluh	River Improvement	
	15	Klang	Klang	Rancangan Mambaiki Kawasan Klang	Urban Drainage Upgrading	
			Kapar Besar	Rancangan Mencegah Banjir Sg. Kapar Besar	River Improvement	
			Klang	RancanganTebatan Banjir, Kelang dan Pelabuhan Kelang	River Improvement	
			Air Hitam	Rancangan Tebatan Banjir Sg. Air Hitam	River Improvement	
			Kuyoh	Rancangan Tebatan Banjir Sg. Kuyoh	River Improvement	
			Kayu Ara	Rancangan Tebatan Banjir Sg. Kayu Ara	River Improvement	
			Klang Ulu	Rancangan Tebatan Banjir Sg. Klang Ulu/Sg. Kerayong	River Improvement	
			Kuang	Rancangan Tebatan Banjir Sg. Kuang	River Improvement	
			Lembah Jaya	Rancangan Tebatan Banjir Sg. Lembah Jaya	River Improvement	
	16	Langat	Jeloh	Rancangan Tebatan Banjir Sg. Jeloh	River Improvement	
			Cheras	Rancangan Tebatan Banjir Sg. Cheras	River Improvement	
			Kandie	Rancangan Tebatan Banjir Sg. Kandis	River Improvement	
			Reko	Rancangan Mencegah Banjir Sungai Reko, Hulu Langat	River Improvement	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 6 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
SELANGOR	16	Langat	Balak	Rancangan Mencegah Banjir Sg. Balak, Hulu Langat	River Improvement	
			Lui	Rancangan Mencegah Banjir Sg. Lui, Hulu Langat	River Improvement	
			Beranang	Rancangan Mencegah Banjir Sungai Beranang	River Improvement	
			Langat	Rancangan Mencegah Banjir Sungai Langat Bhg. 1 Kuala Langat	River Improvement	
	17	Sepang	Jenderam Salak Buah Bukit Tunggul	Rancangan Mencegah Banjir Sg. Jenderam, Sg. Salak/Sg. Buah/Sg. Bukit Tunggul Sepang	River Improvement	
NEGERI SEMBILAN	18	Linggi	Raya	Membaiki Saliran Sungai Raya	River Improvement	
			Setol	Sungai Setol	River Improvement	
			Bukit Melintang	Sungai Bukit Melintang	River Improvement	
			Setol	Rancangan Mengorek Sg. Setol	River Improvement	
			Pertang	Rancangan Mencegah Banjir Sg. Pertang	River Improvement	
			Triang	Rancangan Mencegah Banjir Sg. Triang	River Improvement	
			Gemencheh	Rancangan Mencegah Banjir Sg. Gemencheh	River Improvement	
			Pedas	Rancangan Mencegah Banjir Sg. Pedas	River Improvement	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 7 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
NEGERI SEMBILAN	18	Linggi	Rembau	Rancangan Mencegah Banjir Sg. Rembau	River Improvement	
			Sri Menanti	Rancangan Mencegah Banjir Sri Menanti	River Improvement	
			Simin	Rancangan Mencegah Banjir Sg. Simin	River Improvement	
			Kenaboi	Rancangan Mencegah Banjir Sg. Kenaboi, Jelebu	River Improvement	
			Jerang	Rancangan Mencegah Banjir Sg. Jerang, Jelebu	River Improvement	
			Penajis	Rancangan Mencegah Banjir Sg. Penajis/ Mampung, Rembau	River Improvement	
			Serting	Rancangan Mencegah Banjir Sg. Serting, Jempol	River Improvement	
			Tarun	Rancangan Mencegah Banjir Sg. Tarun, Seremban	River Improvement	
			Linggi	Rancangan Mencegah Banjir Sg. Linggi	River Improvement	
			Linggi	Rancangan Tebatan Banjir Seremban	River Improvement	
			Linggi	Rancangan Tebatan Banjir Bandar Port Dickson	River Improvement	
MELAKA	18	Linggi	Ramuan China Kecil	Mengorek Sg Ramuan China Kecil	River Improvement	
			Simpang Ampat	RMB Sg. Simpang Ampat	River Improvement	
	19	Melaka	Udang	Mengorek Sg. Udang	River Improvement	
			Air Hitam	RMB Sg. Air Hitam	River Improvement	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 8 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
MELAKA	19	Melaka	Salak	RMB Sg. Salak	River Improvement	
			Lendu	RMB Sg. Lendu	River Improvement	
JOHOR	20	Kesang	Kesang	Rancangan Perparitan Sg. Kesang Muar	River Channelisation	
				Ranc. Saliran Sg Kesang Peringkat II	River Channelisation	
	21	Muar	Muar	Rancangan Perparitan Muar Tambahan	Urban Drainage Upgrading	
			Pagoh	Rancangan Pengaluran/Memperbaiki Sg. Pagoh	River Channelisation	
					River Improvement	
			Juasseh	Rancangan Pengaluran Sg. Juasseh	River Channelisation	
			Muar	Rancangan Perparitan Tg. Agas dan Kesang, Muar	Urban Drainage Upgrading	
			Jementah	Rancangan Pengaluran Sg. Jementah	River Channelisation	
			Kapeh	Rancangan Pengaluran Sg. Kapeh	River Channelisation	
	22	Batu Pahat	Sarang Buaya	Rancangan Saliran Sg. Sarang Buaya	Urban Drainage Upgrading	
		Batu Pahat	Chaah	Rancangan Perparitan Cha'ah Baru	Urban Drainage Upgrading	
	23	South West	Tebrau	Rancangan Pengaluran/Memperbaiki Sg.	River Channelisation	
		Johor Rivers		Tebrau Peringkat II	River Improvement	
			Tebrau	Rancangan Pengaluran Sg. Tebrau Fasa III	River Channelisation	
	25	Sedili Besar	Sedili Kecil	Rancangan Pengaluran Sg. Sedili Kecil	River Channelisation	
			Gambut	Rancangan Mencegah Banjir Kg. Gambut	Urban Drainage Upgrading	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 9 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
PAHANG	30	Pahang	Ringlet	RTB Sg. Ringlet	River Improvement	
			Kial	RTB Sg. Kial	River Improvement	
			Bertam	RTB Sg. Bertam Fasa I	River Improvement	
			Bertam	RTB Sg. Bertam Fasa II	River Improvement	
			Ikan/Telom	RTB Sg. Ikan/ Sg. Telom	River Improvement	
TERENG-GANU	32	Kemaman	Sg. Kemaman	Longkang Gong Limau ,Chukai, Kemaman	River Rehabilitation	
			Sg. Kemaman	Rancangan Sistem Saliran Kubang Kurus	Urban Drainage	
			Sg. Kerteh	Rancangan Sistem Saliran Parit Paya Labohan	Urban Drainage	
			Sg. Kemasik	Rancangan Sistem Saliran Parit Pekan Kemasik	Urban Drainage	
	33	Paka	Sg. Paka	Benteng Sungai Paka	Bund Wall Structure	
	34	Dungun	Sg. Dungun	Rancangan Sistem Saliran Bandar Dungun	Drainage Improvement	
			Sg. Dungun	Benteng Pasir Raja	Bund Wall Structure	
	35	Merchang	Sg. Marang	Rancangan Saliran Terkawal Kampung Binjai Bongkok, Bukit Payong, Marang	Urban Drainage	
	36	Terengganu	Sg. Terengganu	Rancangan Sistem Saliran Kampung Padang Macang, Manir, Kuala Terengganu	Urban Drainage	
			Sg. Terengganu	Bukit Batu dan Bukit Tumbuh	Bund Wall Structure	
			Sg. Terengganu	Rancangan Mengurangkan BanjirPulau Duyong	Bund Wall Structure	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 10 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
TERENG-GANU	36	Terengganu	Sg. Terengganu	Tebing Sungai Tersat, Kampung Buluh	Bund Wall Structure	
			Sg. Terengganu	Benteng Gaung Kuala Berang	Bund Wall Structure	
			Sg. Ibai	Rancangan Sistem Saliran Parit Chendering	Urban Drainage	
			Sg. Telemong	Benteng Sungai Telemong	Bund Wall Structure	
	37	Setiu	Sg Setiu	Rancangan Mengurangkan Banjir Sungai Setiu	River Rehabilitation	
	38	Besut	Sg Besut	Rancangan Mengurangkan Banjir Sungai Besut	River Rehabilitation	
			Sg Besut	Benteng Sungai Besut	Bund Wall Structure	
			Sg Besut	Rancangan Sistem Saliran Parit Kampung Raja	Urban Drainage	
			Sg. Keluang	Rancangan Sistem Saliran Parit Baroh Keranji	Urban Drainage	
KELANTAN	39	Kemasin / Semerak	Semerak	Mengorek Sungai Kuala Semerak	River Rehabilitation	
	40	Kelantan	Geting	Mengorek Sungai Kuala Geting & Pak Amat	River Rehabilitation	
			Kelantan	Mengorek Sungai Kuala Besar	River Rehabilitation	
			Pengkalan Chepa	Mengorek Sungai Pengkalan Chepa	River Rehabilitation	
			Kelantan	Rancangan Menstabil Tebing Sg.Kelantan di Kusial	River Rehabilitation	
			Kelar	Rancangan Mencegah Banjir Sg. Kelar.	Flood Mitigation	
			Krai / Tebing	Pengaluran Sg.Krai / Sg.Tebing	River Rehabilitation	

TABLE 4.2: MINOR FLOOD MITIGATION PROJECTS IMPLEMENTED BY JPS IN RANCANGAN MALAYSIA KE-4 TO KE-7 (PAGE 11 OF 11)

State	RBMU		River System	Flood Mitigation Project	Type of Mitigation Works	Remarks
	No.	Name				
KELANTAN	40	Kelantan	Sat & Kemubu	Rancangan Mencegah Banjir Lembah Sg.Sat-Sg.Kemubu	Flood Mitigation	
SABAH	207	Tawau	Belian	RMB Sg. Belian	River improvement	Completed
	208	Kalumpang	Kunak Jaya	RMB Sg. Kunak Jaya	River improvement/ diversion	Completed
	218	Kedamaian	Kawang-kawang	RMB Sg. Kawang-kawang	River improvement/ diversion	Completed
	221	Papar	Sabandil	RMB Sg. Sabandil	River improvement/diversion	Not implemented yet
			Benoni	RMB Sg. Benoni	Construction of river bund	Completed (State Funded)
			Padawan	RMB Sg. Padawan	River canalisation, bund & drainage construction	
	222	Kimanis	Kimanis	RMB Sg. Kimanis	River canalisation, desilting & diversion	Completed
	224	Padas	Menawo Ulu	RMB Sg. Menawo Ulu	River bank protection	
			Kapawa	RMB Sg. Kapawa	Flood mitigation	Bring forward to RM8
			Sembilan	RMB Sg. Sembilan	River improvement/ diversion	Completed
			Mempikit	RMB Sg. Mempikit	River canalisation & dredging	Completed
			Pampang	RMB Sg. Pampang	River canalisation & dredging	Completed
SARAWAK	246	Sarawak	Sarawak	Rancangan Saliran dan Mencegah Banjir Hulu Tuang	Component for Drainage & Flood Mitigation Works	

TABLE 4.3(a): LIST OF URBAN DRAINAGE PROJECTS IMPLEMENTED BY DBKL

Dewan Bandaraya Kuala Lumpur (DBKL); RBMU No. 15, Klang

No.	Project Titile	Project Cost (RM mil)	Date of Commencement	Date of Completion	Remarks
1	Kerja-kerja Mempertingkatkan Anak Kayu Ara di Sg. Penchala (Fasa 1)	1.13	08.07.98	28.04.99	
2	Kerja-kerja Mempertingkatkan Anak Kayu Ara di Sg. Penchala (Fasa 2)	2.53	28.07.99	30.05.00	
3	Projek Penggantian Armco Dengan Pembinaan Paip Secara "pipe jacking" berhampiran Muzium Negara	6.15	09.07.97	17.05.98	
4	Projek Pembinaan Perparitan Sg. Bunus, Setapak (Fasa II)	4.58	19.08.96	20.07.97	
5	Projek Pembinaan Perparitan Sg. Bunus, Setapak (Fasa III)	2.53	05.08.98	13.04.99	
6	Projek Pembinaan Perparitan Sg. Bunus, Setapak (Fasa IV)	5.49	28.07.99	23.10.00	
7	Pembinaan Sistem Perparitan Induk dari Taman Dato Senu hingga ke Sg. Gombak, Bandar Baru, Sentul	2.23	07.09.98	09.05.99	
8	Pembinaan Perangkap Kelodak/Takungan Banjir di Sg. Peran berhampiran Setapak Jaya	1.22	08.09.98	22.09.99	
9	Pembinaan Sistem Perparitan Induk dari Plaza Rakyat melalui Jalan Cheng Lock hingga ke Sg. Klang berhampiran Kompleks Dayabumi	9.50	08.02.99	02.10.00	
10	Kerja-kerja Pembinaan Rumah Pam dan Kolam Takungan Air di Kg. Pasir Baru Petaling	3.89	01.04.97	09.07.98	
11	Mempertingkatkan Sistem Perparitan Induk Dari Jalan Kasawari hingga ke Jalan Gunung Tengah	2.04	09.06.97	07.06.98	
12	Perparitan Induk dari Taman Bamboo hingga ke Sg. Batu, Jalan Ipoh	1.08	23.08.97	02.05.98	
13	Pembinaan Perparitan dari Taman Setapak hingga ke Sg. Air Busuk, Setapak	1.76	15.10.97	15.02.99	
14	Mempertingkatkan Parit Induk berhampiran Rumah Pangsa Sri Perlis 2, Jalan Datuk Keramat	1.05	18.08.98	19.07.99	
15	Mempertingkatkan Parit Induk untuk mangatasi banjir di Taman United, Jalan Sepadu off Jalan Klang Lama	2.19	01.09.98	30.05.00	

TABLE 4.3(a): LIST OF URBAN DRAINAGE PROJECTS IMPLEMENTED BY DBKL

Dewan Bandaraya Kuala Lumpur (DBKL); RBMU No. 15, Klang

No.	Project Titile	Project Cost (RM mil)	Date of Commencement	Date of Completion	Remarks
16	Mempertingkatkan Saliran Sg. Bunus dari Jalan Tun Razak hingga Kelab Sultan Sulaiman,	1.74	03.08.98	14.05.99	
	Jalan Raja Alang				
17	Cadangan Mempertingkatkan Saliran Sg. Bunus Jalan Raja Abdullah hingga ke Jalan Raja	1.40	01.07.99	23.02.00	
	Muda Aziz				
18	Mempertingkatkan Saliran Sg. Jerneh dari Taman Kepong Baru ke Sg. Keroh	1.23	23.03.99	30.08.99	
19	Mempertingkatkan Perparitan Induk di Jalan Kuchai dari Taman Kuchai Jaya hingga ke	1.66	01.08.98	27.03.99	
	Sg. Kerayong				
20	Pembinaan Perparitan di Sg. Bohol bermula dari sempadan WPKL/Selangor hingga ke	1.40	21.12.98	31.07.99	
	kawasan Perindustrian Puchong				
21	Pembinaan Saluran Keluar Taman Dato Senu, Tan Yew Lai ke Sg. Klang Jalan Puchong	1.06	07.09.98	21.02.99	
22	Mempertingkatkan Perparitan Sg. Pantai dari Asrama Zaaba Universiti Malaya hingga ke	1.25	28.05.99	09.12.99	
	Jalan Datuk Abu Bakar				
23	Pembinaan pembetung kekotak dari Jalan Pahang berhampiran Masjid Setapak hingga ke	0.54	28.06.99	15.10.99	
	Sg. Gombak				
24	Mempertingkatkan Sistem Perparitan Induk dari Desa Pandan hingga ke Jalan Kedondong	1.02	18.05.99	04.10.99	
25	Pembinaan Pembetung Kekotak di Jalan Yap Tai Chee	0.45	15.05.99	04.10.99	
26	Pembinaan Perparitan Induk berhampiran Kem Palapes Universiti Malaya ke Anak Sg. Batu,	1.10	24.06.99	29.10.99	
	Jalan Damansara				
27	Pembinaan Parit Induk di Salak Selatan Pusat Perindustrian Ringan Jalan 2	0.90	10.05.99	19.01.00	
	Pembinaan Pembetung Kekotak di sebahagian Parit Lembah Treacher dari Karyaneka ke	1.82	12.05.99	12.12.99	
	Jalan Kia Peng				
28	Dari Taman Sri Kepong Baru ke Sg. Keroh, Kuala Lumpur	1.18	23.09.99	30.08.99	

TABLE 4.3(b): LIST OF URBAN DRAINAGE PROJECTS IMPLEMENTED BY MPMBB

Majlis Perbandaran Melaka Bandaraya Bersejarah (MPMBB); RBMU No. 19, Melaka

No	Project Titile	Project Cost (RM mil)	Date of Commencement	Date of Completion	Remarks
1	Cadangan Membina dan Menyiapkan Longkang Konkrit Besar di Tepi Jalan Padang Temu	0.51	27.10.93	10.05.94	
2	Cadangan Membina dan Menyiapkan Longkang Jenis Pudu-Cut di Taman Sin Hoe Bukit Baru ke Sg. Melaka	0.88	25.07.94	06.02.95	
3	Cadangan Membina dan Menyiapkan Longkang Konkrit di Lorong Pandan	1.06	25.07.94	06.03.95	
4	Cadangan Membina dan Menyiapkan Longkang MGBM di Atas Lot 113/117, Mukim Batu Berendam	0.68	15.07.96	17.11.96	
5	Cadangan Membina dan Menyiapkan Parit Konkrit di Taman Kota Laksamana	2.00	20.08.97	27.05.98	
6	Cadangan Membina dan Menyiapkan Parit Konkrit di Mukim Tanjung Keling	2.13	20.08:97	18.02.98	
7	Cadangan Membina dan Menyiapkan Parit Konkrit di Taman Sentuhan Mutiara, Batu Berendam	1.99	20.08.97	27.05.98	
8	Cadangan Membina dan Menyiapkan Longkang Konkrit dan Tembok Penahan di Tepi Jalan daripada Pasar dan Medan Selera Pantai Jaring ke Pembetong Kondominium Lot 2170 di Pantai Rombang	0.06	20.08.97	20.10.97	
9	Cadangan Membina dan Menyiapkan Parit Konkrit dari Kuarters Polis Bukit Baru hingga Taman Desa Baru	2.32	15.09.98	08.11.99	
10	Cadangan Membina dan Menyiapkan Parit Konkrit di Jalan Pokok Mangga	5.46	28.03.00	21.05.01	
11	Cadangan Menaikkan Taraf Sebahagian Parit Tanah dari Kg. Peringgit ke Sg. Melaka	1.34	07.03.01		Contract Completion Date is 05.02.02
12	Cadangan Menaikkan Taraf Parit di Mukim Klebang Kecil dan Klebang Besar	1.78	26.06.01		Contract Completion Date is 15.04.02
13	Cadangan Membina dan Menyiapkan Parit Konkrit dari Taman Saujana ke Sg. Gapam (Fasa II)	1.78	01.08.01		Contract Completion Date is 12.02.02

TABLE 4.3(c): LIST OF URBAN DRAINAGE PROJECTS IMPLEMENTED BY MBJB

Majlis Bandaraya Johor Bahru (MBJB); RBMU No. 23, South West Johor Rivers

No	Project Titile	Project Cost (RM mil)	Date of Commencement	Date of Completion	Remarks
1	Cadangan Membina Parit Bertembok Batu Baur di Anak Sg. Sengkuang	0.14	20.07.00	12.10.00	
2	Cadangan Kerja Membaikpulih Saluran Konkrit Anak Sg. Tebrau di Jalan Dataran 2/2, Taman Kempas	0.33	01.09.00	03.02.01	
3	Cadangan Menaiktaraf Saluran Konkrit Sg. Tampoi (R 11) dari Jalan Tebrau hingga Jalan Cendana di Kg. Setanggi	1.05	15.08.00	15.03.01	
4	Cadangan Membaiki Struktur Parit Bertembok Batu Baur di Anak Sg. Tengkorak , Taman Permas Jaya	0.23	15.08.00	28.02.01	
5	Cadangan Kerja-kerja Pembersihan Mendakan Lumpur Kolam Pengoksidaan di Taman Rinting, Fasa I	0.39	28.09.00	28.03.01	
6	Cadangan Kerja-kerja Membina Parit Bertembok Batu Bata di Jalan Kijang dan Jalan Seladang, Taman Abad	0.08	20.02.01	09.04.01	
7	Cadangan Kerja Mengatasi Masalah di Jalan Selatan 8, Off Jalan Kempas Lama, Johor Bahru	0.2	15.01.01	15.05.01	
8	Cadangan Kerja Mengatasi Tebing Runtuh di Tepi Rumah Jalan Pesisiran Kempas Lama	0.14	15.03.01	31.07.01	
9	Cadangan Kerja Membina Saluran Konkrit di Sg. Sebulong, Kg. Bendahara (Jalan Keladi), Johor Bahru, Fasa 1, Peringkat Kelima	1.41	16.06.00		Contract Completion Date is 15.06.01
10	Cadangan Kerja-kerja Menaikkan Taraf Sistem Saliran dan Perparitan di Kg. Dato' Sulaiman Menteri dan Kg. Tok Siak, Majidee	0.51	15.04.01		Contract Completion Date is 25.03.02
11	Cadangan Kerja-kerja Mengatasi Banjir di Sek. Men. Dato' Abdul Rahman Yassin	0.25	01.08.01		Contract Completion Date is 09.01.02
12	Cadangan Kerja-kerja Tembok Parit Runtuh di Jalan Dian 24/1, Taman Munsyi Ibrahim	0.1	26.05.01		Contract Completion Date is 26.06.01

TABLE 4.3(c): LIST OF URBAN DRAINAGE PROJECTS IMPLEMENTED BY MBJB

Majlis Bandaraya Johor Bahru (MBJB); RBMU No. 23, South West Johor Rivers

No	Project Titile	Project Cost (RM mil)	Date of Commencement	Date of Completion	Remarks
13	Cadangan Kerja-kerja Membina Tembok Penahan Batu Baur di Parit Utama Taman Kempas	0.12	26.05.01		Contract Completion
					Date is 26.06.01
14	Cadangan Kerja-kerja Membina Pembetung Kekotak Melintasi Jalan Tasek Utara	0.13	26.05.01		Contract Completion
	(Hutan Bandar)				Date is 26.06.01

TABLE 4.3(d):LIST OF URBAN DRAINAGE PROJECTS IMPLEMENTED BY MPSP

Majlis Perbandaran Seberang Perai, (MPSP); RBMU 6, Perai

No.	Project Titile	Project Cost (RM mil)	Date of Commencement	Date of Completion	Remarks
1	Cadangan merekabentuk dan membina rumah pam, membekal, memasang serta menguji	4.51	21/9/99	27/7/00	
	jalan peralatan berkaitan bagi rumah pam kawasan banjir, Taman Chai Leng, SPT.				
2	Cadangan memperbesarkan parit moonson sediada untuk projek tebatan banjir Taman	0.13	7/10/99	30/9/00	
	Chai Leng, SPT.				
3	Cadangan membekal, memasang, meguji pam banjir serta peralatan dan kerja-kerja	1.84	24/7/00	23/6/01	
	berkaitan untuk tebatan banjir di Taman Sentul, Taman Sentul Jaya, Taman Pinang dan				
	Taman Mangga, SPT				
4	Cadangan menaiktaraf sistem perparitan untuk tebatan banjir Taman Setul, Taman Setul	3.35	19/10/00	6/9/01	
	Jaya, Taman Mangga & Taman Pinang, Juru, SPT				
5	Cadangan membina parit konkrit di Jalan Pongsu Seribu (dari Taman Orkid ke USM), Kepala	0.28	7/10/99	30/4/00	
	Batas				
6	Cadangan menaiktaraf pembentung Jalan Telaga Air, Butterworth	0.28	26/11/99	15/9/00	
7	Cadangan menaiktaraf parit dan kerja-kerja berkaitan di Jalan Kg.Gajah (Jln Persekutuan 1)	0.18	11/6/00	30/11/00	
	berhampiran Ipoh Garden, Butterworth				

TABLE 4.4: LIST OF WATER RESOURCES PROJECTS WITH FLOOD MITIGATION COMPONENT IMPLEMENTED BY JKR AND TNB FROM 1980 TO 2000

RBMU		River	Water Resources Project	Year of Completion	Remarks
No.	Name				
10	Perak	Perak	Bersia Dam	1983	Hydroelectric Dam by TNB
		Perak	Kenering Dam	1983	Hydroelectric Dam by TNB
		Perak	Temenggor Dam	1978	Hydroelectric Dam by TNB
36	Terengganu	Terengganu	Kenyir Dam	1984	Hydroelectric Dam by TNB
40	Kelantan	Pergau	Pergau Dam	1996	Hydroelectric Dam by TNB

CHAPTER 5

UPDATING OF CONDITIONS OF FLOODING

5.0 UPDATING OF CONDITIONS OF FLOODING

5.1 SELECTION OF WORST FLOOD EVENT IN EACH RBMU

The conditions of flooding in each RBMU in the JICA 1982 Report were derived from information associated with the worst flood event in each RBMU, between 1963 to 1979. Since then, some RBMU may have projects with major flood mitigation impacts implemented within it. This will mitigate the worst flood event reported by JICA for the pertinent RBMU. Thus, there is a need to select the worst flood event that occurred in the pertinent RBMU, between the year of completion of the project to 2001, for the purpose of updating the conditions of flooding in the pertinent RBMU.

Also, for the RBMU without any major flood mitigation projects implemented within it there may be flood events, during the period 1980 to 2001, that maybe worst than the ones reported by JICA. Thus, there is also a need to select the worst flood event between 1963 to 2001, for the purpose of updating the conditions of flooding in the RBMU.

Figure 5.1 shows a flow chart describing how the worst flood event in each RBMU is selected, depending on whether there are any major flood mitigation projects completed within it. If there is a major projects implemented within a RBMU then the worst flood event that occurred after the completion of the project will be selected. If there are no major projects then a comparison is made between the flooded areas associated with the worst reported flood event between 1980 to 2001, with that reported by JICA for the period 1963 to 1979. If the flooded area associated with the worst flood event between 1980 and 2001 is larger than that reported by JICA, then the worst flood event between 1980 to 2001 will be selected for updating the conditions of flooding in the RBMU. Otherwise, the worst flood event reported by JICA in the 1982 Study will be selected.

The lists of flood mitigation and drainage projects, and water resources projects with flood mitigation components, have been compiled and tabulated in Chapter 4. They are used to derive Table 5.1, which shows the list of RBMU in the country that have projects with major flood mitigation impacts implemented within them. From the information compiled in Table 5.1 and the process described in Figure 5.1 below, the worst flood event in each of the

flood affected RBMU in the country have been selected and tabulated in Table 5.2.

Table 5.2 gives the list of the selected worst flood events, organised by rivers, RBMU and State. For each selected worst flood event the ARI for the event together with the non-flooding ARI are also given. The Table also highlights the RBMU where major flood mitigation impact projects have been implemented and also those that have reported flood events larger than those reported by JICA in the 1982 Study.

5.2 UPDATED FLOOD MAPS FOR EACH RBMU

From the reported flood information associated with the selected worst flood event in each RBMU the updated flood maps for each pertinent RBMU are produced. **Appendix 2** gives an example of the drawing showing the flood map produced for the Perai RBMU. The updated flood maps that have been produced are compiled and presented in the respective accompanying State Flood Reports. A total of 216 number of drawings of the detail flood maps have been produced. These flood maps are drawn by using the 1 in 50,000 scale topographic maps as base maps.

Figures 5.2 and 5.3 show the indicative locations of the flood affected areas in Peninsular Malaysia, Sabah and Sarawak. Table 5.3 list the state flood maps produced for all the states in Malaysia. The A3 size of these maps are given in **Appendix 8**.

5.3 UPDATED FLOOD AREA STATISTICS AND ANNUAL AVERAGE DAMAGE IN EACH RBMU AND STATE

Using the procedure described in detail in Section 2.3 and the information derived from the updated flood maps for each RBMU, the flood area statistics, number of people and houses affected, and the Annual Average Damage (AAD) associated with the worst flood event were computed. Also, for the RBMU, where projects with major flood mitigation impacts have been implemented, the envelope of flood affected areas, as at year 2001, were delineated on the flood maps and the flood-affected area statistics were also computed.

The details on the flood area statistics and AAD for each RBMU are compiled and presented in the respective accompanying State Flood Reports. A summary comparison of the results computed above in the KTA Tenaga (KTAT) 2002 Study, with the results reported in the JICA 1982 Study, for each RBMU, is presented in Table 5.4.

To facilitate comparison of the study results, by state, 14 Tables comparing the total flood area statistics, number of people affected by floods and the AAD, have also been compiled and presented in the respective accompanying State Reports. The pertinent information from the 14 Tables has been extracted and compiled in Table 5.5 to facilitate comparison of the results between states. Table 5.5 also gives the total flooded area, number of people affected, annual average damage and flood-affected areas for the whole country.

5.4 DISCUSSIONS

5.4.1 Comparison by RBMU

Table 5.4 presents the 2002 Study results together with the 1982 Study results, by RBMU. Most of the RBMUs throughout the country have experienced an increase in the flooded area. 20 RBMUs have 'selected worst flood event' which is more severe compared to JICA. Flooded areas for 22% of RBMUs in Peninsular Malaysia, 38% in Sabah and 26% in Sarawak have increased since JICA's study. Several RBMUs like Perlis, Perak, Melaka and Terengganu shows a reduction in flooded areas mainly due to the successful implementation of flood mitigation projects. The number of people affected by floods has also increased for majority of the RBMUs throughout the country due to the corresponding increase in population. Almost all RBMUs has an increased Annual Average Damage compared to JICA's study which is contributed by the change in landuse categories, higher damage values for properties and crops and an increase in the number of households being flooded.

5.4.2 Comparison by State

Table 5.5 presents the 2002 Study results together with the 1982 Study results, by state. Most of the states flood affected area has reduced except for Kedah, Pulau Pinang, Terengganu and Sabah, which is due to flood events selected for several RBMUs being more severe than events reported in JICA. There has been a significant increase in the number of people affected for

most of the states except for Perlis, Perak, Negeri Sembilan, Melaka and Johor. And as for the Annual Average Damage, every state's damage has increased respectively compared to JICA except for Melaka. States undergoing rapid development such as Pulau Pinang, Selangor and Wilayah Persekutuan constitutes almost 37% of the total AAD for Peninsular Malaysia.

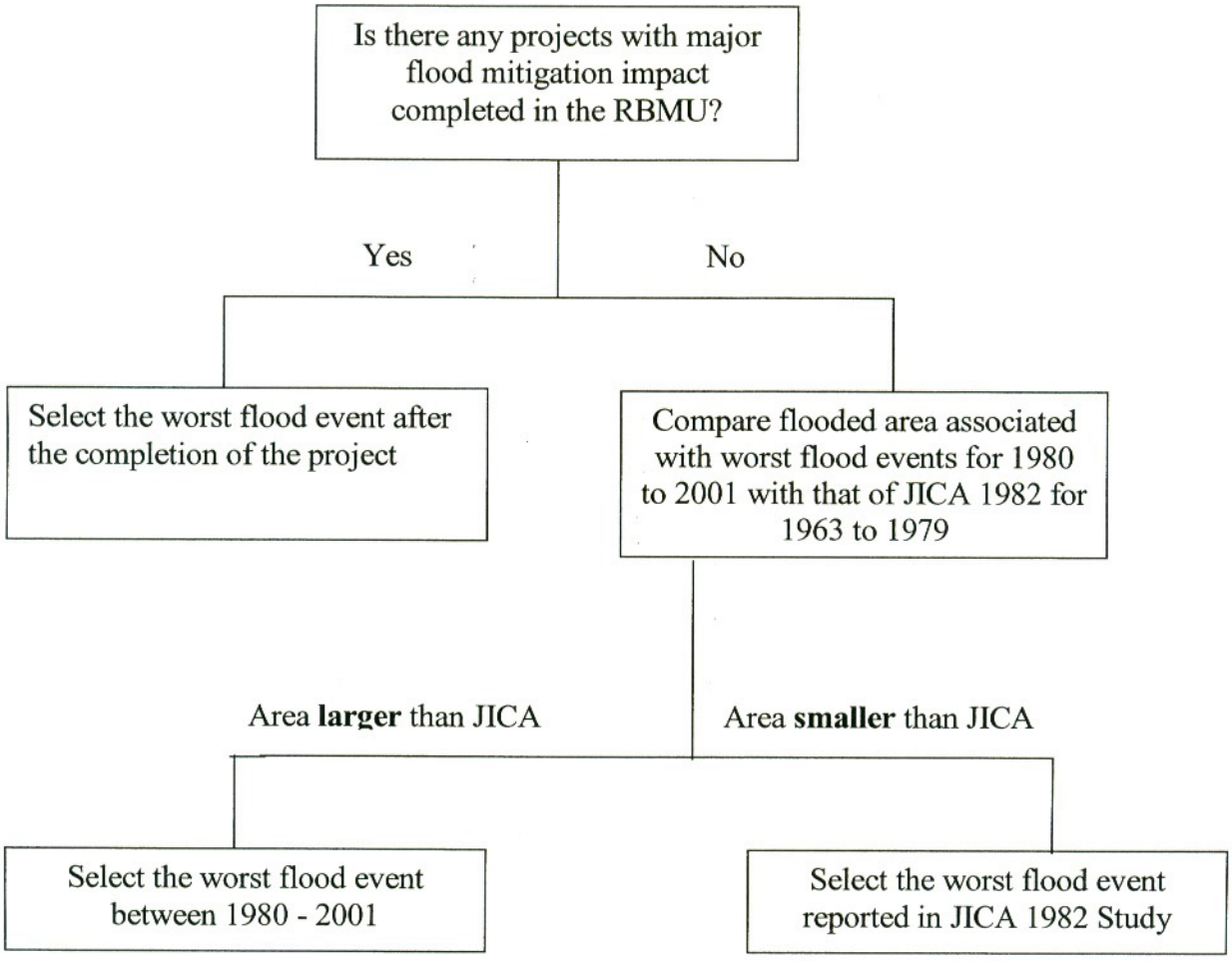


FIGURE 5.1: FLOW CHART TO SELECT THE WORST FLOOD EVENT

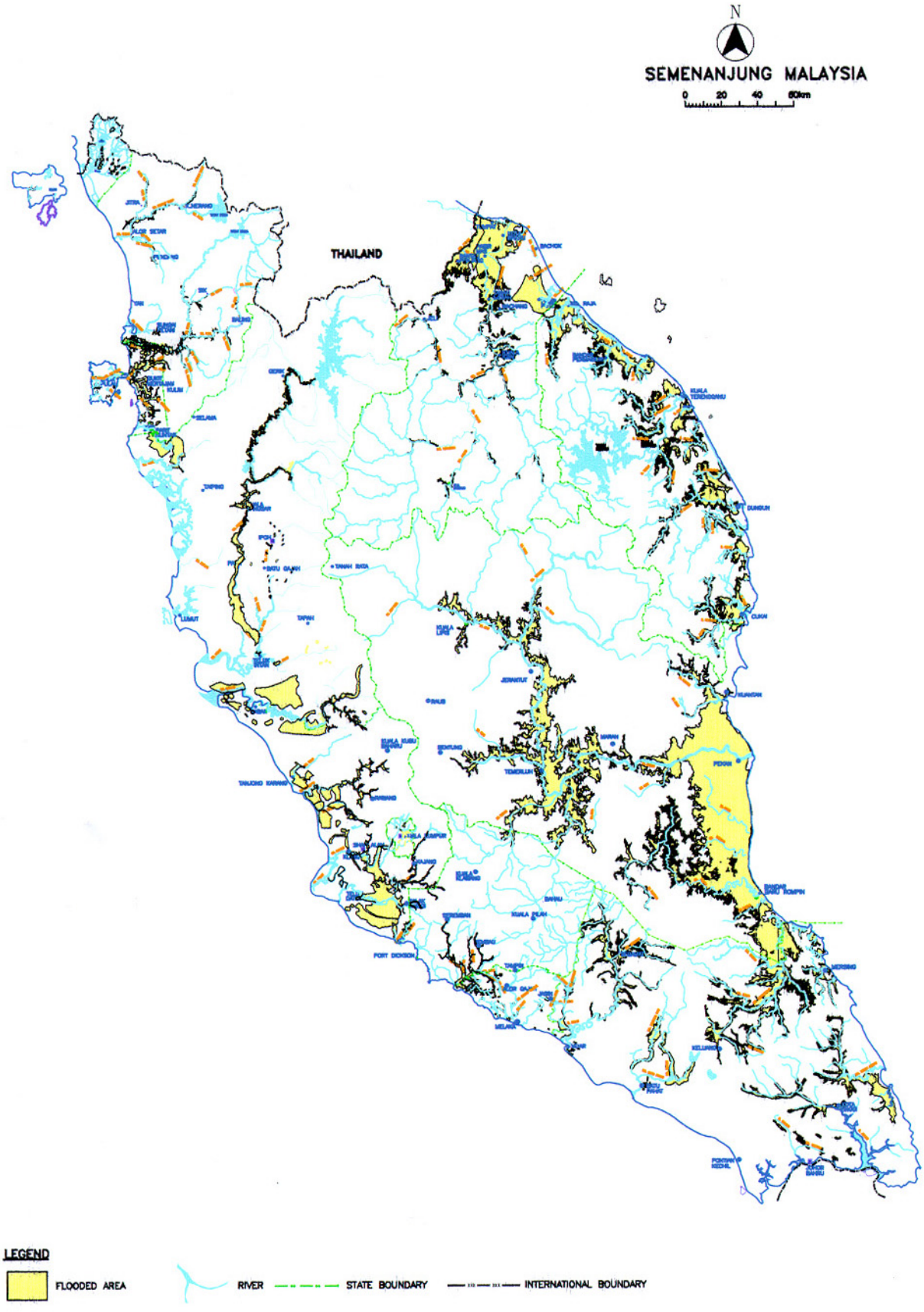


FIGURE 5.2 PENINSULAR MALAYSIA FLOOD AFFECTED AREA MAP

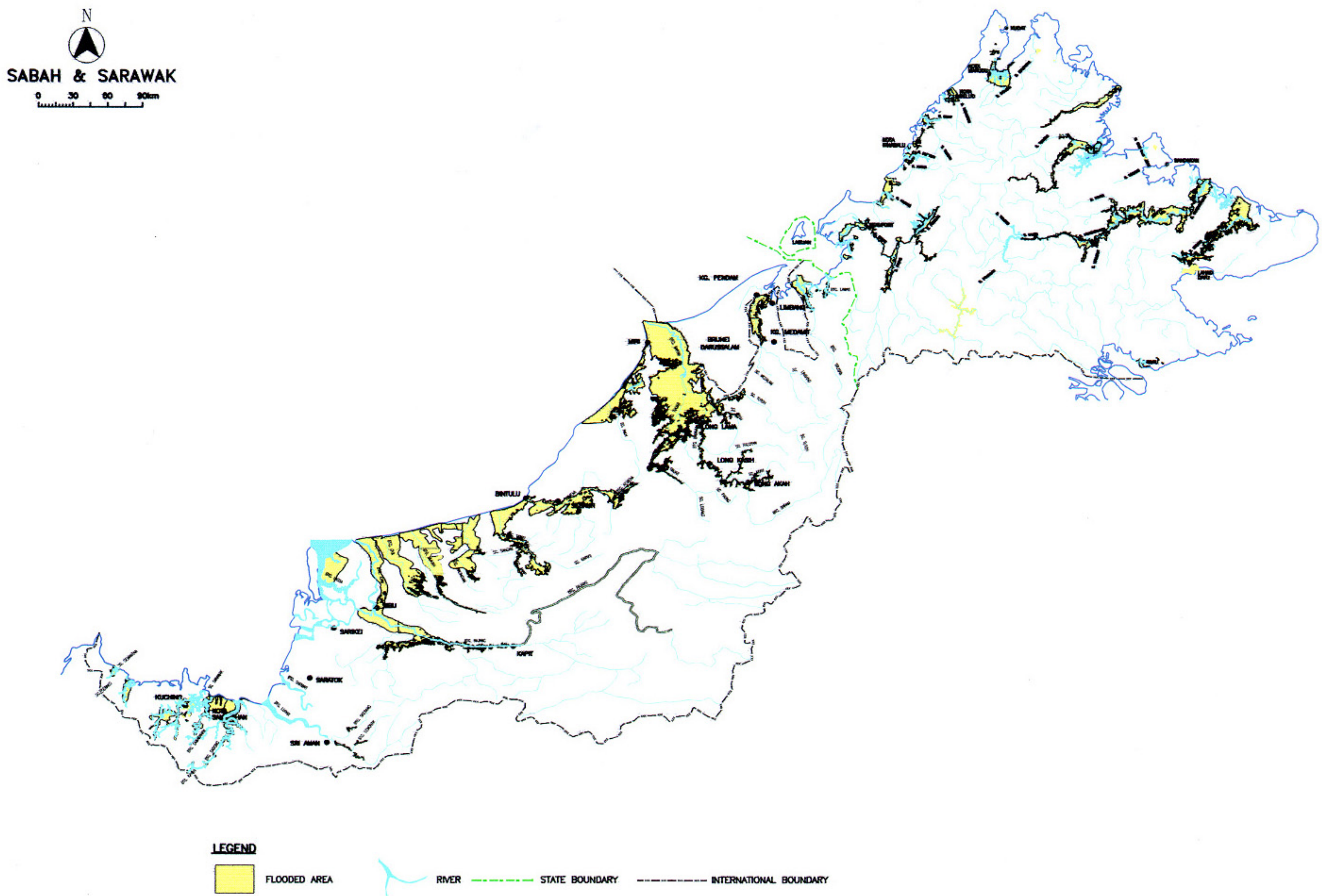


FIGURE 5.3 SABAH & SARAWAK FLOOD AFFECTED AREA MAP

TABLE 5.1: LIST OF RBMU WITH PROJECTS THAT HAVE MAJOR FLOOD MITIGATION IMPACTS IMPLEMENTED FROM 1980 TO 2000

RBMU		PROJECTS WITH MAJOR FLOOD MITIGATION IMPACTS	YEAR COMPLETED	IMPLEMENTED BY
NO.	NAME			
01	Perlis	Timah Tasoh Dam	1992	JPS
		RTB Kangar	1995	JPS
10	Perak	Bersia Dam	1983	TNB
		Kenering Dam	1984	TNB
		Temenggor Dam	1978	TNB
15	Klang	RTB Kuala Lumpur	On-going	JPS
		Batu Dam	1986	JPS
19	Melaka	RMB Sg. Melaka	1991	JPS
20	Kesang	Rancangan Saliran Sg. Kesang Peringkat 1 & 2	RM5 to RM7	JPS
22	Batu Pahat	IADP Johor Barat - Dam Components	1990	JPS
23	South West Johore Rivers	Rancangan Pengaluran Sg. Skudai	RM4 to RM7	JPS
		Rancangan Pengaluran Sg. Tebrau	RM4 to RM7	JPS
36	Terengganu	Kenyir Dam	1984	TNB
39	Kemasin/ Semerak	Program Mencegah Banjir Kemasin/Semarak	2000	JPS

TABLE 5.2: SELECTED WORST FLOOD EVENT, ACCORDING TO RBMU (Sheet 1 of 2)

STATE	RBMU NO.	RBMU NAME	RIVER	SELECTED WORST FLOOD EVENT	ARI (Year)	Non Flooding ARI
PERLIS	01	Perlis	Perlis	22/11/2000 - 25/11/2000	10	5
KEDAH	03	Kedah	Kedah	23/11/2000 - 1/12/2000	5	2
	05	Muda	Muda	1973	10	2
PULAU PINANG	06	Perai	Perai, Juru & Jawi	17/9/1995 - 23/9/1995	15	2
	07	P.Pinang	Pinang	15/11/1998 - 17/11/1998	15	2
PERAK	08	Kerian	Kerian	25/10/1999 - 17/11/1999	50	4
	09	Kurau	Kurau	1980	10	4
	10	Perak	Perak	Oct - Dec 1999	10	2
SELANGOR	11	Bernam	Bernam	1971	20	4
	12	Tengi	Tengi	1971	20	4
	13	Selangor	Selangor	1971	20	4
	14	Buloh	Buloh	1971	20	4
	15	Klang	Klang	1971	80	3
	16	Langat	Langat	1971	30	3
	17	Sepang	Sepang	1971	20	3
WILAYAH P'SEKUTUAN K. LUMPUR	15	Klang	Gombak, Batu, Bunus & Kerayong	26/4/2001	2	1
NEGERI SEMBILAN	18	Linggi	Paroi, Pedas, Rembau Penajis & Simin	1971	30	3
MELAKA	19	Melaka	Melaka	1/8/2000	20	3
	20	Kesang	Kesang	2/3/1984 - 13/3/1984	20	5
JOHOR	21	Muar	Muar	1971	15	2
	22	Batu Pahat	Batu Pahat	Dec-92	5	2
	23	South West Johore Rivers	Benut, Skudai & Tebrau	9/1/1987 - 16/1/1987	5	2
	24	Johor	Johor	2/12/1989 - 6/12/1989	15	2
	25	Sedili Besar	Sedili Besar	1969	10	2
	26	Mersing	Mersing	1971	21	3
	27	Endau	Endau	1969	21	3
PAHANG	28	Rompin	Rompin & Pontian	1971	21	3
	29	Bebar	Bebar & Merchong	1971	21	3
	30	Pahang	Pahang	1971	40	4
	31	Kuantan	Kuantan	1971	36	2
TERENGGANU	32	Kemaman	Kemaman & Kerteh	3/12/1983 - 12/12/1983	20	2
	33	Paka	Paka	5/12/1983 - 9/12/1983	25	2
	34	Dungun	Dungun	4/12/1983 - 15/12/1983	20	3
	35	Marang	Marang	1976	10	2
	36	Terengganu	Terengganu	13/11/2000-29/11/2000	14	1
	37	Setiu	Setiu	1967	10	2
	38	Besut	Besut	20/11/2000 - 23/11/2000	20	2

TABLE 5.2: SELECTED WORST FLOOD EVENT, ACCORDING TO RBMU (Sheet 2 of 2)

STATE	RBMU NO.	RBMU NAME	RIVER	SELECTED WORST FLOOD EVENT	ARI (Year)	Non Flooding ARI
KELANTAN	39	Kemasin/ Semerak	Kemasin/Semarak	21/11/2000 - 25/11/2000	20	3
	40	Kelantan	Kelantan	2/1/1967 - 7/1/1967	40	3
	41	Golok	Golok	2/1/1967 - 7/1/1967	40	2
SABAH	201	Pensiangan	Pensiangan	1981	14	1.8
	207	Tawau	Tawau	13/12/1999 - 15/12/1999	10	1.8
	210	Segama	Segama	31/1/2000 - 14/2/2000	38	1.8
	211	Kinabatangan	Kinabatangan	1981	14	1.8
	212	Seagalid	Seagalid	22/2/1997-24/2/1997	7	1.8
	213	Labuk	Labuk	1963	16	1.7
	214	Sugut	Sugut	1963	16	1.7
	216	Bengkokak	Bengkokak	1977	12	1.8
	217	Bongan	Bongan	1977	12	3.3
	218	Kedamaian	Kedamaian	1977	17	5.25
	219	Tuaran	Tuaran	5/1/1999-6/1/1999	15	1.8
	220	Putatan	Putatan	5/1/1999-6/1/1999	15	1.8
	221	Papar	Papar	5/1/1999-6/1/1999	15	2
	222	Kimanis	Kimanis & Bongawan	26/12/1996-27/12/1996	10	2
	224	Padas	Padas	1981	14	1.25
	225	Lakutan	Lakutan	8/17/1990	7	1.25
SARAWAK	227	Lawas	Lawas	1979	15	2
	228	Trusan	Trusan	1979	15	2
	229	Limbang	Limbang	1979	15	2
	230	Baram	Baram	1979	15	2
	231	Sibuti	Sibuti	1979	15	2
	232	Niah	Niah	1967	14	2
	233	Suai	Suai	1967	14	2
	234	Similajau	Similajau	1967	14	2
	235	Kemena	Kemena	1967	14	1.1
	236	Tatau	Tatau	1967	14	1.1
	237	Balingian	Balingian	25/12/1993 - 26/12/1993	20	1.1
	238	Mukah	Mukah	25/12/1993	20	1.1
	239	Oya	Oya	26/12/1993	20	1.1
	240	Rajang	Rajang	1963	33	1.1
	243	Lupar	Lupar	11/8/1995	20	1.1
	244	Sadong	Sadong	23/12/1999	10	1.1
	245	Samarahan	Samarahan	12/23/1999	20	1.4
	246	Sarawak	Sarawak	1963	50	1.4
	247	Kayan	Kayan	1963	50	1.4

RBMU that has major flood mitigation impact project implemented.

Flood events selected are larger than those reported in JICA 1982 Study.

TABLE 5.3 : LIST OF FLOOD MAPS (Maps are in Appendix 8)

Item	Drawing Title	Drawing No.	Scale (1 : X)	No. of Detail Flood Maps in State Report
1	Flood Map of Perlis	T0036\R\PERLIS	1:75,000	2
2	Flood Map of Kedah	T0036\K\KEDAH	1:300,000	7
3	Flood Map of Pulau Pinang	T0036\P\PENANG	1:100,000	3
4	Flood Map of Perak	T0036\A\PERAK	1:400,000	18
5	Flood Map of Selangor	T0036\B\SELANGOR	1:300,000	16
6	Flood Map of Wilayah Persekutuan	T0036\W\WILAYAH	1:50,000	1
7	Flood Map of Negeri Sembilan	T0036\N\NEGERI SEMBILAN	1:250,000	3
8	Flood Map of Melaka	T0036\M\MELAKA	1:100,000	3
9	Flood Map of Johor	T0036\J\JOHOR	1:400,000	27
10	Flood Map of Pahang	T0036\C\PAHANG	1:600,000	11
11	Flood Map of Terengganu	T0036\T\TERENGGANU	1:400,000	16
12	Flood Map of Kelantan	T0036\D\KELANTAN	1:300,000	19
13	Flood Map of Sabah	T0036\S\SABAH	1:800,000	35
14	Flood Map of Sarawak	T0036\Q\SARAWAK	1:1,000,000	55

TABLE 5.4: COMPARISON OF FLOODED AREA AND AAD BETWEEN KTAT 2002 STUDY AND JICA 1982 STUDY, ACCORDING TO RBMU

RBMU		Flooded Area of Selected Worst Flood Event (km^2)		No. of People Affected		ARI of Selected Worst Flood Event		Annual Average Damage (RM mil)		Flood Affected Area in 2002 Study	
No.	Name	2002 Study	1982 Study	2002 Study	1982 Study	2002 Study	1982 Study	2002 Study (at 2000 price)	1982 Study (at 1980 price)	Total Area (km^2)	People Affected
Peninsular Malaysia											
01	Perlis	18.36	39.00	12146	27900	10	10	2.75	1.76	26.74	12736
03	Kedah	36.53	16.00	28037	14500	5	10	14.84	0.54	52.01	37816
05	Muda	157.43	142.00	79733	73700	10	10	15.36	3.87	157.43	79552
06	Perai	180.56	17.00	239107	7700	15	5	38.7	0.51	180.56	239107
07	P.Pinang	13.23	1.00	38753	9900	15	5	5.82	0.86	26.27	103417
08	Kerian	105.13	17.00	28281	900	50	Not reported	2.65	Not reported	116.03	28281
09	Kurau	152.61	151.00	10749	13600	10	10	2.59	0.45	160.87	12311
10	Perak	156.44	1387.00	84299	375000	10	30	17.4	13.24	385.94	234782
11	Bernam	551.03	70.00	29319	12900	20	20	4.91	0.38	687.45	29319
12	Tengi	74.72	68.00	20271	3100	20	20	2.54	0.06	74.72	20271
13	Selangor	174.48	199.00	68606	22800	20	20	11.4	0.72	174.48	68606
14	Buluh	163.12	123.00	79901	23700	20	20	10.33	0.34	163.12	79901
15	Klang (Selangor)	143.28	142.00	283774	46800	80	80	24.23	2.65	143.28	283774
15	Klang (W.P)	2.65		31437	130700	2	80	99.3	2.96	13.18	157302
16	Langat	388.61	409.00	139967	114700	30	30	16.35	2.18	388.61	139967
17	Sepang	157.03	165.00	47379	Not reported	20	20	6	Not reported	157.03	47379
18	Linggi	129.48	131.00	40887	60900	30	30	3.96	1.57	129.48	40887
19	Melaka	8.79	89.00	9126	61300	20	20	1.33	1.59	13.89	12457
20	Kesang	45.03	105.00	8865	35000	20	20	0.96	1.4	66.96	15354
21	Muar	308.91	353.00	52846	76800	15	15	18.05	3.66	361.70	64750
22	Batu Pahat	86.83	430.00	6008	29500	5	15	3.92	2.72	208.52	37939
23	SW Johor	19.16	713.00	33019	110900	5	10	16.4	3.67	25.02	39701
24	Johor	120.17	91.00	27266	30500	15	10	8.16	0.96	143.23	40155
25	Sedili Besar	303.37	294.00	21814	2000	10	10	7.2	Not reported	303.37	21814
26	Mersing	146.84	122.00	25429	18100	21	10	3.33	0.42	146.84	25429
27	Endau	775.44	756.00	39372	34400	21	10	6.94	1.59	1178.03	60783
28	Rompin	1124.21	877.00	111843	4000	21	10	19.24	0.36	1124.21	233209
29	Bebar	1498.62	1446.00	23670	2000	21	10	5.21	0.31	1498.62	23670
30	Pahang	3373.66	3004.00	288889	299900	40	40	41.1	14.7	3373.66	288889
31	Kuantan	256.76	247.00	48054	29100	36	20	10.6	1.15	275.13	69359
32	Kemaman	409.10	315.00	107646	26800	20	20	22.8	0.87	409.11	107646
33	Paka	97.75	67.00	10369	500	25	10	1.76	0.03	97.75	10369
34	Dungun	271.78	215.00	31212	7900	20	20	13.69	0.29	271.78	31212
35	Marang	109.93	159.00	8767	2600	10	10	2.53	0.14	224.26	17856
36	Terengganu	249.01	612.00	57935	96800	14	30	24.21	2.32	475.23	126842
37	Setiu	366.01	363.00	28064	7300	10	30	7.38	0.32	366.01	28064
38	Besut	378.73	249.00	103406	80400	20	30	29.21	2.95	378.73	103406
39	Kemasin/Semarak	442.90	include in RBMU 40	157563	include in RBMU 40	20	40	23.76	include in RBMU 40	442.90	157563
40	Kelantan	632.37	1732.00	373886	624800	40	40	44.88	16.41	761.57	412531
41	Golok	435.91	include in RBMU 40	144193	include in RBMU 40	40	40	24.68	include in RBMU 40	435.91	144193

RBMU that has major flood mitigation impact project implemented.

Selected Worst Flood event in the RBMU is larger than the one reported in JICA 1982 Study.

TABLE 5.4: COMPARISON OF FLOODED AREA AND AAD BETWEEN KTAT 2002 STUDY AND JICA 1982 STUDY, ACCORDING TO RBMU

RBMU		Flooded Area of Selected Worst Flood Event (km^2)		No. of People Affected		ARI of Selected Worst Flood Event		Annual Average Damage (RM mil)		Flood Affected Area in 2002 Study	
No.	Name	2002 Study	1982 Study	2002 Study	1982 Study	2002 Study	1982 Study	2002 Study (at 2000 price)	1982 Study (at 1980 price)	Total Area (km^2)	People Affected
	Sabah										
201	Pensiangan	39.12	67.32	2733	1000	14	14	1.82	0.015	39.12	2733
207	Tawau	14.32	18.14	43371	5900	10	14	11.11	0.26	16.74	43861
210	Segama	701.41	256.14	46529	4900	38	14	6.97	0.24	701.41	46529
211	Kinabatangan	1052.03	1031.70	34980	5600	14	14	21.57	0.26	1052.03	34980
212	Seagalid	4.68	9.65	3834	6300	7	16	0.85	0.23	5.44	8199
213	Labuk	215.03	259.37	9035	4200	16	16	2.45	0.042	215.03	9035
214	Sugut	167.25	161.98	4540	300	16	16	1.29	0.004	167.25	4540
215	Bengkoka	57.05	44.11	8475	400	12	12	2.07	0.005	60.81	9062
217	Bongan	236.38	368.75	90990	21400	12	12	15.65	0.79	249.57	92063
218	Kedamaian	59.15	62.75	21272	9300	17	17	2.85	0.41	65.87	22345
219	Tuaran	41.41	34.75	24965	4200	15	14	5.08	0.14	49.80	39140
220	Putatan	41.82	7.07	41081	7200	15	14	8.65	0.24	66.41	138048
221	Papar	32.87	22.75	19260	6800	15	16	3.85	0.32	92.74	34600
222	Kimanis	39.75	13.70	19829	1300	10	16	6.78	0.095	63.05	22385
224	Padas	378.97	352.39	133881	4800	14	14	49.28	0.31	422.90	142989
225	Lakutan	15.89	Not reported	1665	Not reported	7	Not reported	0.69	Not reported	15.89	1665
	Sarawak										
227	Lawas	33.95	34.00	1332	300	15	15	1.32	0.005	33.95	1332
228	Trusan	186.40	186.50	2692	800	15	15	4.43	0.096	186.40	2692
229	Limbang	261.67	261.75	15976	2800	15	15	8.73	0.38	261.67	15976
230	Baram	3091.37	5165.15	9752	28400	15	15	20.69	1.224	3091.37	9752
231	Sibuti	210.99	214.10	25416	2500	15	15	8.75	0.2	210.99	25416
232	Niah	241.73	479.70	11104	4900	14	14	3.19	0.226	241.73	11104
233	Suai	183.00	211.75	1783	300	14	14	0.61	0.016	183.00	1783
234	Similajau	24.34	17.00	Insignificant	Not reported	14	14	Insignificant	Not reported	24.34	5
235	Kemena	872.08	884.85	70659	17600	14	14	25.7	0.75	872.08	70659
236	Tatau	697.28	698.45	3813	5200	14	14	9.18	0.059	697.28	3813
237	Balingian	639.83	107.80	6872	Not reported	20	14	0.98	0.034	719.82	6889
238	Mukah	774.39	179.70	12424	1800	20	15	1.43	0.2	822.08	15177
239	Oya	728.37	396.90	14369	800	20	15	3.24	0.24	853.00	16223
240	Rajang	1859.63	1435.10	202391	24300	33	15	47.78	2.2	1859.97	202391
243	Lupar	36.95	Not reported	181	Not reported	20	Not reported	1.01	Not reported	36.95	181
244	Sadong	172.53	95.70	2952	900	10	15	2.11	0.034	284.14	5363
245	Samarahan	34.60	446.10	1029	40900	20	12	0.21	2.85	34.60	1029
246	Sarawak	305.82		69857		50		16.79		353.21	86132
247	Kayan	121.05	180.05	2241	1500	50	12	1.5	0.068	128.92	2575
	TOTAL	27639.07	29021.17	3,943,173	2,736,000			915	100	29799	4,819,264

Total	**P. Malaysia**	14065.98	15316.00	2,981,890	2,519,400			616.50	87.95	15619.62	3,688,600
	Sabah	3097.11	2710.57	506,441	83,600			140.96	3.361	3284.04	652,173
	Sarawak	10475.98	10994.60	454,843	133,000			157.65	8.582	10895.50	478,491
	TOTAL	27639.07	29021.17	3,943,173	2,736,000			915	100	29799.16	4,819,264

TABLE 5.5: COMPARISON OF FLOODED AREA BETWEEN KTAT 2002 STUDY AND JICA 1982 STUDY, ACCORDING TO STATE.

No.	State	Area (km^2)	Total Population (at year 2000)	Flood Affected Area (km^2)		No. of People Affected		Annual Average Damage (RM mil)	
				2002 Study	1982 Study	2002 Study	1982 Study	2002 Study (at 2000 price)	1982 Study (at 1980 price)
1	Perlis	795	198,335	26.74	39.00	12736	27900	2.75	1.76
2	Kedah	9,426	1,572,107	209.44	158.00	117368	88200	30.2	4.41
3	Pulau Pinang	1,030	1,225,501	206.83	18.00	342524	17600	44.52	1.37
4	Perak	21,005	2,030,382	662.84	1555.00	275374	389500	22.64	13.69
5	Selangor	7,955	3,947,527	1788.70	1176.00	669217	224000	75.76	6.33
6	W. P. KL	243	1,297,526	13.18		157302	130700	99.3	2.96
7	Negeri Sembilan	6,643	830,080	129.48	131.00	40887	60900	3.96	1.57
8	Melaka	1,651	602,867	80.85	194.00	27811	96300	2.29	2.99
9	Johor	18,986	2,565,701	2366.71	2759.00	290570	302200	64	13.02
10	Pahang	35,965	1,231,176	6271.62	5574.00	615128	335000	76.15	16.52
11	Terengganu	12,955	879,691	2222.87	1980.00	425396	222300	101.58	6.92
12	Kelantan	14,920	1,289,199	1640.38	1732.00	714287	624800	93.32	16.41
13	Sabah	73,712*	2,519,906*	3284.04	2710.57	652173	83600	140.96	3.361
14	Sarawak	124,449	2,012,616	10895.50	10994.60	478491	133000	157.65	8.58
Total	P.Malaysia	131,574	17,670,100	15620	15316	3,688,600	2,519,400	616.5	88
	Sabah & Sarawak	198,161	4,532,500	14180	13705	1,130,664	216,600	298.6	12
	Total	329,735	22,202,600	29799	29021	4,819,265	2,736,000	915	100

* Includes W.P. Labuan (area of 92 km^2 and population 70,517)

CHAPTER 6

IMPACTS OF PROPOSED FLOOD MITIGATION PROJECTS IN RANCANGAN MALAYSIA KE-8

6.0 IMPACTS OF PROPOSED FLOOD MITIGATION PROJECTS IN RANCANGAN MALAYSIA KE-8

Tables in **Appendix 7** give the list of proposed flood mitigation projects in Rancangan Malaysia Ke-8 (RM8). They are compiled from information obtained from JPS Malaysia and also the respective state offices of JPS.

The proposed projects are organised under their respective RBMU, which are in turn grouped under their respective states. The nature of the flood mitigation works for each project and the type of flood mitigated are also given. The expected benefits (in terms of reduction in flood area and number of people affected) that will result from the implementation of each of the projects are also given. The expected benefits are obtained from information provided by JPS and also from project briefs in the RM8 reports. If the expected benefits are not available the Consultant has attempted to estimate them from flood maps, wherever possible.

The total expected benefits from implementation of the flood mitigation projects for each state are also compiled and presented in Table 6.1.

Table 6.1 is a compilation of the total expected benefits from implementation of the flood mitigation projects in each state. The table also gives the total expected benefits for the whole country.

Table 6.2 gives the list of location maps for the proposed major flood mitigation projects in Rancangan Malaysia ke8, according to states. These location maps, in A3 size, are available in **Appendix 9** of this report.

TABLE 6.1: SUMMARY OF EXPECTED BENEFITS FROM PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS, ACCORDING TO STATES

No.	STATES	EXPECTED BENEFITS		Remarks
		Flood Area Reduced (km^2)	People Benefited (No.)	
1	Perlis	43.0	94,000	
2	Kedah	241.3	149,073	
3	Pulau Pinang	45.0	96,680	
4	Perak	305.2	16,023	
5	Selangor	1013.8	84,655	
6	W.P. Kuala Lumpur	2.9	24,951	
7	Negeri Sembilan	49.3	84,300	
8	Melaka	22.4	10,848	
9	Johor	230.9	160,492	
10	Pahang	22.5	141,000	
11	Terengganu	222.5	119,000	
12	Kelantan	1121.8	1,235,370	
13	Sabah	208.0	243,888	
14	Sarawak	95.9	400,000	
		3624.5	2,860,280	

TABLE 6.2 : LIST OF LOCATION MAPS FOR PROPOSED MAJOR FLOOD MITIGATION PROJECTS IN RANCANGAN MALAYSIA KE 8 (RM8). (Maps are in Appendix 9)

ITEM	DRAWING TITLE	DRAWING NO.	SCALE (1 : X)
1	Proposed Major Flood Mitigation Projects Location Map - Perlis	T0036\R\FLOOD MITIGATION	1:75,000
2	Proposed Major Flood Mitigation Projects Location Map - Kedah	T0036\K\FLOOD MITIGATION	1:300,000
3	Proposed Major Flood Mitigation Projects Location Map - Pulau Pinang	T0036\P\FLOOD MITIGATION	1:100,000
4	Proposed Major Flood Mitigation Projects Location Map - Perak	T0036\A\FLOOD MITIGATION	1:400,000
5	Proposed Major Flood Mitigation Projects Location Map - Selangor	T0036\B\FLOOD MITIGATION	1:300,000
6	Proposed Major Flood Mitigation Projects Location Map - W. Persekutuan	T0036\W\FLOOD MITIGATION	1:50,000
7	Proposed Major Flood Mitigation Projects Location Map - Negeri Sembilan	T0036\N\FLOOD MITIGATION	1:250,000
8	Proposed Major Flood Mitigation Projects Location Map - Melaka	T0036\M\FLOOD MITIGATION	1:100,000
9	Proposed Major Flood Mitigation Projects Location Map - Johor	T0036\J\FLOOD MITIGATION	1:400,000
10	Proposed Major Flood Mitigation Projects Location Map - Pahang	T0036\C\FLOOD MITIGATION	1:600,000
11	Proposed Major Flood Mitigation Projects Location Map - Terengganu	T0036\T\FLOOD MITIGATION	1:400,000
12	Proposed Major Flood Mitigation Projects Location Map - Kelantan	T0036\D\FLOOD MITIGATION	1:300,000
13	Proposed Major Flood Mitigation Projects Location Map - Sabah	T0036\S\FLOOD MITIGATION	1:1,000,000
14	Proposed Major Flood Mitigation Projects Location Map - Sarawak	T0036\Q\FLOOD MITIGATION	1:1,000,000

CHAPTER 7

CONCLUSION AND RECOMENDATIONS

7.0 CONCLUSION AND RECOMMENDATION

7.1 CONCLUSION

The total flood affected area in Malaysia is **29,799** sq.km, which is about **9%** of the total 328,938 sq.km in the country. The total flooded area reported in JICA 1982 Study was 29021 sq. km. Major flood mitigation related projects have reduced the flooded areas in the following RBMUs - Perlis, Perak, Melaka, Kesang, Batu Pahat, South West Johor, Terengganu and Kemasin/Semerak. However, the reduction was off-set by an increase of 2683 sq. km of flooded areas due to the larger flood events reported after the JICA Study.

The total number of people living in the flood affected areas is estimated to be **4.819** million, which is about **22 %** of the total population of 22.2 million in Malaysia as at year 2000. This is an increase of 76% compared to the flood affected population reported in the JICA 1982 Study, which was 2.736 million, representing 20% of the population at that time. This increase is in tandem with the increase in the country's population since 1980. The Statistics Department reported that the increase in population from 1980 to 2000 is 69% in its latest Population and Housing Census report.

The estimated total Annual Average Flood Damage for Malaysia is **RM 915** million (at year 2000 prices), compared to RM100 million (at 1980 prices) reported in the JICA 1982 Study. Table 7.1 provides a summary of the flood condition in Malaysia as at year 2000.

Table 7.2 summarises the flood area statistics for each state and the accumulated figures for the Peninsular and the whole country. Also, Table 7.3 gives the statistics on the landuse flooded for the Peninsular, Sabah, Sarawak and the accumulated figures for the whole country. It can be seen from Table 7.3 that the flooded urban areas increased almost five-folds co mpared to the values reported in the 1982 JICA study. It should also be noted that the flood

damage due to the urban landuse category has contributed significantly to the overall increase in the total flood damage reported for year 2000. Also, it can be seen that the flooded area for the mix-horticulture and palm oil landuse category has also increased significantly.

An attempt has also been made in this report to determine the impacts of the major flood mitigation related projects implemented since 1980. Several RBMUs were identified to have benefited significantly from the implemented projects in Chapter 5, and the results of the analysis are shown in Table 7.4. From the Table it can be seen that if the major flood mitigation projects were not implemented the estimated AAD would have been RM 1356 million, compared to the RM **915** million reported for year 2000. Thus, the projects have helped to reduce the AAD by RM 441 million. However, it must be noted here that the reduction in the flooded areas and number of people affected, as shown in Table 7.4, are indicative only. This is because the flood events selected for comparison were of different ARIs in both scenarios.

7.2 RECOMMENDATION

The Consultant recommends that the information compiled and derived for all the flood events, including the flood event maps, in this study should be archived in the "Flood Events Information Database" of the River Basin Information Management System (RBIMS) developed by JPS. In this way information on the number of flood events in a RBMU and also all pertinent details for any of the archived flood events can be easily retrieved for decision-making.

The Consultant also recommends that the JPS adopts the spreadsheet templates and methodology developed in this study to compile all future flood events information. The compiled information should then be entered into the "Flood Events Information Database" of the River Basin Information Management System (RBIMS) by all the districts. In this way, there will be a continuous updating of the flooding condition database for the whole country. This will allow decision-makers, at the district, state and national levels, to have easy and quick access to the latest updated flood events and statistics.

The database will enable JPS to carry out the following electronically:

a) Access the history of flooding condition, including details for each reported flood events in a RBMU, from 1980 to 2001, for any RBMU or rivers in Malaysia via on-line facilities.
b) Update the flood condition for any future flood events in any RBMU or rivers in Malaysia.

The basic templates for the recommended system are available in the digital copy of this report and are stored in the attached CD-ROM.

TABLE 7.1: SUMMARY OF FLOOD CONDITION IN MALAYSIA (as at year 2000)

	Peninsular Malaysia	Sabah	Sarawak	Malaysia
Total Area (km^2)	131,574	73,712	124,449	329,735
Flood Affected Area (km^2)	15,620	3,285	10,895	29,800
% of Flood Affected Area	11.9%	4.5%	8.8%	9%
Total Population (nos.)	17,670,100	2,519,900	2,012,600	22,202,600
Population Living in Flood Affected Areas (nos.)	3,688,600	652,175	478,490	4,819,265
% of Population Living in Flood Affected Area	21%	26%	24%	22%
Annual Average Damage (RM million)	616.5	141.0	157.5	915
AAD per sq. km. of Flood Affected Area (RM)	39,470	42,920	14,460	30,700

Note: Figures for area and population are obtained from 'Population and Housing Census of Malaysia – Preliminary Count Report 2000' published by Department of Statistics Malaysia in October 2000.

TABLE 7.2 : SUMMARY OF FLOOD AREA STATISTICS

	Perlis	Kedah	Pulau Pinang	Perak	S'gor	W.P. K.Lumpur	Negeri S'bilan	Melaka	Johor	Pahang	T'ganu	K'tan	Pen. M'sia	Sabah	S'wak	Malaysia
Land Use (km^2)																
1. Urban	5.12	12.13	57.06	36.30	95.01	13.16	3.66	3.05	51.42	69.85	53.66	63.33	463.75	92.65	249.33	805.72
2. Mix Horticulture	4.84	34.59	33.65	93.67	110.74	0.00	17.17	8.39	65.64	314.84	205.76	294.30	1183.59	281.16	128.89	1593.65
3. Paddy	8.94	85.25	32.40	68.09	6.82	0.00	15.18	10.86	32.93	125.70	218.50	514.96	1119.63	133.09	2597.36	3850.07
4. Rubber	2.72	43.10	12.32	159.52	55.90	0.00	21.89	19.53	247.76	906.22	292.41	396.51	2157.88	118.73	608.33	2884.94
5. Oil Palm	0.00	15.04	32.81	83.84	836.61	0.00	18.98	7.72	603.66	916.27	202.12	39.45	2756.50	288.82	28.91	3074.22
6. Coconut	0.00	1.03	16.09	1.14	113.67	0.00	0.80	1.93	5.24	9.46	9.06	42.80	201.22	50.72	340.47	592.41
7. Other Tree Crops	0.53	1.16	2.08	23.11	9.79	0.00	1.96	4.24	38.54	30.98	38.88	5.62	156.89	71.87	68.50	297.26
8. Forest	0.33	5.77	5.32	10.10	69.58	0.01	5.68	1.33	539.05	2560.43	463.10	67.34	3728.03	899.47	472.59	5100.09
9. Mining	0.12	1.26	1.52	4.42	79.11	0.00	3.21	0.01	16.29	11.43	4.06	0.80	122.22	1.36	0.00	123.58
10. Swamp	3.53	5.59	6.80	126.70	357.63	0.01	31.33	18.40	661.23	1072.46	639.95	129.28	3052.90	884.65	4985.47	8923.02
11. Pasture/Grassland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.38	0.00	0.00	0.00	20.38	458.86	1337.78	1817.02
12. Unused Land	0.61	4.53	6.78	55.95	53.83	0.00	9.62	5.39	84.57	253.98	95.37	85.99	656.63	2.67	77.88	737.18
Total Flood Area (km^2)	**26.74**	**209.44**	**206.83**	**662.84**	**1788.70**	**13.18**	**129.48**	**80.85**	**2366.71**	**6271.62**	**2222.87**	**1640.38**	**15619.62**	**3284.04**	**10895.50**	**29799.16**
No. of people affected	**12736**	**117368**	**342524**	**275374**	**669217**	**157302**	**40887**	**27811**	**290570**	**615128**	**425396**	**714287**	**3688600**	**652173**	**478491**	**4819264**
Annual Average Damage (RM mil)	**2.75**	**30.2**	**44.52**	**22.64**	**75.76**	**99.33**	**3.96**	**2.29**	**64.00**	**76.15**	**101.58**	**93.32**	**616.50**	**140.96**	**157.66**	**915.12**

TABLE 7.3: COMPARISON OF FLOOD AFFECTED AREAS ACCORDING TO LANDUSE

	Pen. M'sia		Sabah		Sarawak		Malaysia	
	2002 Study	1982 Study	2002 Study	1982 Study	2002 Study	1982 Study	2002 Study	1982 Study
Land Use (km^2)								
1 Urban	463.75	113.00	92.65	14.20	249.33	41.00	805.73	168.20
2 Mix Horticulture	1,183.59	831.00	281.16	71.55	128.89	52.95	1,593.64	955.50
3 Paddy	1,119.63	1,502.00	133.09	81.28	2,597.36	3,300.60	3,850.08	4,883.88
4 Rubber	2,157.88	2,270.00	118.73	156.97	608.33	587.45	2,884.94	3,014.42
5 Oil Palm	2,756.50	388.00	288.82	14.31	28.91	65.00	3,074.23	467.31
6 Coconut	201.22	577.00	50.72	45.84	340.47	130.60	592.41	753.44
7 Other Tree Crops	156.89	108.00	71.87	7.68	68.50	172.90	297.26	288.58
8 Forest	3,728.03	2,974.00	899.47	926.99	472.59	2,529.10	5,100.09	6,430.09
9 Mining	122.22	86.00	1.36	0.00	0.00	0.00	123.58	86.00
10 Swamp	3,052.90	6,201.00	884.65	1,348.30	4,985.47	3,857.65	8,923.02	11,406.95
11 Pasture / Grassland	20.38	262.00	458.86	40.35	1,337.78	251.10	1,817.02	553.45
12 Unused Land	656.63	4.00	2.67	3.10	77.88	6.25	737.18	13.35
Total Flood Area (km^2)	**15,619.62**	**15,316.00**	**3,284.05**	**2,710.57**	**10,895.51**	**10,994.60**	**29,799.18**	**29,021.17**

TABLE 7.4: ESTIMATED IMPACT OF MAJOR FLOOD MITIGATION RELATED PROJECTS IMPLEMENTED IN SEVERAL RBMUs

RBMU NO.	RMBU	Total Flooded Area (km^2)			People Affected (Nos.)			AAD (RM mil)		
		No Implementation	After Implementation	Flood Area Reduced	No Implementation	After Implementation	People Benefited	No Implementation	After Implementation	AAD Reduced
01	Perlis	39	26.74	12.26	42,729	12,736	29,993	10.64	2.75	7.89
10	Perak	1387	385.94	1001.06	713,914	234,782	479,132	138.47	17.4	121.07
15	Klang (W.P.K.Lumpur)	17.89	13.182	4.708	253,785	157,302	96,483	198.87	99.3	99.57
19	Melaka	89	13.89	75.11	95,989	12,457	83,532	18.09	1.33	16.76
20	Kesang	105	66.96	38.04	55,358	15,354	40,004	7.06	0.96	6.10
22	Batu Pahat	430	208.52	221.48	78,237	37,939	40,298	29.66	3.92	25.74
23	SW Johor	713	25.02	687.98	97,327	39,701	57,626	26.15	16.4	9.75
36	Terengganu	612	475.23	136.77	163,348	126,842	36,506	153.19	24.21	128.98
39	Kemasin/Semerak	663.72	442.9	220.82	236,121	157,563	78,558	49.05	23.76	25.29
	Total	**4057**	**1658**	**2398**	**1,736,807**	**794,676**	**942,131**	**631.19**	**190.03**	**441.16**

Note :

1 Total flooded area in RBMUs if no flood mitigation projects were implemented were obtained from JICA 1982 report. Kuala Lumpur figures were from JICA 1989 report.

2 Types of landuse flooded in 'no implementation' scenario were assumed to be directly proportional to the types of landuse flooded after implementation of major flood mitigation related projects.

3 Population Affected by floods were calculated using urban and rural landuse of the total flooded area in the 'no implementation' scenario and then checked against the population figures provided in 'Preliminary Count Report for Urban and Rural areas' published by the Statistics Department in 2000.

4 Flood area reduced and people benefited are indicative only as events selected for determining flooded area are not of the same ARI in most cases.

LIST OF REFERENCE

List of reference documents:

1. Laporan Banjir Tahunan for all States
2. Laporan Banjir Semasa
3. Laporan Banjir Tahunan Ringkas
4. Laporan Banjir Negeri by Bahagian Keselamatan Negara – Pejabat Negeri
5. Inventory of Flood Warning Stations – JPS
6. Inventory of Flood Mitigation Works and Programmes (March 1988) – JPS
7. List of Flood Mitigation Projects (Rancangan Malaysia ke-4 – k3-7) Bahagian Korporat, JPS
8. Rancangan Malaysia ke-8 (2001-2005) Projek Baru bagi Rancangan Tebatan Banjir – Bahagian Korporat, JPS
9. Rancangan Malaysia Ke-8 (2001-2005) Program/ Projek RM7 Dan Sambungan – Bahagian Korporat, JPS
10. Laporan Kemajuan Kewangan, Akhir Tahun 1990 – Bahagian Korporat, JPS
11. Laporan Kemajuan Kewangan, Akhir Tahun 1995 – Bahagian Korporat,JPS
12. Laporan Kemajuan Kewangan, Akhir Tahun 2000 – Bahagian Korporat, JPS
13. Various Flood Mitigation Project Design Reports
14. Register of Dams in Malaysia (2000) – Jabatan Kerja Raya, Water Supply Division
15. Banci Penduduk dan Perumahan Malaysia (1991)
16. Banci Penduduk dan Perumahan Malaysia – Laporan Kiraan Permulaan (2000)
17. Flood Maps or Plans or Sketches from Flood Reports (various scales)
18. Topographic Maps (1:50,000) for flood-prone areas in Malaysia
19. State Road Maps
20. Malaysia Physical Maps
21. Sarawak Land Use Maps (1:250,000)
22. Sabah Peta Guna Tanah (1:25,000)
23. Peninsular Malaysia Land Use Maps 1997 (1:50,000) in digitised format – Land Use Division, Jabatan Pertanian.

List of Annual Flood Reports available at JPS Hydrology Department (Ampang office):

	State & National	Year of Flood Report																				Remarks
		2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	
1	Perlis			✓	✓					✓	✓	✓	✓	✓	✓	✓		✓	✓				
2	Kedah		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓					
3	P. Pinang			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓					
4	Perak		✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓						
5	Selangor		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓					
6	Kuala Lumpur		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓					
7	N. Sembilan	✓	✓	✓	✓				✓	✓	✓			✓		✓	✓	✓					
8	Melaka						✓		✓					✓			✓	✓					
9	Johor		✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
10	Pahang		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		
11	Terengganu		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓			✓	✓			
12	Kelantan	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	
13	Sabah	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	
14	Sarawak	✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
15	Malaysia*							✓	✓					✓									

* Summary Reports for Malaysia is also available in 3 volumes, i.e. for years 1925 - 1988, 1987 - 1992 and 1990 - 1997.

APPENDIX 1

TERMS OF REFERENCE

TERMS OF REFERENCE FOR
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

SCOPE OF WORK

The National Water Resources Study, Malaysia, completed in 1982 by JICA for the Government of Malaysia has included an assessment of flood condition for Peninsular Malaysia, Sabah and Sarawak. Statistics on flooded area, number of people affected as well as flood damages were presented in the study. Since then, the Government of Malaysia has implemented numerous flood mitigation and drainage projects, which have reduced the extent of flooding to various degrees at different localities. Some water resources projects such as the construction of hydropower and water supply dams must have also reduced the magnitude and therefore the extent of flooding downstream of the related river systems. The overall flood prone area in the country is expected to have become significantly smaller. On the other hand, the growth in population and urban centers and the rather rapid land, property and infrastructure development throughout the country in the last two decades are likely to have resulted in greater flood damage potential. Besides, the incidence of flash flood occurrence has increased, causing much disruption to social economic activities. All these have necessitated a national update be carried out to give a more accurate representation of the present flooding condition in the country.

The scope of the update should cover the followings:

1. Establish the base line data and information of flood condition in Malaysia using the 1982 JICA Study referred to above.

2. Obtain, compile, organise and document an up-to-date information on flood mitigation and drainage works undertaken by Jabatan Pengairan dan Saliran at Federal, State, District and Project levels.

3. Obtain, compile, organise and document an up-to-date information of urban drainage works undertaken by Kuala Lumpur City Hall and other Local Authorities that undertake major urban drainage projects.

4. Obtain, compile, organise and document an up-to-date information on water resources projects that have an effect of flood mitigation such as hydropower and water supply dams.

5. Assess the impacts of the flood mitigation, urban drainage as well as of other relevant projects that have modified the extent of flooding. The assessment should result in:

    - Areas by river basin still prone to flooding as at year 2000

- Areas by river basin still prone to flooding if all flood mitigation projects proposed under Eight Malaysia Plan have been implemented.
- Flood maps showing the flood prone areas

6. The assessment above should also update on the number of people affected by floods and damages (tangible and intangible) caused by the floods.

7. The Consultant should carry out the study in consultation with State DID's and the relevant Local Authorities and verification through field visits should be conducted wherever necessary.

APPENDIX 2

SAMPLE CALCULATION OF ANNUAL AVERAGE DAMAGE AND FLOOD MAP FOR PERAI RBMU

FLOOD AREA STATISTICS

RBMU : **6**

Basin : **Perai**

State : **P.Pinang**

Flood Event **1995**

1- Land Use		Area (ha)
a. Urban Area		3764
b. Mixed Horticulture		3023
c. Paddy		3094
d. Rubber		1197
e. Oil Palm		3281
f. Coconuts		1528
g. Other Tree Crops		192
h. Forest		513
I. Mining		152
j. Swamp		675
k. Pasture/Grassland		0
k. Unused Land		637
	Total Flood Area	18056
2- Roads in Flood Area (km)		0
3- Railway in Flood Area (km)		0

ESTIMATE OF FLOOD DAMAGES

RBMU:	7	Basin name :	Perai	State :	P.Pinang		Flood Event :	1995

1. Population — Urban 189586; Rural 49521; No. of People Affected by Flood 239107

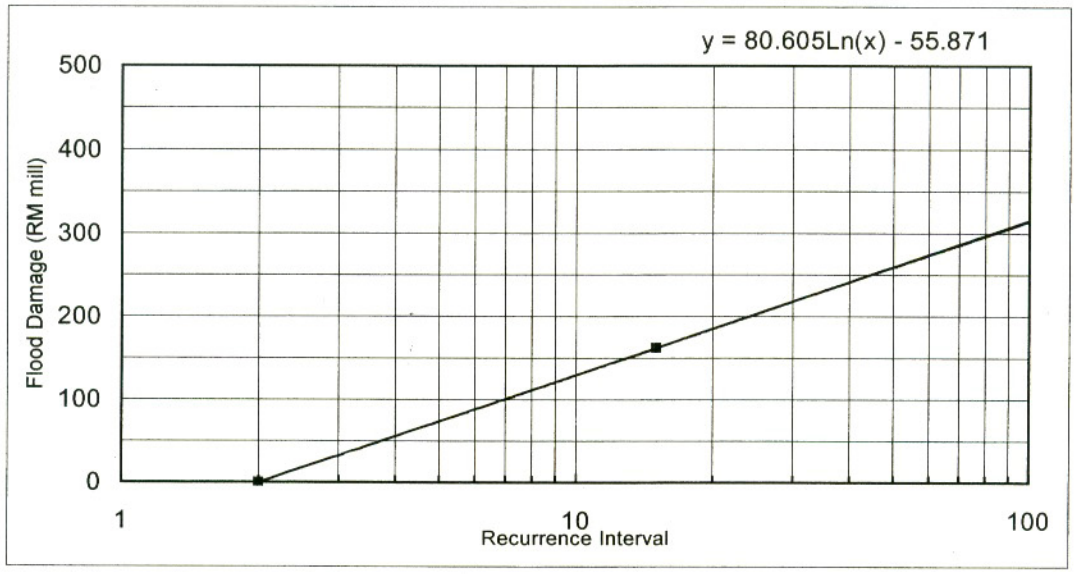
2. Household size (person/household) — Urban 4.4; Rural 4.7

3. Residential Area (ha) — Urban 3764; Rural 3023

ESTIMATE OF FLOOD DAMAGE — **Return Period 1 : 15**

Damage Item		Area (ha)	Flood Duration (day)	Flood Depth (m)	Damage Factor (%)	% of Total Area	Value (RM)	Unit	Damages (RM)
1- Rural Industries									
a- Crops									
Horticulture	mixed	3023	3	1	10		4,700	ha	1,420,810
Paddy		3094	3	1	40		1,471	ha	1,820,510
Rubber	mortality	1197	3	1	5	9	5,200	ha	28,010
	production loss	1197	3	1			23.50	ha	84,389
Oil Palm	mortality	3281	3	1	10	9	3,500	ha	103,352
Coconuts	mortality	1528	3	1	10	9	6,200	ha	85,262
Other Tree Crops	mortality	192	3	1	10	10	6,400	ha	12,288
b- Livestocks							25	No.R-house	263,411
					Sub-total				**3,818,031**
2- Structures/Properties		No. of Household							
Housing	Urban house	43,088		0.5	3.5		22,000	household	33,177,507
	Household articles			0.5	5.7		18,000	household	44,207,951
	Rural house	10,536		1	4.5		15,500	household	7,349,161
	Household articles			1	9.6		16,600	household	16,790,856
Public Building				0.5	3.5		3,780,000	Pre 10000 population	3,163,385
Utilities & Facilities					30				13,107,016
Industrial Facilities					10				3,317,751
					Sub-total				**121,113,627**
3- Indirect Damages					30				37,479,497
					Total				**162,411,154**

Damage Frequency Curves
RBMU: 6
Basin name: Perai **State: P.Pinang**



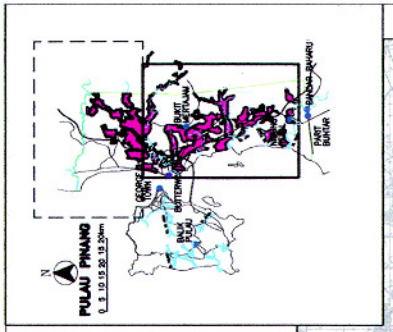
Annual Average Flood Damage (AAD)

$$AAD = SUM\ [(D_{i-1} + D_i)/2 \times (P_{i-1} - P_i)]$$

where D_i = Probable flood damage value of i-year return period
P_i = Occurrence probability of i-year return period

Damage in RM 1,000

Return Period (i)	Occurrence Probability (P=1/i)	Probable Damage (D_i)	Average Damge ($D_{i-1}+D_i)/2$	Occurrence Probability ($P_{i-1}-P_i$)	Probable Damage
2	0.50	0			
5	0.2	73,858	36,929	0.30	11,079
10	0.1	129,729	101,793	0.1	10,179
20	0.05	185,600	157,664	0.05	7,883
50	0.02	259,458	222,529	0.03	6,676
100	0.01	315,329	287,393	0.01	2,874
Annual Average Flood Damage					38,691



289000E

570000N

CONTINUE FROM DWG NO. T0036\K\RBMU6\02

265000E

570000N

265000E

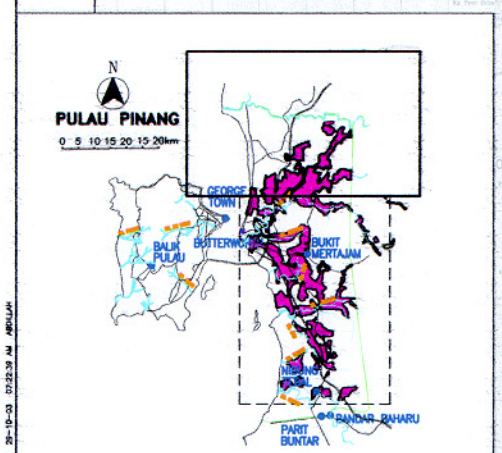
LEGEND

FLOODED AREA OF WORST EVENT

OTHER FLOODED AREA

0 1000m 2000m 3000m 4000m 5000m

CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\P\RBMU6\01	ORIGINAL SCALE: 1 :50000	CONSULTANT: KTA Tenaga sdn bhd, BANGUNAN KTA TENAGA, 01-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : FLOOD MAP OF SG. PERAI, SG. JURU AND SG. JAWI OF SUNGAI PERAI, PULAU PINANG.	ELECTRONIC FILE NAME: RBMU6-01_R1.DWG	ORIGINAL SIZE: A1	



CONTINUE TO DWG NO. T0036\K\RBMU5\02

CONTINUE TO DWG NO. T0036\P\RBMU6\01

LEGEND

FLOODED AREA OF WORST EVENT

OTHER FLOODED AREA

0 1000m 2000m 3000m 4000m 5000m

CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\K\RBMU6\02	ORIGINAL SCALE: 1 :50000	CONSULTANT: KTA Tenaga sdn bhd, BANGUNAN KTA TENAGA, 01-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : FLOOD MAP OF SG. MUDA AND SG. TEMBUS OF SG. MUDA & SG. KERIH AND SG. JARAK OF SG. PERAI, KEDAH.	ELECTRONIC FILE NAME: RBMU6-02_R1.DWG	ORIGINAL SIZE: A1	

APPENDIX 3

BASIC DATA OF POPULATION AND HOUSEHOLDS

A 3.1 Population and Average Annual Growth Rate of Urban and Rural Areas (1980-2000) for :

- **a) Peninsular Malaysia**
- **b) Sabah**
- **c) Sarawak**

A 3.2: Population Density for :

- **a) Peninsular Malaysia**
- **b) Sabah**
- **c) Sarawak**

A 3.3 : Household Density (2000) for :

- **a) Peninsular Malaysia**
- **b) Sabah**
- **c) Sarawak**

A) Population And Average Annual Growth Rate (%) For Peninsular Malaysia, 1980-2000.

State	Population				Growth Rate %		**Assumed Growth Rate %	
	1980		2000		Urban	Rural	Urban	Rural
	Urban	Rural	Urban	Rural				
Perlis	12949	131833	67080	131255	8.22	-0.02	4.11	-0.01
Kedah	155503	922312	608696	963411	6.82	0.22	3.41	0.11
P. Pinang	427805	472967	974779	250722	4.12	-3.17	2.06	-1.59
Perak	562202	1181453	1207948	822434	3.82	-1.81	1.91	-0.91
Selangor	487233	939017	3483765	463762	9.84	-3.53	4.92	-1.76
KL	919610	0	1297526	0	1.72	0.00	0.86	0.00
N.9	179514	371928	456535	373545	4.67	0.02	2.33	0.01
Melaka	104381	342388	405917	196950	6.79	-2.76	3.40	-1.38
Johor	556836	1023587	1638772	926929	5.40	-0.50	2.70	-0.25
Pahang	200863	567938	518176	713000	4.74	1.14	2.37	0.57
Trengganu	225181	300074	434270	445421	3.28	1.97	1.64	0.99
Kelantan	241028	618242	431861	857338	2.92	1.63	1.46	0.82

(B) Population And Average Annual Growth Rate (%) For Sabah, 1980-2000.

District	Population				Growth Rate %		**Assumed Growth Rate %	
	1980		2000		Urban	Rural	Urban	Rural
	Urban	Rural	Urban	Rural				
Tawau	43200	70508	213903	90985	8.00	1.27	4.00	0.64
Lahad Datu	14938	24324	74601	81458	8.04	6.04	4.02	3.02
Sempona	5353	46862	43311	64925	10.45	1.63	5.23	0.82
Sandakan	70420	43076	275375	71959	6.82	2.57	3.41	1.28
Kinabatangan*	1468	13215	8678	78105	8.88	8.88	4.44	4.44
Beluran*	3007	27059	7090	63810	4.29	4.29	2.14	2.14
K. Kinabalu	55997	52728	305382	48771	8.48	-0.39	4.24	-0.20
Ranau	4223	23824	15648	55001	6.55	4.18	3.27	2.09
Kota Belud*	4550	40953	10114	62223	3.99	2.09	2.00	1.05
Tuaran*	4837	43537	8221	73991	2.65	2.65	1.33	1.33
Penampang*	3800	34198	118237	12572	17.19	-5.00	8.59	-2.50
Papar*	4072	36650	27597	59052	9.57	2.39	4.78	1.19
Kudat	9781	28616	26746	41496	5.03	1.86	2.51	0.93
Kota Marudu*	2715	24434	5884	52957	3.87	3.87	1.93	1.93
Pitas*	1652	14868	3085	27769	3.12	3.12	1.56	1.56
Beaufort*	3640	32763	12504	49194	6.17	2.03	3.08	1.02
Kuala Penyu*	1257	11309	1651	14860	1.37	1.37	0.68	0.68
Sipitang*	1208	10868	2931	26380	4.43	4.43	2.22	2.22
Tenom*	2635	23718	4620	41582	2.81	2.81	1.40	1.40
Nabawan*	837	7531	2389	21501	5.25	5.25	2.62	2.62
Keningau	3938	37266	43870	101892	12.05	5.03	6.03	2.51
Tambunan*	1420	12784	2785	25067	3.37	3.37	1.68	1.68

* 1980 and 2000 Population Census show no urban population in district.
10 % of district population is assumed as urban population.

Remarks: The asumption is to account for the urban areas shown in the district landuse map.

** Growth rate in the flood affected area is taken as 50% of the state/district growth rate.

(C) Population And Average Annual Growth Rate (%) For Sarawak, 1980-2000.

District	Population				Growth Rate %		**Assumed Growth Rate %	
	1980		2000		Urban	Rural	Urban	Rural
	Urban	Rural	Urban	Rural				
Kuching	72555	189530	423873	72123	8.83	-4.83	4.41	-2.42
Bau*	3145	28304	4213	37919	1.46	1.46	0.73	0.73
Lundu*	2158	19418	2738	24638	1.19	1.19	0.60	0.60
Serian*	6454	58088	8006	72055	1.08	1.08	0.54	0.54
Simunjan*	3443	30983	3756	33805	0.44	0.44	0.22	0.22
Sri Aman	4552	53181	21842	41113	7.84	-1.29	3.92	-0.64
Lubok Antu*	1974	17762	2327	20939	0.82	0.82	0.41	0.41
Betong*	3562	32054	5146	46317	1.84	1.84	0.92	0.92
Saratok*	12618	21580	4300	38699	-5.38	2.92	-2.69	1.46
Sarikei	12618	28540	25038	31954	3.43	0.56	1.71	0.28
Maradong*	2703	24325	2893	26039	0.34	0.34	0.17	0.17
Daro/Matu*	980	8816	1485	13362	2.08	2.08	1.04	1.04
Julau*	2624	23616	3191	28722	0.98	0.98	0.49	0.49
Sibu	85231	40023	166322	42690	3.34	0.32	1.67	0.16
Dalat/Oya*	2257	20316	2340	21062	0.18	0.18	0.09	0.09
Mukah*	3321	29885	4522	40702	1.54	1.54	0.77	0.77
Kanowit*	2669	24021	2721	24485	0.10	0.10	0.05	0.05
Bintulu	8712	34109	102761	35508	12.34	0.20	6.17	0.10
Kapit*	3585	32262	13541	44299	6.65	1.59	3.32	0.79
Song*	1553	13975	1913	17216	1.04	1.04	0.52	0.52
Belaga*	1150	10347	2286	20578	3.44	3.44	1.72	1.72
Miri	52125	40429	167535	52036	5.84	1.26	2.92	0.63
Marudi*	5163	46469	7141	64271	1.62	1.62	0.81	0.81
Limbang	7928	16119	18991	20750	4.37	1.26	2.18	0.63
Lawas*	1978	17799	3267	29402	2.51	2.51	1.25	1.25

*10 % of district population is assumed as urban population.

Remarks: The asumption is to account for the urban areas shown in the district landuse map.

** Growth rate in the flood affected area is taken as 50% of the state/district growth rate.

Source: a) Preliminary Count Report For Urban and Rural Areas. (Population and Housing Census of Malaysia 2000)

b) Year Book of Statistics Malaysia 2000.

(A) 1975 Population Density for Peninsular Malaysia (Persons/km^2)

State	Population Density used in JICA 1982 Study		Population Density used in KTAT 2002 Study	
	Urban	*Rural	Urban	*Rural
Perlis	3700	2100	8284	2091
Kedah	4600	2100	8998	2146
P. Pinang	6700	3900	10071	2046
Perak	4800	2900	7011	2012
Selangor	4700	4700	12277	2292
KL	7200	0	11953	0
N.9	2800	2400	4441	2405
Melaka	5800	2800	11309	1598
Johor	3700	2900	6302	2626
Pahang	3700	1000	5910	1120
Trengganu	5300	1300	7341	1582
Kelantan	5100	1800	6812	2118

Remarks: *Rural = Mix horticulture

Source: National Water Resource Study (NWRS - 1982)
Sectoral Report, Volume 5: River Condition

(B) 1980 Population Density for Sabah (Persons/km^2)

District	Pop. Density used in JICA 1982 Study				Pop. Density used in KTAT 2002 Study			
	Urban	Rural			Urban	Rural		
		Mix horticulture	Tree crop	Crop land		Mix horticulture	Tree crop	Crop land
Tawau	3606	2392	65	0	7900	2716	74	0
Lahad Datu	2279	1790	62	1806	5013	3247	112	3276
Sempona	2173		161	5727	6020	0	189	6737
Sandakan	5874	721	68	2610	11485	930	88	3368
Kinabatangan	519	1052	168	256	1238	2509	401	611
Beluran	708	806	89	148	1082	1232	136	226
K. Kinabalu	6000	3756	100	902	13769	3612	96	867
Ranau	1300	608	757	75	2476	920	1145	113
Kota Belud	2363	544	398	112	3509	670	490	138
Tuaran	2654	835	69	163	3454	1087	90	212
Penampang	1788	1576	131	267	4862	1168	97	198
Papar	3882	1010	62	180	9884	1280	79	228
Kudat	5054	1202	75	96	8306	1446	90	116
Kota Marudu	1587	1362	86	109	2328	1998	126	160
Pitas	5721	1242	78	99	7800	1693	106	135
Beaufort	1408	594	48	290	2585	727	59	355
Kuala Penyu	3472	613	67	265	3978	702	77	304
Sipitang	1224	732	81	147	1898	1135	126	228
Tenom	2452	1089	44	216	3240	1439	58	285
Nabawan	3070	925	0	73	5152	1552	0	123
Keningau	1003	1453	161	185	3233	2388	265	304
Tambunan	1613	792	286	76	2252	1106	399	106

Source: National Water Resource Study (NWRS - 1982)
Sectoral Report, Volume 5: River Condition

(C) 1980 Population Density for Sarawak (Persons/km^2)

District	Population Density				Pop. Density used in KTAT 2002 Study			
	Urban	Rural			Urban	Rural		
		Mix horticulture	Tree crop	Crop land		Mix horticulture	Tree crop	Crop land
Kuching	1853	3358	282	123	4395	1247	105	46
Bau	843	164	109	28	975	190	126	32
Lundu	732	168	140	18	824	189	158	20
Serian	1600	222	169	27	1781	247	188	30
Simunjan	375	145	132	47	392	151	138	49
Sri Aman	905	320	179	17	1953	247	138	13
Lubok Antu	1848	554	157	6	2006	601	170	7
Betong	7462	204	206	19	8962	245	247	23
Saratok	538	0	148	17	312	0	198	23
Sarikei	3854	2997	111	17	5413	3171	117	18
Maradong	1300	156	88	25	1345	161	91	26
Daro/Matu	251	326	136	26	309	401	167	32
Julau	1794	0	186	7	1978	0	205	8
Sibu	4863	1926	32	8	6775	1989	33	8
Dalat/Oya	720	216	166	11	733	220	169	11
Mukah	421	503	284	23	491	587	331	27
Kanowit	796	319	179	10	804	322	181	10
Bintulu	2127	2540	628	101	7043	2592	641	103
Kapit	1196	3935	364	8	2300	4608	426	9
Song	1083	325	362	6	1202	361	402	7
Belaga	2352		715	5	3307	0	1005	7
Miri	2739	1346	470	106	4870	1526	533	120
Marudi	2279	2490	81	8	2678	2926	95	9
Limbang	3222	3210	152	10	4963	3641	172	11
Lawas	366	124	281	20	470	159	361	26

Source: National Water Resources Study (NWRS-1982)
Sectoral Report, Volume 5: River Condition.

(A) 2000 Household Density for Peninsular Malaysia (Persons/household)

State	Population		Number of household		Household density	
	Urban	Rural	Urban	Rural	Urban	Rural
Perlis	67080	131255	15498	29389	4.3	4.5
Kedah	608696	963411	137153	205010	4.4	4.7
P. Pinang	974779	250722	231949	53020	4.2	4.7
Perak	1207948	822434	287629	184086	4.2	4.5
Selangor	3483765	463762	827267	102604	4.2	4.5
KL	1297526	0	310508	0	4.2	0.0
N.9	456535	373545	102681	84163	4.4	4.4
Melaka	405917	196950	92347	43243	4.4	4.6
Johor	1638772	926929	383165	197258	4.3	4.7
Pahang	518176	713000	121590	154559	4.3	4.6
Trengganu	434270	445421	87455	87624	5.0	5.1
Kelantan	431861	857338	88193	168721	4.9	5.1

Average household density (Persons/household) **urban = 4.4**
rural = 4.7

(B) 2000 Household Density for Sabah (Persons/household)

District	Population		Number of household		Household density	
	Urban	Rural	Urban	Rural	Urban	Rural
Tawau	213903	90985	40321	19381	5.3	4.7
Lahad Datu	74601	81458	13581	16838	5.5	4.8
Sempona	43311	64925	6460	11229	6.7	5.8
Sandakan	275375	71959	50925	14320	5.4	5.0
Kinabatangan	0	86783	0	20714	0.0	4.2
Beluran	0	70900	0	14955	0.0	4.7
K. Kinabalu	305382	48771	60917	8864	5.0	5.5
Ranau	15648	55001	2759	9892	5.7	5.6
Kota Belud	10114	62223	1928	12097	5.2	5.1
Tuaran	0	82212	0	15931	0.0	5.2
Penampang	118237	12572	24754	2460	4.8	5.1
Papar	27597	59052	5162	11483	5.3	5.1
Kudat	26746	41496	5045	8095	5.3	5.1
Kota Marudu	0	58841	0	11158	0.0	5.3
Pitas	0	30854	0	6341	0.0	4.9
Beaufort	12504	49194	2499	9491	5.0	5.2
Kuala Penyu	0	16511	0	3495	0.0	4.7
Sipitang	0	29311	0	5913	0.0	5.0
Tenom	0	46202	0	8871	0.0	5.2
Nabawan	0	23890	0	4776	0.0	5.0
Keningau	43870	101892	8539	19666	5.1	5.2
Tambunan	0	27852	0	5142	0.0	5.4
Kunak	15602	32969	2561	6858	6.1	4.8
Tongod	0	20646	0	5687	0.0	3.6

Average household density (Persons/household) **urban = 5.2**
rural = 5.0

(C) 2000 Household Density for Sarawak (Persons/household)

District	Population		Number of household		Household density	
	Urban	Rural	Urban	Rural	Urban	Rural
Kuching	423873	72123	87213	13381	4.9	5.4
Bau	0	42132	0	7996	0.0	5.3
Lundu	0	27376	0	5528	0.0	5.0
Samarahan	23329	23872	0	8514	0.0	2.8
Serian	0	80061	0	15996	0.0	5.0
Simunjan	0	37561	0	7725	0.0	4.9
Sri Aman	21842	41113	4739	9710	4.6	4.2
Lubok Antu	0	23266	0	5191	0.0	4.5
Betong	0	51463	0	10033	0.0	5.1
Saratok	0	42999	0	8738	0.0	4.9
Sarikei	25038	31954	5378	7434	4.7	4.3
Maradong	0	28932	0	6186	0.0	4.7
Daro	0	14847	0	3083	0.0	4.8
Julau	0	31913	0	6739	0.0	4.7
Sibu	166322	42690	34553	9869	4.8	4.3
Dalat	0	23402	0	4988	0.0	4.7
Mukah	0	45224	0	9712	0.0	4.7
Kanowit	0	27205	0	6084	0.0	4.5
Bintulu	102761	35508	22675	9142	4.5	3.9
Tatau	0	22865	0	5651	0.0	4.0
Kapit	13541	44299	2766	9780	4.9	4.5
Song	0	19129	0	3910	0.0	4.9
Belaga	0	22864	0	5542	0.0	4.1
Miri	167535	52036	35866	12319	4.7	4.2
Marudi	0	71412	0	15301	0.0	4.7
Limbang	18991	20750	3989	4076	4.8	5.1
Lawas	0	32669	0	6469	0.0	5.1
Matu	0	11179	0	2418	0.0	4.6
Asajaya	0	28540	0	5280	0.0	5.4

Average household density (Person/household) **urban = 4.9**
rural = 4.6

Source: a) Preliminary Count Report For Urban and Rural Areas.
(Population and Housing Census of Malaysia 2000)

APPENDIX 4

UNIT VALUES OF CROPS, BUILDINGS AND HOUSEHOLD ARTICLE

Table A4.1: Comparison of Unit Values used in KTAT 2002 Study and JICA 1982 Study.

1- Crop Production Values		Unit	2002 Study Value (RM)	1982 Study Value (RM)
Mix Horticulture		ha	4,700	2,900
Paddy	Perlis	ha	1,872	1,270
	Kedah		1,857	1,110
	Pinang		1,471	1,118
	Perak		1,500	860
	Selangor		1,911	900
	N. Sembialan		1,359	1,070
	Melaka		1,412	1,060
	Johor		1,197	1,010
	Pahang		967	760
	Terengganu		1,644	800
	Kelantan		1,519	620
	Sabah		1,409	1,130
	Sarawak		809	1,060
Rubber	(Mortality)	ha	5,200	2,880
	Production loss	/ha/day	23.50	12.83
Oil Palms	(Mortality)	ha	3,500	1,930
Coconuts Palms	(Mortality)	ha	6,200	3,440
Other Crops	(Mortality)	ha	6,400	3,540
2- Building / Properties				
Private Housing	Urban house	household	22,000	7,500
	Household effects	household	18,000	0
	Rural house	household	15,500	3,000
	Household effects	household	16,600	0
Public Buildings		per 10,000 population	3,780,000	2,000,000

Table A4.2: Comparison of Flood Damage Factors and Damage Values for Buildings and Household Articles

a) Urban

Depth of Flooding	2002 Study					1982 Study				
	Factor %		Damage (RM)			Factor %		Damage (RM)		
	Building	HA	Building	HA	Total	Building	HA	Building	HA	Total
less than 0.5 m	3.5	5.7	770	1026	1796	3	0	225	0	225
0.5 -1.0 m	4.5	9.6	990	1728	2718	5	0	375	0	375
1.0 - 1.5 m	6.1	11.9	1342	2142	3484	7	0	525	0	525
1.5 - 2.0 m	6.8	13.5	1496	2430	3926	11	0	825	0	825
2.0 - 3.0 m	11.2	33.6	2464	6048	8512	15	0	1125	0	1125
more than 3.0 m	17	68.7	3740	12366	16106					

b) Rural

Depth of Flooding	2002 Study					1982 Study				
	Factor %		Damage (RM)			Factor %		Damage (RM)		
	Building	HA	Building	HA	Total	Building	HA	Building	HA	Total
less than 0.5 m	3.5	5.7	542.5	946	1489	3	0	90	0	90
0.5 -1.0 m	4.5	9.6	697.5	1594	2291	5	0	150	0	150
1.0 - 1.5 m	6.1	11.9	945.5	1975	2921	7	0	210	0	210
1.5 - 2.0 m	6.8	13.5	1054	2241	3295	11	0	330	0	330
2.0 - 3.0 m	11.2	33.6	1736	5578	7314	15	0	450	0	450
more than 3.0 m	17	68.7	2635	11404	14039					

Remarks:

i) For unit values of Buildings and Household Articles(HA), refer to Table A4.1

ii) Flood Damage Factors in the 2002 Study are adopted from JICA 2000 Study: The Study on Integrated Urban Drainage Improvement for Melaka and Sg. Petani.

Table A4.3: Parameters and Assumptions used in KTAT 2002 Study and JICA 1982 Study

	KTAT 2002 Study			JICA 1982 Study		
	Peninsular Malaysia	**Sabah**	**Sarawak**	**Peninsular Malaysia**	**Sabah**	**Sarawak**
Maps						
1. Flood Map	1980-2001/02	1980-2001/02		1960-1979	1960-1979	
2. Topographic Map	1:50000	1:50000		1:63360	1:50000	
3. Landuse Map	1997	1991-2000		1974	1970	
	GIS Format From DOA	1:25000	1:250000			
		Hardcopy from respective states				
Unit Values (RM) *						
1. Crops	RBIS, JICA 1999 Study			Same for Peninsular Malaysia, Sabah & Sarawak		
2. Paddy	RBIS, JICA 1999 Study Paddy Statistics of M'sia 1995, DOA			Use 1980 prices		
3. Urban & Rural Houses	JICA 1995 Study					
4. Households effects	JICA 1995 Study					
5. Public Buildings	JICA 1982 Study Figure with inflation rate of 3.6% applied over 18 years					
Population Category	Urban Rural	Urban Mix Horticulture Tree crop Crop land		Urban Rural	Urban Mix Horticulture Tree crop Crop land	
Household Density (person / household)	Census Report 2000	Census Report 2000		Census Report 1970	Census Report 1980	
Urban	4.4	5.2	4.9	5.5	5.31	5.6
Rural	4.7	5	4.6	5.5	5.31	5.6
Flood Damage Factor						
1. Crops	JICA's 1999 Study	JICA's 1999 Study		JICA's 1982 Study	JICA's 1982 Study	
2. Paddy	JICA's 1999 Study	JICA's 1999 Study		JICA's 1982 Study	JICA's 1982 Study	
3. Urban & Rural Houses #	JICA's 2000 Study	JICA's 2000 Study		JICA's 1982 Study	JICA's 1982 Study	
4. Households Articles #	JICA's 2000 Study	JICA's 2000 Study		Not consider	Not consider	
5. Utilities & Facilities	30 % of damages to Public Buildings and Private Houses			30 % damage to buildings		
6. Industrial Facilities	10 % damage to urban houses			10 % damage to urban houses		
7. Indirect losses	30 % of direct losses			30 % of direct losses		
8. Mining, Forest, Grassland and Swamp	Minor damages and not estimated			Minor damages and not estimated		

Notes:

1. JICA's 1982 Study : National Water Resources Study, Malaysia.
2. JICA's 1991 Study : The Study on Flood Mitigation and Drainage in Pulau Pinang.
3. JICA's 1995 Study : Comprehensive Management Plan of Muda River Basin Study.
4. JICA's 1999 Study : Sg. Perak River Basin Information Systems.
5. JICA's 2000 Study: The Study on Integrated Urban Drainage Improvement for Melaka and Sg. Petani in Malaysia.

Remarks:

* Refer also Table A4.1 : Comparison of Unit Values used in KTAT 2002 Study and JICA 1982 Study

Refer also Table A4.2 : Comparison of Flood Damage Factors and Damage Values for Buildings and Household Articles.

APPENDIX 5

FLOOD FREQUENCY OF VARIOUS JPS STREAMFLOW STATIONS

APPENDIX 5 Flood Frequency Analysis of Various JPS Streamflow Stations (m^3/s)

No.	State	Catchment Area (sq. km)	Station No.	River	Q_T Return Period T (Years)						
					T = 2	T = 5	T = 10	T = 20	T = 25	T = 50	T = 100
1	PERLIS	42	6602401	Sungai Pelaritat Wang Mu	19	27	34	41	44	54	65
2		24	6502401	Sungai Jerneh At Titi Tampang	2	4	6	8	9	11	15
3		21	6503401	Sungai Arau At Ladang Tebu Felda	10	16	19	24	25	30	35
4		126	6502432	Sungai Tasoh At Titi Baru	14	19	23	26	27	30	33
5		6	6502402	Sungai Buloh At Kampung Batu Tangkup	9	13	15	17	18	19	20
1	KEDAH	3330	5606410	Sungai Muda At Jam.Syed Omar	518	857	1,152	1,504	1,632	2,085	2,637
2		1710	5806414	Sungai Muda At Jenlang	304	377	418	454	465	495	521
1	PULAU PINANG	4010	5505412	Sungai Muda At Ladang Victoria	469	625	731	834	867	969	1,072
2		129	5405421	Sungai Kulim At Ara Kuda	43	53	58	62	63	66	69
1	PERAK	629	5206432	Sungai Krian At Selama	144	191	230	274	290	345	410
2		80	4907422	Sungai Kurau At Bt.14 Jalan Taiping	22	40	58	81	90	125	172
3		337	5007421	Sungai Kurau At Pondok Tanjung	79	98	107	114	115	120	123
4		216	5106433	Sungai Liok At Titi Liok	61	80	90	99	101	107	113
5		1088	4911445	Sungai Plus At Kampung Lintang	174	251	306	360	378	435	495
6		245	4610466	Sungai Pari At Jalan Siliban Ipoh	77	105	125	143	149	167	184
7		7769	4809443	Sungai Perak At Jambatan Iskandar	1,091	1,817	2,430	3,143	3,398	4,289	5,350
8		267	4611463	Sungai Kinta At Tanjung Rambutan	150	244	308	369	388	449	509
9		192	4511468	Sungai Raja At Keramat Pulai	43	55	63	69	71	76	81
10		119	4212467	Sungai Cenderiang At Bt.32 Jalan Tapah	41	59	71	82	85	97	108
11		455	4111455	Sungai Batang Padang At Tanjung Keramat	96	109	116	123	125	130	135
12		289	3913458	Sungai Sungkai At Sungkai Perak	68	96	116	136	142	162	183
13		339	4012401	Sungai Bidor At Malayan Bidor	123	164	189	210	217	236	254
14		66	3813414	Sungai Trolak At Trolak	50	71	86	101	106	121	137
15		455	3814416	Sungai Slim At Slim River	82	96	105	114	117	126	135
16		1700	4310401	Sungai Kinta At Weir Tanjung Tualang	13	13	14	14	14	15	15

APPENDIX 5 Flood Frequency Analysis of Various JPS Streamflow Stations (m^3/s)

No.	State	Catchment Area (sq. km)	Station No.	River	Q_T Return Period T (Years)						
					T = 2	T = 5	T = 10	T = 20	T = 25	T = 50	T = 100
17		314	3814413	Sungai Slim At Kg.Slim Perak	30	36	40	43	44	47	49
18		41	3814415	Sungai Bil At Jalan Tg.Malim Slim	15	25	34	46	51	66	86
19		479	3911457	Sungai Sungkai At Jalan Anson	65	74	79	82	83	85	87
20		373	4011451	Sungai Bidor At Bt9 Jalan Anson	80	103	118	134	138	154	169
21		339	4012452	Sungai Bidor At Bt.18 Jalan Anson	67	80	89	97	100	109	118
22		1054	4410461	Sungai Kinta At Batu Gajah	155	185	201	215	219	230	239
23		352	5610401	Sungai Ru At Jam Jln Raya Prk	51	64	69	73	74	77	78
1	SELANGOR	1240	2816441	Sungai Langat At Dengkil	226	384	507	640	685	836	1,005
2		457	3116430	Sungai Klang At Suleiman Bridge	158	249	331	430	466	595	756
3		122	3116433	Sungai Gombak At Kuala Lumpur	45	71	93	118	126	156	190
4		145	3116434	Sungai Batu At Sentul	40	58	73	89	94	112	132
5			3117402	Sungai Klang At Lorong Yap Kwan Seng	66	87	102	118	123	141	160
6		68	3118445	Sungai Lui At Kg.Lui	18	28	36	43	46	53	61
7		1450	3414421	Sungai Selangor At Rantau Panjang	197	239	268	296	305	333	362
8		321	3516422	Sungai Selangor At Rasa	105	146	169	188	193	209	222
9		186	3615412	Sungai Bernam At Tanjung Malim	64	91	114	139	148	178	212
1	NEGERI	228	2920432	Sungai Triang Atkampung Chener	28	64	108	174	203	321	506
2	SEMBILAN	904	3022431	Sungai Triang At Juntai	103	131	149	165	169	184	197
3		111	2520423	Sungai Pedas At Kampung Pilin	32	42	48	53	54	58	61
4		133	2524416	Sungai Gemencah At Gedok	25	39	50	63	69	81	97
5		21	2723401	Sungai Kepis	28	44	56	69	73	88	103
6		370	2722413	Sungai Muar At Kuala Pilah	38	57	70	83	87	81	97
7		1212	2625412	Sungai Muar At Bt.57 Jln Gemas Rompin	124	186	228	270	283	324	366
8		230	2619401	Sungai Linggi At Jam. Jalan Persekutuan	83	111	127	141	145	157	167
9		523	2519421	Sungai Linggi At Sua Bentong	73	97	112	127	132	146	161

APPENDIX 5 Flood Frequency Analysis of Various JPS Streamflow Stations (m^3/s)

No.	State	Catchment Area (sq. km)	Station No.	River	Q_T Return Period T (Years)						
					T = 2	T = 5	T = 10	T = 20	T = 25	T = 50	T = 100
1	MELAKA	350	2322413	Sungai Melaka At Pantai Belimbing	49	73	91	111	118	141	167
2		161	2224432	Sungai Kesang At Chin-Chin	13	19	23	27	29	34	40
1	JOHOR	143	1836403	Sungai Pengeli At Felda Inas	139	227	277	320	332	368	399
2		587	2235401	Sungai Kahang At Bt.26 Jalan Kluang	294	485	643	824	888	1,108	1,366
3		660	2528414	Sungai Segamat At Segamat	141	307	478	710	801	1,155	1,644
4		3130	2527411	Sungai Muar At Buloh Kasap	191	295	383	486	522	650	803
5		207	2237471	Sungai Langsar At Bt.42 Kluang Mersing	129	186	227	271	286	334	385
6		624	1836402	Sungai Sayong At Jam.Johor Tenggara	105	164	209	257	273	326	384
7		209	1836401	Sungai Linggui At Rancangan Tanah Jengli	42	74	108	154	173	247	351
8		1130	1737451	Sungai Johor At Rantau Panjang	208	342	441	545	580	694	817
9		186	1931423	Sungai Sembrong At Rrizay Bridge	51	75	91	107	112	127	141
10		350	2130422	Sungai Bekok At Yong Peng	49	62	70	77	79	85	90
1	PAHANG	19000	3424411	Sungai Pahang At Temerloh	3,035	4,339	5,202	6,031	6,294	7,103	7,907
2		241	3519426	Sungai Bentong At Jam.Kuala Lumpur	100	143	171	199	208	235	261
3		25600	3527410	Sungai Pahang At Lubok Paku	2,668	4,099	5,114	6,142	6,480	7,555	8,680
4		560	3629403	Sungai Lepar At Jambatan Gelugor	260	374	446	512	533	594	652
5		582	3930401	Sungai Kuantan At Bukit Kenau	1,409	2,086	2,490	2,848	2,955	3,270	3,560
6		1670	4019462	Sungai Lipis At Benta	223	290	334	376	390	431	473
7		13200	4023412	Sungai Pahang At Stesen Telemetrik Sg.Yap	3,355	4,778	5,606	6,326	6,540	7,158	7,717
8		7300	4121413	Sungai Jelai At Stesen Telemetrik Jeram Bungor	998	1,275	1,425	1,549	1,584	1,684	1,769
9		497	4320401	Sungai Kecau At Kampung Dusun	325	378	404	422	427	440	450

APPENDIX 5 Flood Frequency Analysis of Various JPS Streamflow Stations (m^3/s)

No.	State	Catchment Area (sq. km)	Station No.	River	Q_T Return Period T (Years)						
					T = 2	T = 5	T = 10	T = 20	T = 25	T = 50	T = 100
1	TERENGGANU	505	4131453	Sungai Cherul At Ban Ho Terengganu	261	447	613	815	889	1,156	1,488
2		630	4232451	Sungai Kemaman At Kg.Tayor Terengganu	472	601	664	714	727	763	793
3		626	4232452	Sungai Kemaman At Rantau Terengganu	382	524	609	686	709	777	841
4		1480	4832441	Sungai Dungun At Jam.Jerangau	1,125	1,726	2,069	2,362	2,449	2,696	2,916
5		3340	5130432	Sungai Terengganu At G.Tanggol Terengganu	3,134	4,464	5,344	6,188	6,456	7,281	8,100
6		160	5129437	Sungai Telemong At Paya Rapat Terengganu	221	358	466	584	624	761	916
7		21	5428401	Sungai Chalok At Jam .Chalok Terengganu	56	93	120	148	157	187	219
8		393	5229436	Sungai Nerus At Kg.Bukit Terengganu	410	644	806	965	1,017	1,179	1,344
9		787	5724411	Sungai Besut At Jam.Jerteh Terengganu	1,175	1,983	2,579	3,201	3,410	4,088	4,817
10		57	5724413	Sungai Pelagat At Pelagat Terengganu	178	258	312	365	382	435	489
1	KELANTAN	11900	5721442	Sungai Kelantan At Jam.Guillemard	5,033	8,899	11,953	15,318	16,485	20,412	24,861
2		7770	5320443	Sungai Galas At Dabang	2,404	3,922	5,142	6,514	6,993	8,623	10,497
3		2430	5222452	Sungai Lebir At Kampung Tualang	1,627	2,828	3,845	5,027	5,452	6,930	8,693
4		561	6019441	Sungai Golok At Rantau Panjang	511	633	707	773	794	853	909
5		4759	6022421	Sungai Kemasin At Peringat	59	96	125	158	169	208	252
6		216	5818401	Sungai Golok At Kg.Jenok	159	267	347	430	458	549	647

APPENDIX 6

NUMBER OF FLOOD EVENTS BY RBMU

TABLE A6.1: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **PERLIS**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1983	1	Perlis	1
1986	1	Perlis	3
1987	1	Perlis	2
1988	1	Perlis	4
1989	1	Perlis	2
1990	1	Perlis	1
1991	1	Perlis	3
1992	1	Perlis	2
1997	1	Perlis	1
1998	1	Perlis	1
2000	1	Perlis	1
		Total	21

TABLE A6.2: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **KEDAH**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1984	3	Kedah	1
1985	5	Muda	2
1986	3	Kedah	1
	5	Muda	1
1987	3	Kedah	2
1988	3	Kedah	1
	5	Muda	1
1991	5	Muda	2
1992	5	Muda	1
1993	3	Kedah	2
	5	Muda	4
1995	3	Kedah	2
	5	Muda	1
1996	3	Kedah	2
	5	Muda	2
1997	3	Kedah	1
	5	Muda	1
1998	3	Kedah	2
	5	Muda	3
1999	3	Kedah	1
	5	Muda	1
2000	3	Kedah	1
		Total	35

TABLE A6.3: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **PULAU PINANG**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1986	6	Perai	2
	7	Pulau Pinang	1
1987	6	Perai	7
	7	Pulau Pinang	1
1988	6	Perai	3
1989	6	Perai	6
	7	Pulau Pinang	1
1990	6	Perai	2
	7	Pulau Pinang	1
1991	6	Perai	1
	7	Pulau Pinang	1
1992	6	Perai	1
	7	Pulau Pinang	1
1993	6	Perai	4
	7	Pulau Pinang	1
1995	6	Perai	1
	7	Pulau Pinang	1
1996	6	Perai	4
	7	Pulau Pinang	1
1997	6	Perai	4
	7	Pulau Pinang	1
1998	6	Perai	1
	7	Pulau Pinang	1
		Total	47

TABLE A6.4: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **PERAK**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1988	9	Kurau	1
	10	Perak	8
1991	8	Kerian	1
	9	Kurau	1
1993	10	Perak	2
1994	10	Perak	1
1995	9	Kurau	2
	10	Perak	1
1996	8	Kerian	2
	9	Kurau	1
	10	Perak	4
1997	8	Kerian	1
	9	Kurau	4
	10	Perak	4
1998	8	Kerian	1
	9	Kurau	2
	10	Perak	2
1999	8	Kerian	5
	9	Kurau	1
	10	Perak	71
		Total	115

TABLE A6.5: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **SELANGOR**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1984	12	Tengi	1
	13	Selangor	2
	15	Klang	1
1985	13	Selangor	1
	14	Buloh	1
	15	Klang	1
	16	Langat	3
	17	Sepang	1
1986	15	Klang	4
	16	Langat	3
1987	11	Bernam	1
	13	Selangor	1
	14	Buloh	2
	15	Klang	5
	16	Langat	4
1990	13	Selangor	1
	15	Klang	3
1991	13	Selangor	5
	14	Buloh	2
	15	Klang	4
	16	Langat	1
1992	11	Bernam	1
	13	Selangor	2
	15	Klang	3
	16	Langat	2
1993	11	Bernam	1
	12	Tengi	2
	13	Selangor	3
	14	Buloh	1
	15	Klang	7
	16	Langat	4
1994	11	Bernam	1
	13	Selangor	1
	14	Buloh	2
	15	Klang	2
	16	Langat	1
1995	11	Bernam	2
	13	Selangor	1
	14	Buloh	1
	15	Klang	2
	16	Langat	1
1996	11	Bernam	3
	13	Selangor	1
	14	Buloh	1
	15	Klang	7
	16	Langat	1
1997	13	Selangor	2
	14	Buloh	1
	15	Klang	3
	16	Langat	2
1998	15	Klang	3
	16	Langat	1
1999	13	Selangor	1
	14	Buloh	1

TABLE A6.5: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **SELANGOR**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1999	15	Klang	3
	16	Langat	4
	17	Sepang	1
		Total	122

TABLE A6.6: NUMBER OF FLOOD EVENTS (1980 - 2001) BY RBMU IN **WILAYAH PERSEKUTUAN, KUALA LUMPUR**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1984	15	Klang	5
1985	15	Klang	3
1986	15	Klang	4
1987	15	Klang	6
1988	15	Klang	6
1989	15	Klang	2
1991	15	Klang	1
1993	15	Klang	3
1994	15	Klang	1
1995	15	Klang	1
1996	15	Klang	1
1997	15	Klang	4
1998	15	Klang	3
1999	15	Klang	11
2000	15	Klang	15
2001	15	Klang	5
		Total	71

TABLE A6.7: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **NEGERI SEMBILAN**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1990	18	Linggi	1
1991	18	Linggi	1
1992	18	Linggi	1
1993	18	Linggi	1
1996	18	Linggi	2
1998	18	Linggi	1
1999	18	Linggi	7
2000	18	Linggi	3
		Total	17

TABLE A6.8: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **MELAKA**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1984	19	Melaka	2
1985	19	Melaka	1
	20	Kesang	1
1988	19	Melaka	1
	20	Kesang	1
1992	20	Melaka	1
1993	20	Melaka	1
1994	20	Melaka	1
1995	20	Melaka	1
1996	18	Linggi	1
1998	20	Melaka	1
2000	18	Linggi	1
	19	Melaka	1
		Total	14

TABLE A6.9: NUMBER OF FLOOD EVENTS (1980 - 2001) BY RBMU IN **JOHOR**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1980	21	Muar	1
1981	23	South West Johor Rivers	1
	24	Johor	1
	25	Sedili Besar	1
	27	Endau	1
1982	21	Muar	2
	22	Batu Pahat	1
1983	23	South West Johor Rivers	1
	24	Johor	1
	27	Endau	1
1984	21	Muar	1
	23	South West Johor Rivers	1
	24	Johor	1
1985	21	Muar	1
	26	Mersing	1
1986	21	Muar	4
	22	Batu Pahat	1
	23	South West Johor Rivers	1
	24	Johor	2
	25	Sedili Besar	1
	27	Endau	1
1987	21	Muar	2
	22	Batu Pahat	1
	23	South West Johor Rivers	2
	24	Johor	2
	25	Sedili Besar	1
	26	Mersing	1
	27	Endau	2
1988	21	Muar	2
1989	21	Muar	1
	22	Batu Pahat	1
	23	South West Johor Rivers	1
	24	Johor	1
	25	Sedili Besar	1
	27	Endau	1
1990	21	Muar	1
	22	Batu Pahat	2
	24	Johor	1
	27	Endau	1
1991	21	Muar	1
	22	Batu Pahat	1
	23	South West Johor Rivers	1
	24	Johor	1
	27	Endau	1
1992	21	Muar	1
	22	Batu Pahat	1
	23	South West Johor Rivers	1
	24	Johor	1
	27	Endau	1
1993	21	Muar	1
	27	Endau	1
1994	21	Muar	1
	22	Batu Pahat	1
	23	South West Johor Rivers	1

TABLE A6.9: NUMBER OF FLOOD EVENTS (1980 - 2001) BY RBMU IN **JOHOR**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1994	24	Johor	1
	25	Sedili Besar	1
1995	21	Muar	1
	26	Mersing	1
1996	24	Johor	1
1997	21	Muar	1
1998	24	Johor	1
	25	Sedili Besar	1
	26	Mersing	1
	27	Endau	1
1999	25	Sedili Besar	1
	27	Endau	2
2000	24	Johor	1
2001	21	Muar	1
	22	Batu Pahat	1
	23	South West Johor Rivers	1
	24	Johor	2
	26	Mersing	2
	27	Endau	1
		Total	87

TABLE A6.10: NUMBER OF FLOOD EVENTS (1980 - 2001) BY RBMU IN **PAHANG**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1982	30	Pahang	1
	31	Kuantan	1
1983	30	Pahang	1
	31	Kuantan	1
1984	30	Pahang	3
	31	Kuantan	3
1986	30	Pahang	2
	31	Kuantan	2
1987	28	Rompin	1
	30	Pahang	1
	31	Kuantan	1
1988	28	Rompin	1
	30	Pahang	1
	31	Kuantan	1
1992	30	Pahang	1
1993	30	Pahang	1
	31	Kuantan	2
1994	30	Pahang	1
	31	Kuantan	1
1995	30	Pahang	2
	31	Kuantan	1
1996	30	Pahang	1
1998	30	Pahang	1
	31	Kuantan	2
1999	30	Pahang	5
2001	30	Pahang	1
	31	Kuantan	1
		Total	40

TABLE A6.11 : NUMBER OF FLOOD EVENTS (1980 - 2001) BY RBMU IN **TERENGGANU**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1982	32	Kemaman	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1983	32	Kemaman	1
	33	Paka	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1986	32	Kemaman	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1987	32	Kemaman	1
	33	Paka	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1988	32	Kemaman	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1989	36	Terengganu	1
1990	32	Kemaman	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	2
	37	Setiu	1
	38	Besut	1
1991	36	Terengganu	2
	38	Besut	1
1992	32	Kemaman	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1993	32	Kemaman	1
	34	Dungun	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1994	32	Kemaman	1
	34	Dungun	1

TABLE A6.11 : NUMBER OF FLOOD EVENTS (1980 - 2001) BY RBMU IN **TERENGGANU**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1994	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1995	32	Kemaman	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1996	32	Kemaman	1
	33	Paka	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1997	32	Kemaman	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
1998	32	Kemaman	1
	35	Merchang	1
	36	Terengganu	1
1999	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
2000	35	Merchang	1
	36	Terengganu	1
	37	Setiu	1
	38	Besut	1
2001	32	Kemaman	1
	34	Dungun	1
	35	Merchang	1
	36	Terengganu	1
	38	Besut	1
		Total	95

TABLE A6.12: NUMBER OF FLOOD EVENTS (1980 - 2001) BY RBMU IN **KELANTAN**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1980	39	Kemasin/Semerak	1
	41	Golok	1
1981	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1982	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1983	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1984	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1986	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1987	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1988	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1990	40	Kelantan	1
	41	Golok	1
1991	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1992	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1993	40	Kelantan	1
	41	Golok	1
1994	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1995	40	Kelantan	1
	41	Golok	1
1996	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1997	39	Kemasin/Semerak	1
	40	Kelantan	1
	41	Golok	1
1998	40	Kelantan	1
	41	Golok	1
1999	39	Kemasin/Semerak	2
	40	Kelantan	2
	41	Golok	2
2000	39	Kemasin/Semerak	2
	40	Kelantan	2
	41	Golok	2
2001	40	Kelantan	2

TABLE A6.12: NUMBER OF FLOOD EVENTS (1980 - 2001) BY RBMU IN **KELANTAN**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
2001	41	Golok	2
		Total	62

TABLE A6.13: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **SABAH**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1982	220	Putatan	1
1984	211	Kinabatangan	1
	224	Padas	3
1986	211	Kinabatangan	1
	213	Labuk	1
	217	Bongan	1
	218	Kedamaian	1
	224	Padas	1
1987	217	Bongan	1
	220	Putatan	1
	221	Papar	1
1988	207	Tawau	1
	217	Bongan	2
	220	Putatan	1
	221	Papar	1
	224	Padas	1
1989	225	Lakutan	2
1990	214	Sugut	1
	217	Bongan	3
	220	Putatan	2
	225	Lakutan	1
1991	217	Bongan	1
	220	Putatan	3
	225	Lakutan	1
1992	220	Putatan	2
1993	211	Kinabatangan	1
	213	Labuk	1
	217	Bongan	1
	219	Tuaran	1
	220	Putatan	2
	221	Papar	1
	224	Padas	1
1994	211	Kinabatangan	1
	220	Putatan	1
	224	Padas	2
1995	207	Tawau	1
	220	Putatan	1
	221	Papar	1
	224	Padas	1
1996	217	Bongan	1
	218	Kedamaian	1
	221	Papar	1
	222	Kimanis	1
	224	Padas	2
1997	211	Kinabatangan	1
	213	Labuk	1
	217	Bongan	1
	224	Padas	1
1998	217	Bongan	1
1999	207	Tawau	1
	217	Bongan	1
	218	Kedamaian	1
	219	Tuaran	1
	220	Putatan	1

TABLE A6.13: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **SABAH**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1999	221	Papar	1
	224	Padas	1
2000	210	Segama	1
	211	Kinabatangan	2
	217	Bongan	1
	224	Padas	2
		Total	75

TABLE A6.14: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **SARAWAK**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1980	239	Oya	1
	240	Rajang	1
	242	Saribas	1
	246	Sarawak	1
1981	227	Lawas	1
	229	Limbang	1
	230	Baram	1
	231	Sibuti	1
	232	Niah	1
	235	Kemena	1
	236	Tatau	1
	237	Balingian	1
	240	Rajang	1
	246	Sarawak	1
1982	240	Rajang	2
	244	Sadong	1
1983	230	Baram	2
	232	Niah	1
	237	Balingian	1
	239	Oya	1
	240	Rajang	1
	242	Saribas	1
	244	Sadong	2
	245	Samarahan	1
	246	Sarawak	1
	247	Kayan	1
1984	230	Baram	1
	240	Rajang	1
	242	Saribas	1
	246	Sarawak	2
	247	Kayan	1
1985	227	Lawas	1
	228	Trusan	1
	229	Limbang	1
	235	Kemena	1
	236	Tatau	1
	245	Samarahan	1
	246	Sarawak	2
1986	240	Rajang	1
	244	Sadong	1
	246	Sarawak	2
	247	Kayan	1
1987	247	Kayan	1
1988	230	Baram	1
	235	Kemena	1
	236	Tatau	1
	237	Balingian	1
	239	Oya	1
	240	Rajang	2
1989	240	Rajang	1
	242	Saribas	1
	245	Samarahan	1
	246	Sarawak	2
1991	230	Baram	1

TABLE A6.14: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **SARAWAK**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1991	232	Niah	1
	240	Rajang	3
1992	240	Rajang	1
	244	Sadong	1
	246	Sarawak	1
	247	Kayan	1
1993	227	Lawas	1
	229	Limbang	1
	230	Baram	1
	237	Balingian	1
	238	Mukah	1
	239	Oya	1
	240	Rajang	2
	247	Kayan	1
1994	240	Rajang	1
	246	Sarawak	1
1995	240	Rajang	4
	242	Saribas	1
	243	Lupar	2
	244	Sadong	1
	246	Sarawak	2
1996	229	Limbang	1
	230	Baram	1
	235	Kemena	1
	236	Tatau	1
	237	Balingian	1
	238	Mukah	1
	239	Oya	1
	240	Rajang	1
	244	Sadong	1
	246	Sarawak	1
	247	Kayan	1
1997	229	Limbang	1
	240	Rajang	2
	246	Sarawak	1
	247	Kayan	1
1998	229	Limbang	1
	230	Baram	2
	235	Kemena	1
	246	Sarawak	1
1999	227	Lawas	1
	227	Trusan	1
	230	Baram	1
	231	Sibuti	1
	232	Niah	1
	235	Kemena	2
	236	Tatau	3
	237	Balingian	1
	238	Mukah	1
	239	Oya	1
	240	Rajang	1
	241	Krian	1
	243	Lupar	1
	244	Sadong	1

TABLE A6.14: NUMBER OF FLOOD EVENTS (1980 - 2000) BY RBMU IN **SARAWAK**

Year of Flood	RBMU		No. of Flood Events
	No.	Name	
1999	244	Sadong	1
	245	Samarahan	1
	246	Sarawak	1
	247	Kayan	1
2000	230	Baram	4
		Total	137

APPENDIX 7

LIST OF PROPOSED RM8 FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS

TABLE A7.1: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **PERLIS** (Sheet 1 of 1)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
01	Perlis	Perlis	RTB Negeri Perlis	Urban Drainage Upgrading	Widespread			
			- RTB Arau			2.0	10,000	
			- RTB Kuala Perlis			2.0	10,000	
			- RTB Kangar			3.0	25,000	
			- RTB Padang Besar			1.0	10,000	
			- RTB Simpang Empat			2.0	8,000	
			- RTB Pauh			1.0	6,000	
			- RTB Beseri			2.0	5,000	
			- Terusan Banjir Utama Hilir Empangan Timah Tasoh			30.0	20,000	
					State Total:	43.0	94,000	

Note: Expected Benefits figures are given by JPS Negeri Perlis

TABLE A7.2: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **KEDAH** (Sheet 1 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
02	Langkawi	Melaka	Ran Mencegah Banjir Sungai Melaka	River Rehabilitation	Localised	1.8	100	
		Cenang	Ran Mencegah Banjir Sg Cenang, Langkawi	River Rehabilitation	Localised	1.6	25	
		Itau	RTB Sg Itau, Langkawi	River Rehabilitation	Localised	0.2	25	
		Kuah	RTB Padang Lunas Jln Penarak dan Kg Atas	River Rehabilitation	Localised	1.0	100	
03	Kedah	Alor Malai	RTB Alor Setar Fasa II (Alor Malai Drainage Catchment Improvement Works)	River Channelisation Drainage Improvement Pump Station	Widespread	2.5	5,000	
		Mempelam, Terus & Peremba	RTB Alor Setar Fasa II (Sg Mempelam, Sg Terus & Sg Peremba Drainage Catchment Improvement Works)	River Channelisation Drainage Improvement Pump Station	Widespread	3.0	3,000	
		Kedah/ Anak Bkt	RMB Sg Kedah / Sg.Anak Bukit	River Rehabilitation	Localised	9.0	500	
		Jabi	RMB Sg. Jabi	River Rehabilitation	Localised	4.5	300	

Notes: Expected Benefits figures are given by JPS Negeri Kedah

TABLE A7.2: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **KEDAH** (Sheet 2 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
03	Kedah	Pdg Kerbau	Ran Mencegah Banjir	Bund Protection	Localised	9.0	500	
		& Rambai	Padang Kerbau/					
			Sg. Lampam					
		P. Kundor	RTB Kota Setar	River Rehabilitation	Widespread	3.2	2,000	
		Alor Merah &						
		Tj Bendahara						
		Tj Pauh,	RTB Jitra	River Rehabilitation	Widespread	1.7	20,000	
		Jitra Lama						
		Alor						
		Changleh						
		& Keroncho						
		-	Ran Saliran Pekan Tikam	Drainage Improvement	Localised	1.8	500	
			Batu, Kuala Muda, Kedah					
		Alor Tok	RTB Kuala Kedah	Urban Drainage Upgrading	Widespread	2.7	350	
		Pasai						
		Alor Melaka						
		& Teluk						
		Kechai						
		Nawa	RTB Pokok Sena	River Rehabilitation	Localised	1.8	not available	
		Pendang	RTB Pekan Pendang	Urban Drainage Upgrading	Localised	2.7	200	

Notes: Expected Benefits figures are given by JPS Negeri Kedah

TABLE A7.2: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **KEDAH** (Sheet 3 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
03	Kedah	Bata &	RMB Sg.Bata/Temin,	River Rehabilitation	Localised	7.0	25,000	
		Temin	Kubang Pasu	Drainage Improvement				
		Pendang	Ran Mencegah Banjir	River Rehabilitation	Localised	7.2	1,000	
			Sg Pendang					
04	Merbok	Petani	Ran Saliran Bandar	River Channelisation	Localised	5.0	50,000	
			Sg Petani, Kuala Muda					
		-	Ran Kolam Takungan	River Channelisatiion	Widespread	4.5	132	
			Gurun Diversion, Yan					
		Bongkok	RMB Sg. Bongkok Bedong	River Channelisation	Localised	1.6	700	
		Parit MADA	RMB Guar Cempedak, Yan	Sub Urban Drainage Improvement	Localised	1.8	not available	
05	Muda	Muda, Ketil Chepir & Baling	RTB Sg Muda	River Rehabilitation	Widespread	70.2	30,500	
		Karangan	RMB Sg.Karangan	River Channelisation	Localised	5.4	288	
		Jenara	Ranc. Saliran Pekan, Jeniang	Bund Protection	Localised	2.0	500	
		Sedim	RMB Sg. Sedim	River Channelisation	Localised	27.0	300	

Notes: Expected Benefits figures are given by JPS Negeri Kedah

TABLE A7.2: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **KEDAH** (Sheet 4 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
05	Muda	Terap	RMB Sg.Terap, Kulim	River Channelisation	Localised	3.6	200	
				River Rehabilitation				
		-	RMB Kaw.Pdg.Serai, Kulim	Urban Drainage Upgrading	Localised	4.5	483	
		Keladi	Ran Saliran Bandar Kulim	River Channelisation,	Widespread	3.0	5,000	
			(Projek Menaiktaraf	River Rehabilitation				
			Sg Keladi)					
06	Perai	Air Merah	Ran Saliran Bandar Kulim	River Channelisation	Widespread	13.5	520	
		Utara	(Cadangan Menaiktaraf	River Rehabilitation				
		Jarak, Kelang	Sungai-sungai)					
		Lama, Badak						
		Air Merah						
		Tengah						
		& Seluang						
	Jawi	Air Merah	Ran Saliran Bandar Kulim	River Channelisation	Widespread	2.3	1,450	
		Selatan	(Cadangan Menaiktaraf Sg	River Rehabilitation				
			Air Merah Selatan)	Detention Pond.				
08	Kerian	Kerian	Ran Saliran Sg Kerian	Sub Urban Drainage	Localised	24.8	300	
			Bandar Baharu, Kedah	Improvement				
08	Kerian	Serdang	Ran Saliran Pekan Serdang	Urban Drainage Upgrading	Localised	11.5	100	
			Bandar Baharu, Kedah					
					State Total:	241.3	149,073	

Notes: Expected Benefits figures are given by JPS Negeri Kedah

TABLE A7.3: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **PULAU PINANG** (Sheet 1 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
05	Muda	Muda	RTB Sg. Muda	River/Drainage Improvement	Widespread	not available	3,700	
06	Perai	Perai	RTB Sg. Perai	River/Drainage Improvement	Widespread	4.8	5,950	
		Puyu	RTB Butterworth	River/Drainage Improvement	Localised	3.6	40,610	
		Rambai/Juru	RTB Sg. Rambai	River/Drainage Improvement	Localised	5	8,070	
		Rambai	RTB Bukit Mertajam	Urban Drainage	Localised	0.8	8,920	
		Jejawi/ Junjung	RTB Sg. Jejawi/Sg. Junjung	River/Drainage Improvement	Localised	5.6	15,300	
07	Pulau Pinang	Pinang & Air Hitam	RTB Perbandaran P.Pinang	River/Drainage Improvement	Localised	8.0	9,000	
		Bayan Lepas	RTB Bayan Lepas	River/Drainage Improvement	Localised	5.0	1,000	
		Bagan Air Itam	RTB Kawasan Barat	River/Drainage Improvement	Localised	not available	not available	
		Relau	RTB Balik Pulau	River/Drainage Improvement	Localised	11.5	2,500	

Note: Expected Benefits figures are given by JPS Negeri Pulau Pinang

TABLE A7.3: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **PULAU PINANG** (Sheet 2 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
08	Kerian	Kerian	RTB Nibong Tebal	Drainage Improvement	Localised	0.7	1,630	
					State Total:	45.0	96,680	

Note: Expected Benefits figures are given by JPS Negeri Pulau Pinang

TABLE A7.4: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **PERAK** (Sheet 1 of 3)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
8	Kerian	Kerian	RTB Sg. Kerian	River Improvement	Localised	35	980	
9	Kurau	Kurau	RTB Sg. Kurau, Kerian	River Improvement	Localised	10.5	420	
10	Perak	Pari	RTB Sg. Pari, Fasa II, Ipoh	River Improvement	Localised	14.5	1000	
		Larut	RTB Taiping, Fasa 1, Taiping, Perak	River Improvement	Localised	4.6	4200	
		Choh/Pinji	RTB Sg. Choh/Sg. Pinji	River Improvement	Localised	5	2000	
		Bidor	RTB Teluk Intan, Fasa II	River Improvement	Localised	5	4000	
		Pahlawan	Rancangan Pengaluran Sungai Pahlawan	River Channelisation	Localised	1.1	420	
		Bidor	RTB Sg. Bidor	River Improvement	Localised	70	280	
		Sungkai	RTB Sg. Sungkai	River Improvement	Localised	7.4	200	
		Siput	RTB Sg. Siput (U), Perak	River Improvement	Localised	3.4	570	
		Kinta	RTB Sg. Kinta	River Improvement	Localised	63	6000	
		Bukit Gantang	RTB Sg. Bukit Gantang Fasa 1, Taiping, Perak	River Improvement	Localised	41	50	

Note: Expected Benefits figures are given by JPS Negeri Perak

TABLE A7.4: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **PERAK** (Sheet 2 of 3)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
10	Perak	Pelus	RTB Sg. Pelus, Sg. Siput (U)	River Improvement	Localised	not available	400	
		Ijok	RTB Sg. Ijok, Fasa II	River Improvement	Localised	5.5	100	
		Behrang	RTB Kaw. Perindustrian Tanjung Malim	Urban drainage upgrading	Localised	68.9	400	
		Resam	RTB Sg. Resam	River Improvement	Localised	0.4	400	
		Seluang	RTB Sri Iskandar	River Improvement	Localised	21.2	200	
		Air Tawar	RTB Air Tawar Fasa II	River Improvement	Localised	2.3	200	
		Hangai	RTB Gerik	River Improvement	Localised	12	2023	
		Kinta	RTB Bandar Ipoh	River Improvement	Localised	30	2400	
		Pulau	RTB Sg. Pulau	River Improvement	Localised	9.8	50	
		Trong	RTB Sg. Trong	River Improvement	Localised	41	50	
		Sepetang/ Air Kuning	RTB Sg. Sepetang/Sg. Air Kuning	River Improvement	Localised	1.4	200	
		Bandar Air	RTB Kg. Gajah	River Improvement	Localised	2.1	200	

Note: Expected Benefits figures are given by JPS Negeri Perak

TABLE A7.4: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **PERAK** (Sheet 3 of 3)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
10	Perak	Selama	RTB Pengaloran	River Improvement	Localised	0.7	50	
			Sg. Selama					
		Lawin	RTB Sg. Lawin	River Improvement	Localised	35	250	
		Chempias	RTB Sg. Chempias	River Improvement	Localised	2.3	200	
		Kangsar	RTB Sg. Kangsar	River Improvement	Localised	3	300	
					State Total	305.2	16023	

Note: Expected Benefits figures are given by JPS Negeri Perak

TABLE A7.5: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND BENEFITS
STATE: **SELANGOR** (Sheet 1 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
11	Bernam	Bernam	RTB Daerah	River Improvement	Localised	12.81	1465	
			Sabak Bernam	Drainage Upgrading				
				Bund Protection				
		Bernam	RTB Daerah	River Improvement	Localised	2.60	4370	
			Hulu Selangor	River Rehabilitation				
				Bund Protection				
12	Tengi	Tengi	RTB Sg. Tengi	River Improvement	Localised	0.40	200	
				Bund protection				
		Tengi	RTB Daerah	River Improvement	Localised	2.57	1745	
			Kuala Selangor	Bund Protection				
14	Buloh	Buloh	RTB Lembangan	River Improvement	Localised	1.75	625	
			Sg. Buluh	Bund Protection				
15	Klang	Damansara	RTB Lembangan	River Improvement	Localised	2.83	11250	
			Sg. Damansara, Petaling	Bund Protection				
				River Rehabilitation				
		Klang	RTB Daerah Petaling	River Improvement	Localised	2.95	12600	
				Drainage Upgrading				
		Klang	RTB Daerah Gombak	River Improvement	Localised	1.36	5685	
				Drainage Upgrading				
				River Rehabilitaion				

Note: Expected Benefits figures are given by JPS Selangor (Pelan Tindakan Mengatasi Banjir Negeri Selangor)

TABLE A7.5: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND BENEFITS
STATE: **SELANGOR** (Sheet 2 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
15	Klang	Kapar Besar	RTB Sg. Kapar Besar	River Improvement	Localised	0.50	300	
		Aur	RTB Sg. Aur	Drainage Upgrading	Localised	0.20	1000	
		Klang	RTB Daerah Klang	River Improvement	Localised	18.20	13100	
				Drainage Upgrading				
16	Langat	Langat	RTB Lembangan Sg. Langat	River Improvement	Localised	715.97	18230	
		Langat	RTB Daerah Hulu Langat	River Improvement	Localised	240.81	9050	
		Langat	RTB Daerah Kuala Langat	River Improvement	Localised	0.13	1485	
		Ampang	RTB Sg. Ampang Hulu Langat	River Improvement	Localised	4.66	2500	
17	Sepang	Sepang	RTB Daerah Sepang	River Improvement	Localised	6.05	1050	
				River Rehabilitation				
					State Total	1013.79	84655	

Note: Expected Benefits figures are given by JPS Selangor (Pelan Tindakan Mengatasi Banjir Negeri Selangor)

TABLE A7.6: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8(RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **WILAYAH PERSEKUTUAN KUALA LUMPUR** (Sheet 1 of 1)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
15	Klang	Klang	RTB Lembah Sg. Klang	Urban Drainage	Localised	2.94	24,951	
				Upgrading				
					State Total	2.94	24,951	

Note: Expected Benefits figures are estimated from flood maps

TABLE A7.7: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND BENEFITS
STATE: **NEGERI SEMBILAN** (Sheet 1 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
17	Sepang	-	RTB Port Dickson	River/Drainage	Localised	4.8	11,000	
				Improvement				
18	Linggi	Linggi	RTB Bandar Seremban	River/Drainage	Localised	3.9	33,700	
				Improvement				
		Tarun	RMB Sg. Tarun	River/Drainage	Localised	not available	not available	
			Seremban	Improvement				
		Simin	RMB Sg. Simin	River/Drainage	Localised	1.4	3,000	
			Seremban	Improvement				
		Linggi	RMB Sg. Linggi	River/Drainage	Localised	3.6	8,000	
			Port Dickson	Improvement				
		Pajam	RMB Sg. Pajam	River/Drainage	Localised	0.47	3,000	
			Seremban	Improvement				
		Bt. Labu	RMB Sg. Batang Labu	River/Drainage	Localised	2.3	3000	
			Seremban	Improvement				
		Pedas	RMB Sg. Pedas	River/Drainage	Localised	5.3	700	
			Rembau	Improvement				
		Chuai	RMB Sg. Chuai	River/Drainage	Localised	0.4	200	
			Rembau	Improvement				

Note: Expected Benefits figures are given by JPS Negeri Sembilan

TABLE A7.7: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND BENEFITS
STATE: **NEGERI SEMBILAN** (Sheet 2 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
18	Linggi	Chembung	RMB Sg. Chembung Rembau	River/Drainage Improvement	Localised	1.9	350	
		Kindung	RMB Sg. Kindung Rembau	River/Drainage Improvement	Localised	1.3	500	
		Gadong	RMB Sg. Gadong Gadong	River/Drainage Improvement	Localised	0.95	250	
		Rembau	RMB Sg. Rembau Rembau	River/Drainage Improvement	Localised	not available	not available	
		Penajis	RMB Sg. Penajis Mampung	River/Drainage Improvement	Localised	not available	not available	
19	Melaka	Tampin	RMB Sg. Tampin Tampin	River/Drainage Improvement	Localised	2.1	500	
		Btg. Melaka	RMB Sg. Btg. Melaka Tampin	River/Drainage Improvement	Localised	2	1,500	
21	Muar	Gemencheh	RMB Sg. Gemencheh Tampin	River/Drainage Improvement	Localised	1.9	500	
		Menanti	RMB Sg. Menanti Kuala Pilah	River/Drainage Improvement	Localised	0.54	1,500	

Note: Expected Benefits figures are given by JPS Negeri Sembilan

TABLE A7.7: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND BENEFITS
STATE: **NEGERI SEMBILAN** (Sheet 3 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
21	Muar	Serting	RMB Sg. Serting Jempol	River/Drainage Improvement	Localised	0.55	800	
		Jempol	RMB Sg. Jempol Jempol	River/Drainage Improvement	Localised	0.35	500	
		Pilah	RMB Sg. Pilah Kuala Pilah	River/Drainage Improvement	Localised	1.8	4,000	
		Terachi	RMB Sg. Terachi Kuala Pilah	River/Drainage Improvement	Localised	1.35	1,000	
		Jelai	RMB Sg. Jelai Kuala Pilah	River/Drainage Improvement	Localised	1.9	2,000	
		Johol	RMB Sg. Johol Kuala Pilah	River/Drainage Improvement	Localised	1.44	1,500	
		Juaseh	RMB Sg. Juaseh Kuala Pilah	River/Drainage Improvement	Localised	0.78	800	
		Gemas	RMB Sg. Gemas Tampin	River/Drainage Improvement	Localised	2.1	3,000	
30	Pahang	Triang	RMB Sg. Triang, Jelebu	River/Drainage Improvement	Localised	4.5	2,000	

Note: Expected Benefits figures are given by JPS Negeri Sembilan

TABLE A7.7: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND BENEFITS
STATE: **NEGERI SEMBILAN** (Sheet 4 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
30	Pahang	Kenaboi	RMB Sg. Kenaboi, Jelebu	River/Drainage	Localised	1.7	1,000	
				Improvement				
					State Total	49.33	84,300	

Note: Expected Benefits figures are given by JPS Negeri Sembilan

TABLE A7.8: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **MELAKA** (Sheet 1 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
18	Linggi	Sempang Ampat	Projek Menaiktaraf Sg. Sempang Ampat	River Rehabilitation	Localised	1.5	294	
		Air Limau	Projek Menaiktaraf Sg Air Limau	River Rehabilitation	Localised	2.1	412	
		Durian Daun	Projek Menaiktaraf Sg Durian Daun	River Rehabilitation	Localised			
		Durian Daun & Bharu	Rancangan Saliran Bdr Masjid Tanah, Alor Gajah (Fasa II)	Urban Drainage Upgrading	Localised			
19	Melaka	Lendu	Projek Menaiktaraf Sg Lendu	River Rehabilitation	Localised	4.6	908	
		Air Hitam	Projek Menaiktaraf Sg Air Hitam Fasa II	River Rehabilitation	Localised	1.7	2,131	
		Air Salak	Projek Menaiktaraf Sg Air Salak Fasa II	River Rehabilitation	Localised	3.1	3,876	
		Durian Tunggal	Projek Menaiktaraf Sg Durian Tunggal	River Rehabilitation	Localised	0.5	95	
		Lereh	Projek Menaiktaraf Sg Lereh	River Rehabilitation	Localised	1.7	2,081	

Note: Expected Benefits figures are estimated from flood maps

TABLE A7.8: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **MELAKA** (Sheet 2 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
19	Melaka	Malim	Projek Menaiktaraf Sg Malim	River Rehabilitation	Localised	not available	not available	
20	Kesang	Nyalas	RMB Sg.Nyalas	River Rehabilitation	Widespread	not available	not available	
		Kesang	Projek Menaiktaraf Sg Kesang Fasa II	River Rehabilitation	Widespread	2.5	363	
		Ulu Jasin	Projek Menaiktaraf Sg Ulu Jasin	River Rehabilitation	Widespread	3.3	487	
		Asahan	Projek Menaiktaraf Sg Asahan	River Rehabilitation	Widespread	1.4	201	
					State Total:	22.4	10,848	

Note: Expected Benefits figures are estimated from flood maps

TABLE A7.9: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **JOHOR** (PAGE 1 OF 6)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
20	Kesang	Tangkak	Rancangan Saliran Sg Padang Lerek, Tangkak	Urban Drainage Upgrading	Localised	10.0	8,000	
21	Muar	Muar	Rancangan Perparitan & RTB Bandar Maharani, Muar	Urban Drainage Upgrading	Localised	10.0	10,000	
		Segamat	Pengaluran Sg Kapeh	River Channelisation	Widespread	not available	not available	
		Segamat	Pengaluran Sg. Segamat	River Channelisation	Localised	2.6	not available	
		Juasseh	Pengaluran Sg Juasseh	River Channelisation	Widespread	not available	not available	
		Jementah	Pengaluran Sg Jementah	River Channelisation	Widespread	not available	not available	
		Muar	Mencegah Banjir Kilat di Pekan Parit Jawa, Muar	Urban Drainage Upgrading	Localised	2.0	5,000	
			Membenteng Pantai dari Pt Perupuk ke Pt Kassim, Muar	Bund Protection	Localised	2.0	500	
		Siput & Jementah	Pengaluran Sg Siput, Jementah	Urban Drainage Upgrading	Localised	11.0	1200	
		Kenawar & Jementah	Pembinaan Pt Konkrit Bukit Siput, Segamat	Urban Drainage Upgrading	Localised	5.0	5,000	

Note: Expected Benefits figures are given by JPS Negeri Johor

TABLE A7.9: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **JOHOR** (PAGE 2 OF 6)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
		Pagoh	Mencegah Banjir Pekan	Urban Drainage Upgrading	Localised	5.0	5,000	
			Pagoh					
		Labis	Pengaluran Sg. Labis	River Channelisation	Localised	1.1	not available	
		Paya Merah	Pengaluran Sg. Paya	River Channelisation	Localised	1.1	not available	
			Merah					
			Pengurusan Sungai-sungai		Localised	2.0	not available	
22	Batu	Batu Pahat	RTB & Saliran Bandar	Urban Drainage Upgrading	Localised	10.0	15,000	
	Pahat		Batu Pahat					
		Bekok	Saliran Pekan Bekok,	Urban Drainage Upgrading	Widespread	3.0	6,000	
			Segamat					
		Simpang Kiri	Projek Saliran Pekan	River Channelisation	Widespread	2.0	5,000	
			Parit Sulong	Bund Protection				
		Kg Dalam &	Saliran Utama Km 3	River Channelisation	Widespread	2.0	5,000	
		Temehel	Jln Labis, Yong Peng	Bund Protection				
			Membaikpulih Kawasan	Drainage Upgrading	Localised	3.2	107	
			Terbiar Peradong, Kluang					

Note: Expected Benefits figures are given by JPS Negeri Johor

TABLE A7.9: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **JOHOR** (PAGE 3 OF 6)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
23	South	Skudai	Pengaluran Sg Skudai	River Channelisation	Localised	not available	27,300	
	West		Fasa IV					
	Johor							
	Rivers	Tebrau	Pengaluran Sg Tebrau	River Channelisation	Localised	30	2,500	
			Fasa III					
		Pontian	Tebatan Banjir Bandar	Urban Drainage Upgrading	Localised	10.0	10,000	
		Kechil	Pontian					
			Pembaikan Sistem	Urban Drainage Upgrading	Localised	10	5,000	
			Saliran Pekan Machap					
		Masai	Membina Pt Konkrit Sg	Urban Drainage Upgrading	Localised	10.0	8,000	
			Masai					
		Nyior &	Membaiki Sistem Saliran	Bund Protection	Localised	0.5	20	
		Pendas	Kg Ladang, Tg Kupang					
		Melana	Pengaluran Sg. Melana	River Channelisation	Localised	2.5	not available	
		Plentong	Pengaluran Sg. Plentong	River Channelisation	Localised	2.5	not available	
			Fasa II					
24	Johor	Sayong	Penambahbaikan Sg	River Channelisation	Localised	2.0	6,000	
			Sayong, Pekan	Bund Protection				
			Renggam					

Note: Expected Benefits figures are given by JPS Negeri Johor

TABLE A7.9: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **JOHOR** (PAGE 4 OF 6)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
24	Johor	Segundal	Pengaluran Sg	River Channelisation	Localised	6.5	400	
		Telok Jeri &	Segundal, Sedili,	Urban Drainage Upgrading				
		Sri Gading	Kota Tinggi					
			RTB Bandar Johor Bahru	Urban Drainage Upgrading	Localised	5.0	12,000	
			Tebatan Banjir Kota	Urban Drainage Upgrading	Localised	10.0	15,000	
			Tinggi					
		Rengit	Pengaluran Sg Rengit,	Urban Drainage Upgrading	Localised	6.0	1,300	
			Pengerang	River Channelisation				
		Telur &	Pengaluran Sg Telur,	Urban Drainage Upgrading	Localised	20	1,000	
		Kepala Orang	Kota Tinggi	River Channelisation				
		Punggai	Pengaluran Sg Punggai,	River Channelisation	Localised	8.0	750	
			Kota Tinggi					
		Sayong	Pengaluran Sg. Sayong	River Channelisation	Localised	2.5	not available	
		Tiram	Pengaluran Sg. Tiram	River Channelisation	Localised	3.0	not available	
			Fasa II					
		Sayong	Pengaluran Sg. Sayong	River Channelisation	Localised	1.2	not available	
			Kota Tinggi					

Note: Expected Benefits figures are given by JPS Negeri Johor

TABLE A7.9: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **JOHOR** (PAGE 5 OF 6)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
24	Johor	Berangan	Pengaluran Sg. Berangan Kota Tinggi	River Channelisation	Localised	0.7	not available	
25	Sedili Besar	Sedili Besar & Gembut	RMB Kg.Gambut, Kota Tinggi	Urban Drainage Upgrading	Localised	not available	1,000	
		Sedili Kecil	Pengaluran Sg Sedili Kecil, Kota Tinggi	River Channelisation	Localised	not available	not available	
		Mupor, Semalok & Pak Kenik	Pengaluran Sg Mupor	River Channelisation	Localised	not available	not available	
		Ambat	Pengaluran Sg. Ambat	River Channelisation	Localised	0.5	not available	
26	Mersing	Segenting	Rancangan Pengaluran Sg Segenting, Kg Tjg Segenting, Mersing	River Channelisation	Localised	0.5	300	
		Siapu	Rancangan Pengaluran Sg Siapu	River Channelisation	Localised	0.8	200	
27	Endau	Mengkibol	Tebatan Banjir Bandar Kluang	Urban Drainage Upgrading	Localised	not available	not available	

Note: Expected Benefits figures are given by JPS Negeri Johor

TABLE A7.9: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **JOHOR** (PAGE 6 OF 6)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
27	Endau	Lambak	Mengatasi Banjir di Kg Tengah/ Tmn Indah Jaya III, Kluang	Urban Drainage Upgrading	Localised	5.0	3,000	
		Kahang	Mengatasi Banjir di Kg Cth Bt 22, Kluang	Urban Drainage Upgrading	Localised	15.0	800	
		Kahang	Pengaluran Sg. Kahang, Kluang	River Channelisation	Localised	1.1	not available	
		Paloh Pengeli	Pengaluran Sg Paloh	River Rehabilitation River Channelisation	Localised	not available	115	
		Sembrong Besar	Pengaluran Sg Sembrong Besar	River Channelisation	Localised	2.1	not available	
		Penggeli	Pengaluran Sg Penggeli	River Channelisation	Localised	2.1	not available	
		Sepuluh	Pengaluran Sg. Sepuluh	River Channelisation	Localised	0.25	not available	
		Selang Bani	Pengaluran Sg. Selang Bani	River Channelisation	Localised	0.6	not available	
		Mersing	Pengaluran Sg. Mersing	River Channelisation	Localised	0.50	not available	
					State Total:	230.9	160,492	

Note: Expected Benefits figures are given by JPS Negeri Johor

TABLE A7.10: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **PAHANG** (Sheet 1 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
26	Rompin	Rompin	RTB Rompin	River Rehabilitation	Localised	1.3	8,000	
				Urban Drainage Upgrading				
				Bund Protection				
		Rompin & Ulu Sg Merchong	RTB Muadzam	Urban Drainage Upgrading	Localised	not available	8,000	
30	Pahang	Pahang	RTB Pekan	River Rehabilitation	Localised	13.6	30,000	
				Urban Drainage Upgrading				
				Bund Protection				
		Ketapa, Awur & Ara	RTB Temerloh/Mentakab	River Rehabilitation	Localised	4.0	25,000	
				Urban Drainage Upgrading				
		Betong & Nahar	RTB Jerantut	River Rehabilitation	Localised	not available	5,000	
				Urban Drainage Upgrading				
				Bund Protection				
		Sempalit, Koman, Lampan & Rotan Tunggal	RTB Raub	River Rehabilitation	Localised	1.3	15,000	
				Urban Drainage Upgrading				
				Bund Protection				
		Penjuring & Bentong	RTB Bentong	River Rehabilitation	Localised	not available	15,000	
				Urban Drainage Upgrading				
				Bund Protection				

Note: Expected Benefits figures are given by JPS Negeri Pahang

TABLE A7.10: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **PAHANG** (Sheet 2 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
				Bund Protection				
30	Pahang	Pagar, Lebing	RTB Bera	River Rehabilitation	Localised	not available	10,000	
		Chandan &		Urban Drainage Upgrading				
		Anak Sg		Bund Protection				
		Triang						
		Lipis &	RTB Lipis	River Rehabilitation	Localised	not available	15,000	
		Tempoyang		Urban Drainage Upgrading				
		Bertam, Kial,	RTB Cameron Highlands	Urban Drainage Upgrading	Localised	not available	not available	
		Ikan						
		Maran	RTB Maran	Urban Drainage Upgrading	Localised	not available	not available	State Funded
31	Kuantan	Kuantan &	RTB Kuantan	Urban Drainage Upgrading	Localised	2.4	10,000	
		Galing Besar						
					State Total:	22.5	141,000	

Note: Expected Benefits figures are given by JPS Negeri Pahang

TABLE A7.11: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **TERENGGANU** (Sheet 1 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
32	Kemaman	Kemaman	RTB Bandar Chukai	River/Drainage Improvement	Widespread	24.75		
		Kemaman	Penempatan Semula Nelayan Kampung Paya Berenjut	Resettlement	Localised	not available	30,000	
		Kemaman	Sistem Saliran Kerteh, Kemasik	Urban Drainage Upgrading	Localised	not available		
32 & 33	Kemaman & Paka	Kemaman & Paka	Sistem Saliran Pekan Paka - Kerteh	Urban Drainage Upgrading	Localised	not available	6,000	
34	Dungun	Dungun	RTB Dungun	Urban Drainage Upgrading	Localised	9.90	10,000	
		Pimpin	Pengaluran Sg. Pimpin	River Channelisation	Localised	not available		
35	Merchang	Marang	RTB Marang	Urban Drainage Upgrading	Localised	4.90	8,000	
36	Terengganu	Terengganu	RTB Bandar K.Terengganu	Urban Drainage Upgrading	Localised	58.90	30,000	
		H.Terengganu	RTB H.Terengganu	Drainage Improvement	Localised	38.00		
37	Setiu	Setiu	RTB Setiu	Urban Drainage Upgrading	Localised	62.00	15,000	

Note: Expected Benefits figures are given by JPS Negeri Terengganu

TABLE A7.11: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **TERENGGANU** (Sheet 2 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
38	Besut	Besut	RTB Besut	Urban Drainage Upgrading	Localised	24.00	20,000	
					State Total:	222.45	119,000	

Note: Expected Benefits figures are given by JPS Negeri Terengganu

TABLE A7.12: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **KELANTAN** (Sheet 1 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flooding Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
39	Kemasin	Kemasin	Saliran Bandar Bachok	Urban Drainage Upgrading	Localised	3.0	5,000	
	Semerak							
		Semerak	Saliran Bandar Pasir	Urban Drainage Upgrading	Localised	1.0	35,000	
			Puteh					
40	Kelantan	Kelantan	Saliran Bandar Tanah	Urban Drainage Upgrading	Localised	2.0	10,000	
			Merah					
		Kelantan	Saliran Bandar Machang	Urban Drainage Upgrading	Localised	10.0	12,000	
		Kelantan	Saliran Bandar Kuala Krai	Urban Drainage Upgrading	Localised	4.4	50,000	
		Pergau	Saliran Bandar Jeli	Urban Drainage Upgrading	Localised	1.0	8,000	
		Galas	Saliran Bandar Gua	Urban Drainage Upgrading	Localised	3.0	8,000	
			Musang					
		Krai &	Pengaluran Sg.Krai/	Urban Drainage Upgrading	Localised	4.0	3,000	
		Tebing	Sg.Tebing					
		Sat &	Mencegah Banjir	Urban Drainage Upgrading	Localised	11.0	6,000	
		Kemubu	Lembangan Sg.Sat -					
			Sg.Kemubu,Machang					
		Kelantan	RTB Jajahan Kuala Krai	River Rehabilitation &	Localised	1.7	2,670	
				Bund Protection				

Note: Expected Benefits figures are obtained from RM8 Project Briefs.

TABLE A7.12: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **KELANTAN** (Sheet 2 of 2)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flooding Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
40	Kelantan	Kelantan	Saliran Bandar Pasir Mas	Urban Drainage Upgrading	Localised	8.0	50,000	
		Kelantan	RTB Lembangan Sg. Kelantan	Dam Construction, River Rehabilitation & River Channelisation	Widespread	901.4	864,000	
		Kelantan	RTB Kota Bharu	Urban Drainage Upgrading & Bund Protection	Localised	26.81	25,700	
41	Golok	Kelantan & Golok	RTB Lemal & Rantau Panjang	River Rehabilitation, Sub Urban Drainage & Bund Protection	Widespread	70.0	128,000	
		Golok	RTB Tumpat	River Rehabilitation, Sub Urban Drainage Improvement & Bund Protection	Localised	62.0	20,000	
		Golok	Saliran Bandar Tumpat	Urban Drainage Upgrading	Localised	12.5	8,000	
					State Total:	1121.8	1,235,370	

Note: Expected Benefits figures are obtained from RM8 Project Briefs.

TABLE A7.13: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **SABAH** (Sheet 1 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
207	Tawau	Tawau	RTB Bandaran Sg. Tawau	River Improvement	Widespread	6.0	16,500	
209	Silibukan	Pancuran	RTB Bandaran Sg. Pancuran	River Improvement & new drains	Widespread	3.5	23,000	
212	Segalid	Sibuga	RTB Bandaran Sg. Sibuga	Urban drainage upgrading	Widespread	100	20,000	Sg. Gum-Gum /Sibuga catchmt. area
		Anip	RTB Bandaran Sg. Anip	Urban drainage upgrading & river improvement	Widespread	5.0	50,000	
		Anip	RTB Bandaran Jalan Lapangan Terbang	Urban drainage upgrading	Widespread	4.0	50,000	
			RTB Bandaran BDC	Urban drainage upgrading	Widespread	5.0	40,000	
		Sandakan	RTB Bandaran Jln. Cecily /	Urban drainage upgrading	Widespread	0.5	500	
213	Labuk	Lingkudau	RTB Bandaran Sg. Lingkudau	Urban drainage upgrading	Localised	not available	not available	
218	Kedamaian	Gurung-gurung	RTB Bandaran Sg. Gurung-gurung	Urban drainage upgrading	Widespread	0.5	2,350	
		Kawang-kawang	RMB Sg. Kawang-kawang Kota Belud	River channelisation	Localised	5.0	3,250	

Note: Expected Benefits figures are obtained from RM8 Project Briefs and JPS Negeri Sabah

TABLE A7.13: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **SABAH** (Sheet 2 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
218	Kedamaian	Kedamaian	RMB Sg. Kedamaian, Kota Belud	River channelisation	Widespread	20	17,288	
220	Putatan	Menggatal	RTB Bandaran Sg. Menggatal	Urban drainage upgrading	Widespread	not available	not available	
		Putatan	RTB Bandaran Putatan	Urban drainage upgrading	Widespread	7.1	3,500	
		Kawasan Kota Kinabalu / Penampang	RTB Bandaran Pembaikan Perparitan Kota Kinabalu / Penampang	Urban dranage upgrading	widespread	10	5,000	
		Gudon	RTB Bandaran Sg. Gudon Menggatal Utara	Sub-Urban drainage improvement	Widespread	9.0	1,000	
		Kawasan Putatan	RTB Bandaran Putatan	Urban drainage upgrading	Localised	5.0	3,000	
		Kawasan Telipok Selatan	RTB Bandaran Telipok Selatan	Urban drainage upgrading	Localised	6.0	1,000	
		Rampayan / Menggatal	RTB bandran Kg. Rampayan	Sub-Urban drainage improvement	Widespread	5.0	1,000	

Note: Expected Benefits figures are obtained from RM8 Project Briefs and JPS Negeri Sabah

TABLE A7.13: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **SABAH** (Sheet 3 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
220	Putatan	Miliwat	RTB Bandaran Sg. Miliwat	Sub-Urban drainage improvement	Widespread	4.0	2,000	
221	Papar	Papar	RMB Sg. Papar	River mouth deeping	Widespread	2.0	1,000	For ease of navigation especially during low tide
		Kinarut	RMB Sg. Kinarut	Sub-urban drainage	Localised	5.0	1,000	
221	Papar	Parit Jalan Lama	RTB Bandaran Parit Jalan Lama, Papar	Urban drainage upgrading	Localised	5.0	2,500	
		Kinarut Selatan	RTB Bandaran Pekan Baru Kinarut Selatan	Flood Preventation	Localised	see remarks	see remarks	Construction of rains for Kinarut South New Township (no flooding has been reported so far) total land area of the newtownship = 10km2 alignments of drains will be as per local plan

Note: Expected Benefits figures are obtained from RM8 Project Briefs and JPS Negeri Sabah

TABLE A7.13: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8 (RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **SABAH** (Sheet 4 of 4)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flood Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
224	Padas	Bunut Drain	RTB Bandaran Bunut Drain, Tenom	Urban drainage upgrading	Widespread	not available	not available	
					State Total:	**208**	**243,888**	

Note: Expected Benefits figures are obtained from RM8 Project Briefs and JPS Negeri Sabah

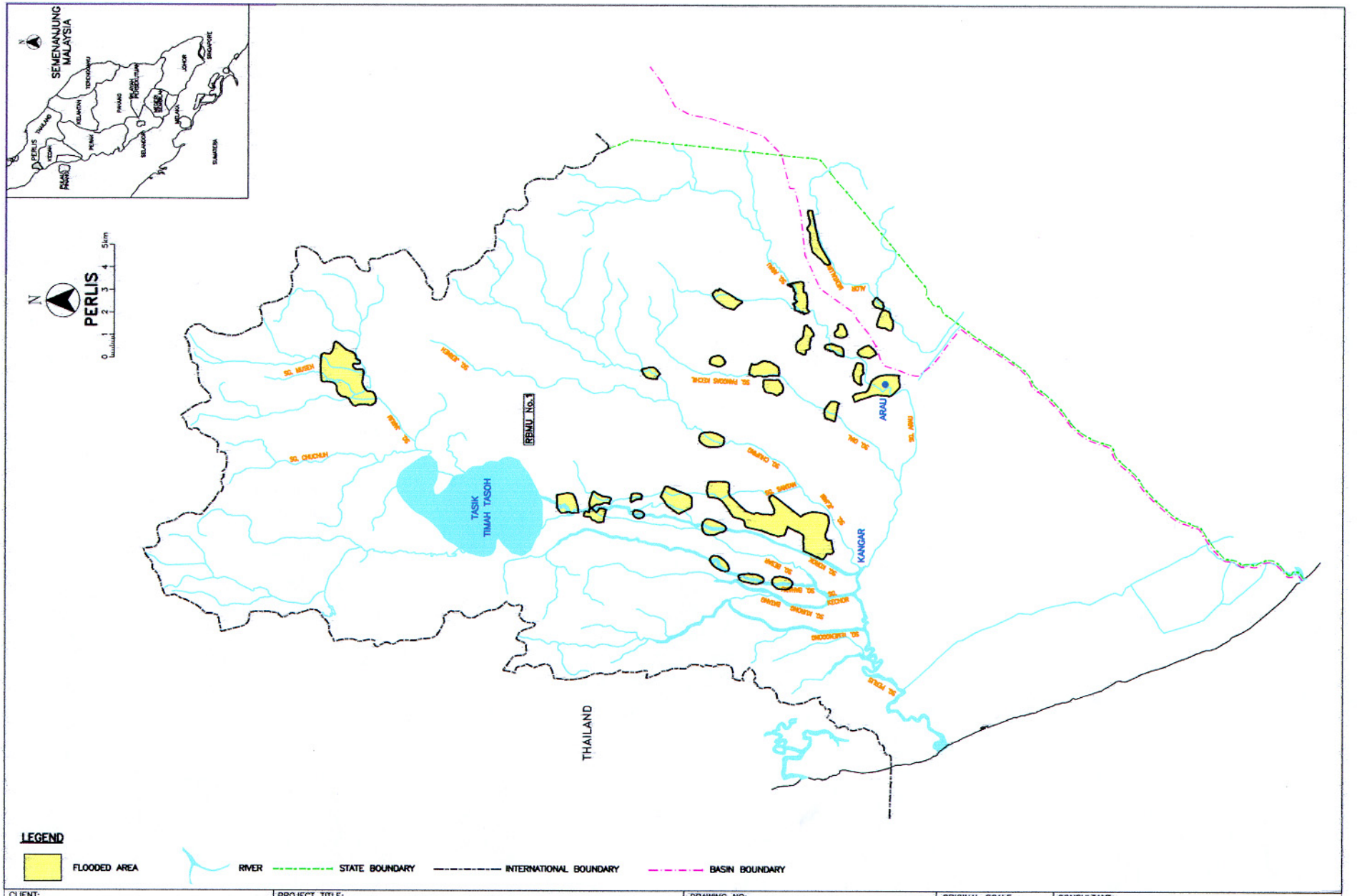
TABLE A7.14: LIST OF PROPOSED RANCANGAN MALAYSIA KE 8(RM8) FLOOD MITIGATION PROJECTS AND EXPECTED BENEFITS
STATE: **SARAWAK** (Sheet 1 of 1)

RBMU		River	Proposed RM8 Flood Mitigation Project	Nature of Mitigation Works	Type of Flooding Mitigated	Expected Benefits		Remarks
No.	Name					Flood Area Reduced (km^2)	People (No.)	
230	Baram	Miri	Projek Kawalan Banjir	Town Flood Mitigation	Localised	2.17	100,000	
			Di Miri					
240	Rajang	Rajang	Projek Kawalan Banjir	Town Flood Mitigation	Localised	31.85	100,000	
			Di Sibu					
246	Sarawak	Sarawak	Projek Kawalan Banjir	Town Flood Mitigation	Localised	61.87	200,000	
			Di Kuching					
					State Total:	95.89	400,000	

Note: Expected Benefits figures are obtained from RM8 Project Briefs.

APPENDIX 8

STATE FLOOD MAPS



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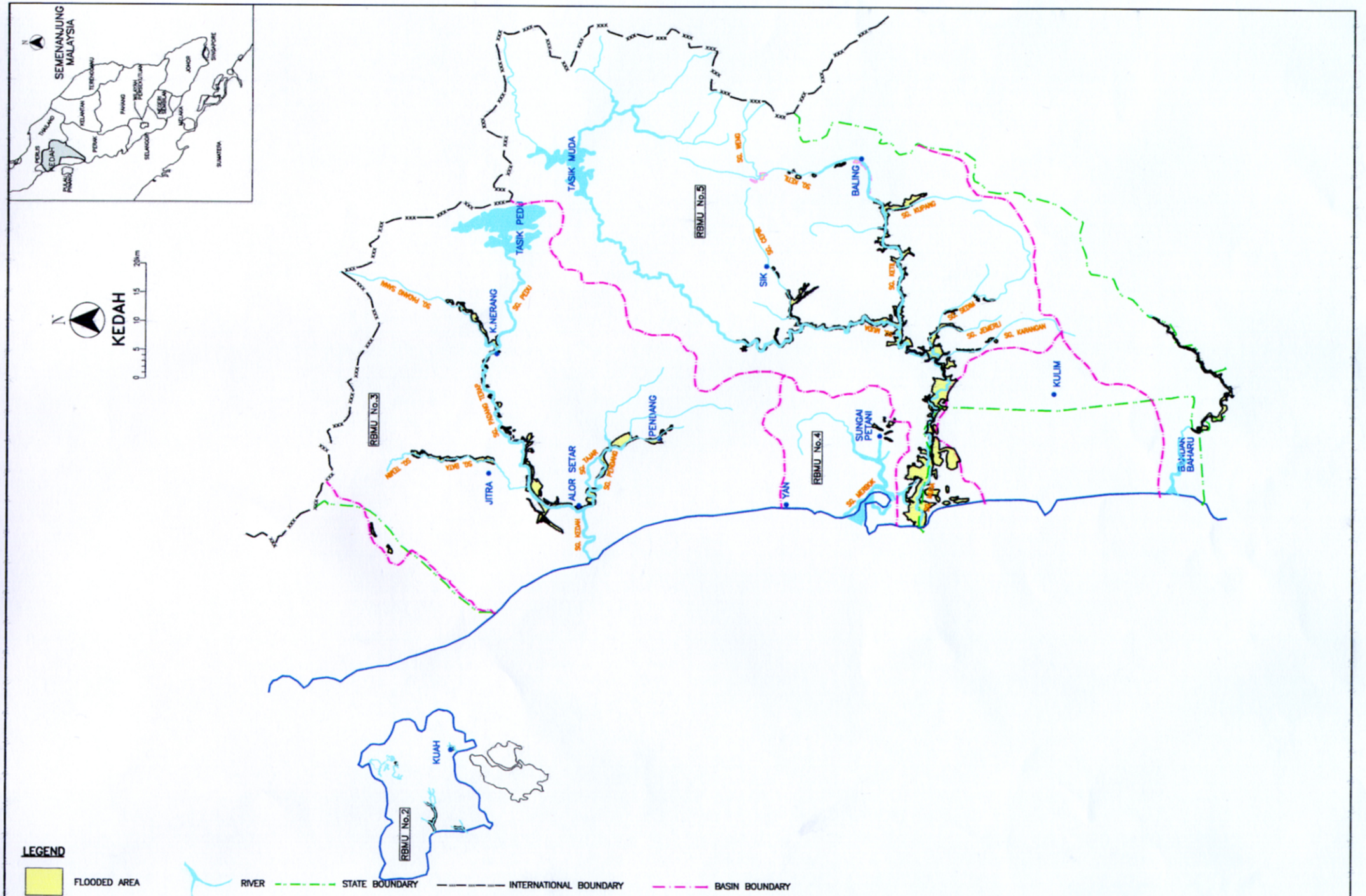
	DRAWING TITLE : FLOOD MAP OF PERLIS.	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\PERLIS\PERLIS_R1.DWG	ORIGINAL SIZE : A1	



CLIENT:
JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
FLOOD MAP OF KEDAH

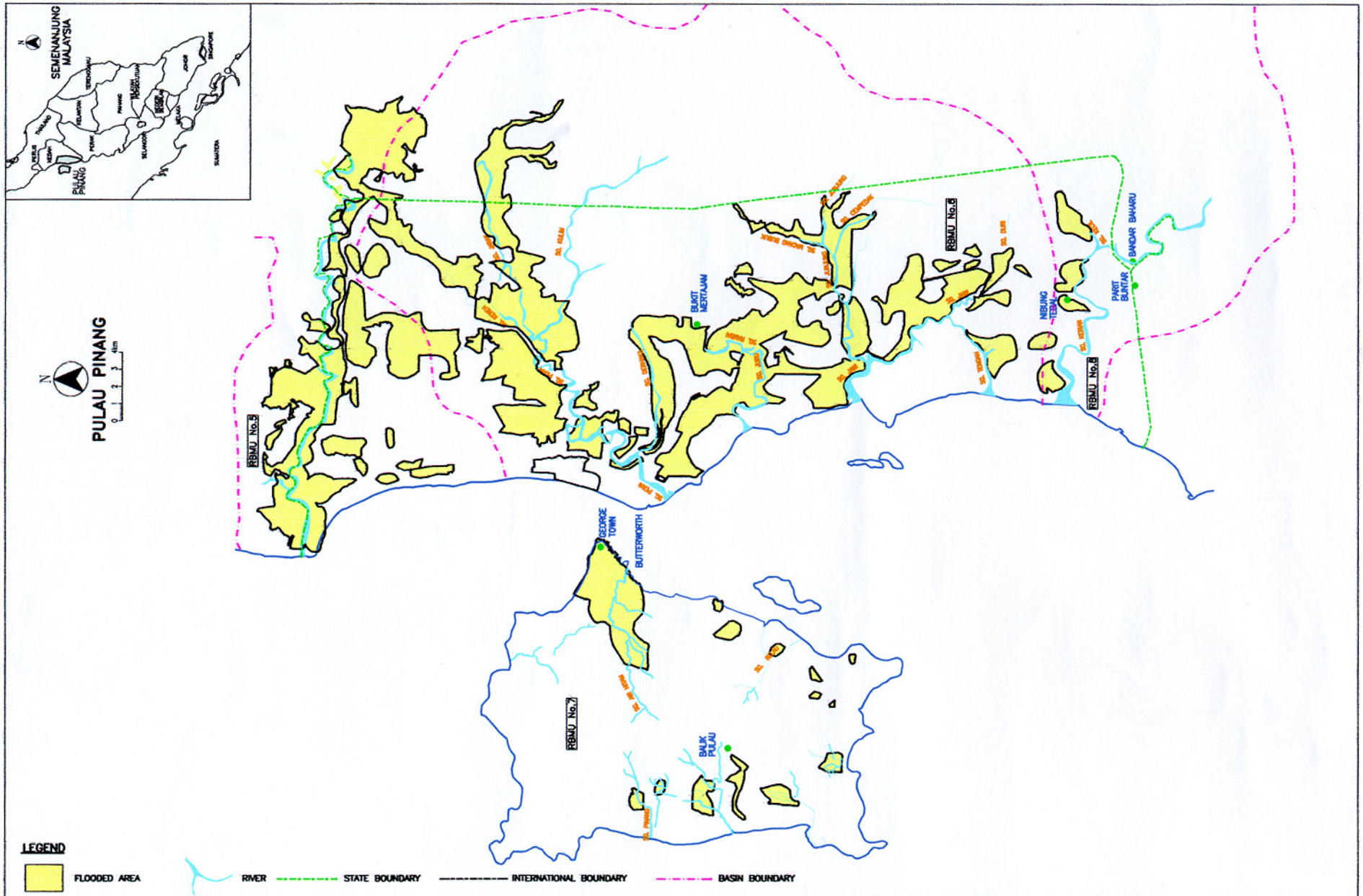
DRAWING NO:
T0036\K\KEDAH

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\KEDAH\KEDAH_R1.DWG

ORIGINAL SCALE :
1 :300000

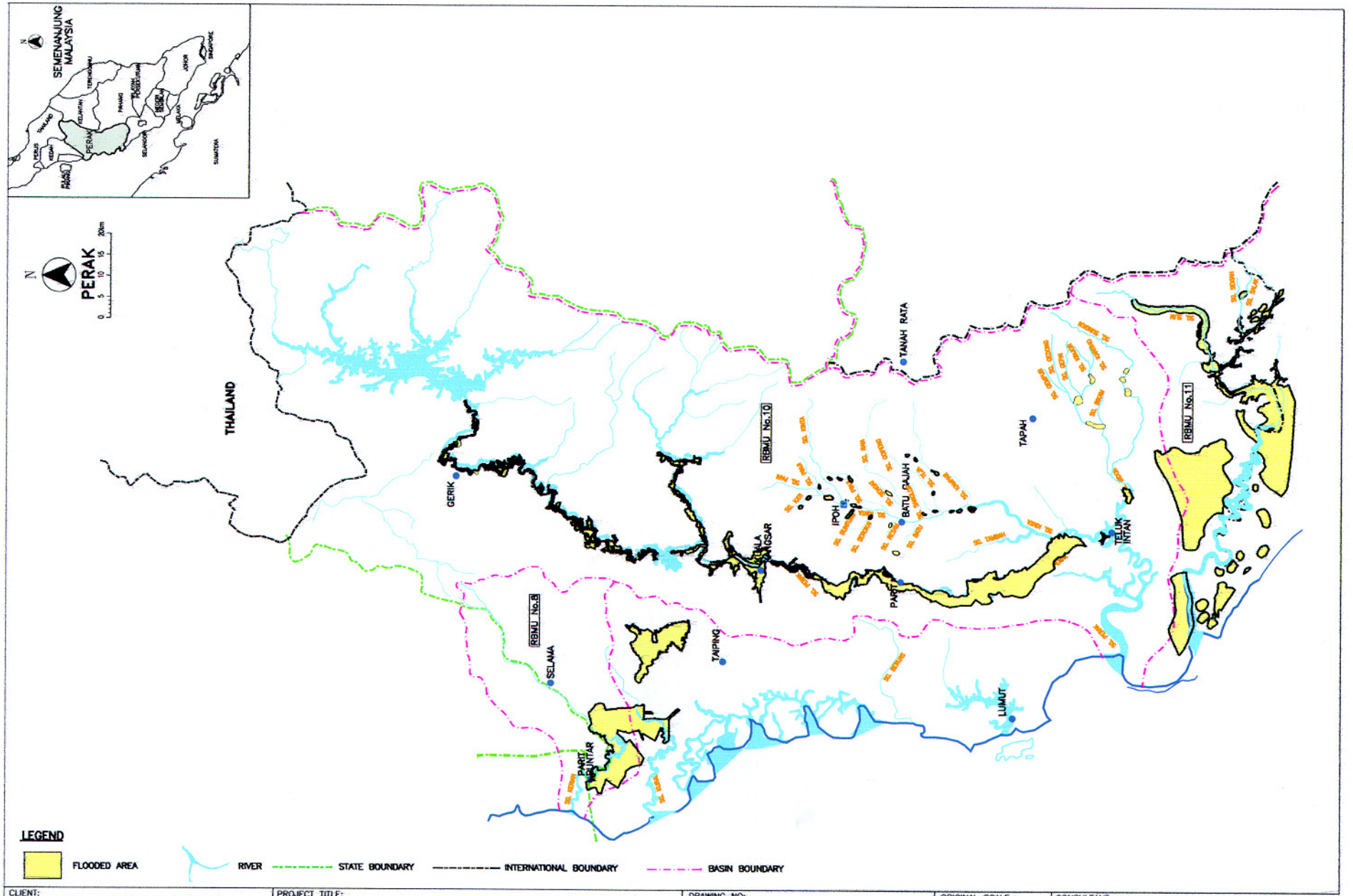
ORIGINAL SIZE :
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 239199-V
BANGUNAN KTA TENAGA,
D1-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\P\PENANG	ORIGINAL SCALE : 1 :100000
	DRAWING TITLE : FLOOD MAP OF PULAU PINANG.	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\PENANG\PENANG_R1.DWG	ORIGINAL SIZE : A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS - JURUTERA PERUNDING
Company No: 239199-V
BANGUNAN KTA TENAGA,
01-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE : FLOOD MAP OF PERAK.

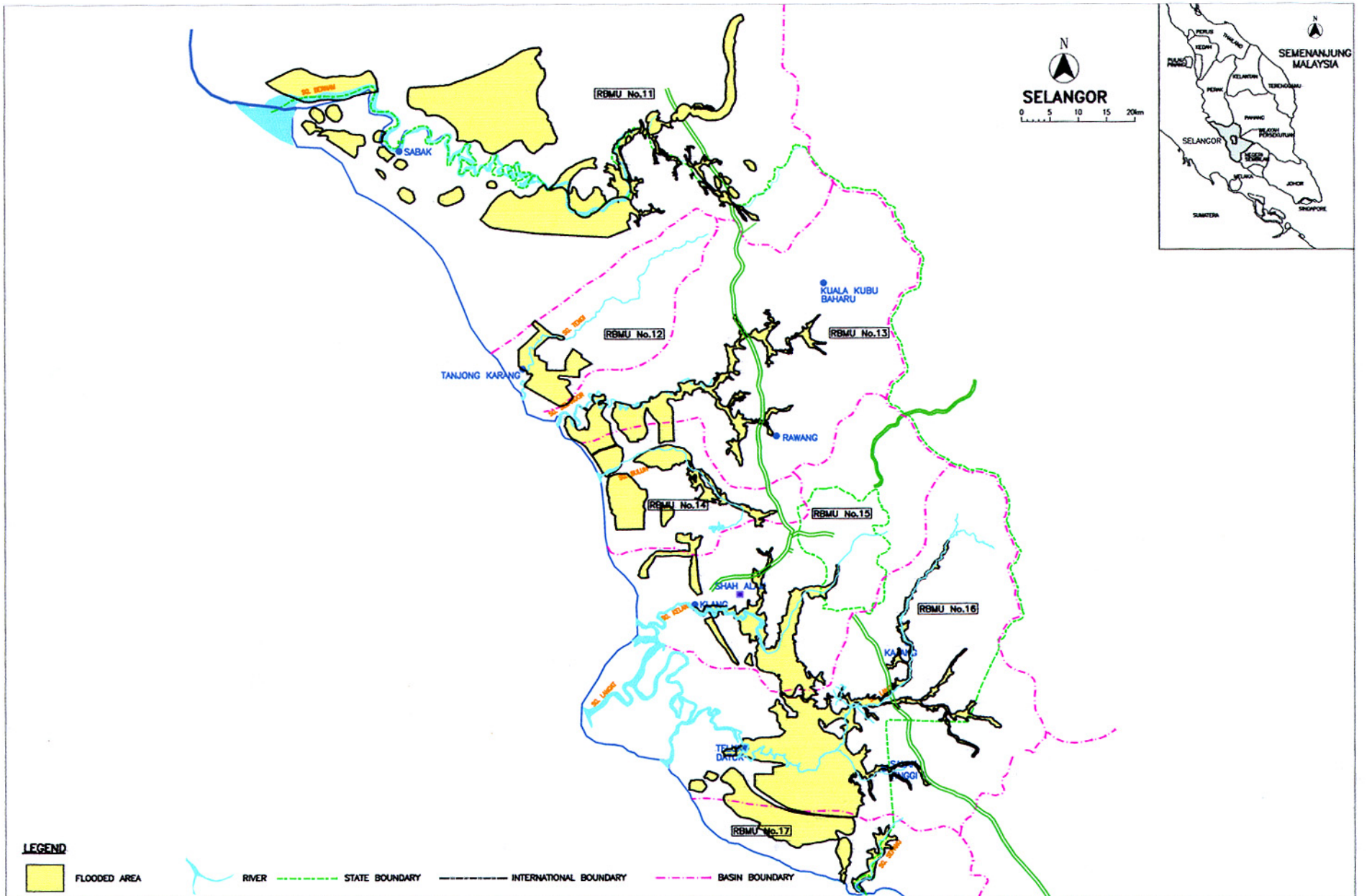
DRAWING NO: T0036\A\PERAK

ELECTRONIC FILE NAME: H:\PROJECTS\T0036\PERAK\PERAK_R2.DWG

ORIGINAL SCALE : 1: 400000

ORIGINAL SIZE : A1

CONSULTANT: KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 239199-V
BANGUNAN KTA TENAGA
D1-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA
SELANGOR DARUL EHSAN, MALAYSIA.



CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\B\SELANGOR	ORIGINAL SCALE : 1: 300000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS - JURUTERA PERUNDING Company No. 230109-V BANGUNAN KTA TENAGA 01-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : FLOOD MAP OF SELANGOR.	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\SELANGOR\SELANGOR_R2.DWG	ORIGINAL SIZE : A1	

N

WILAYAH

0 2.5km 5km

LEGEND

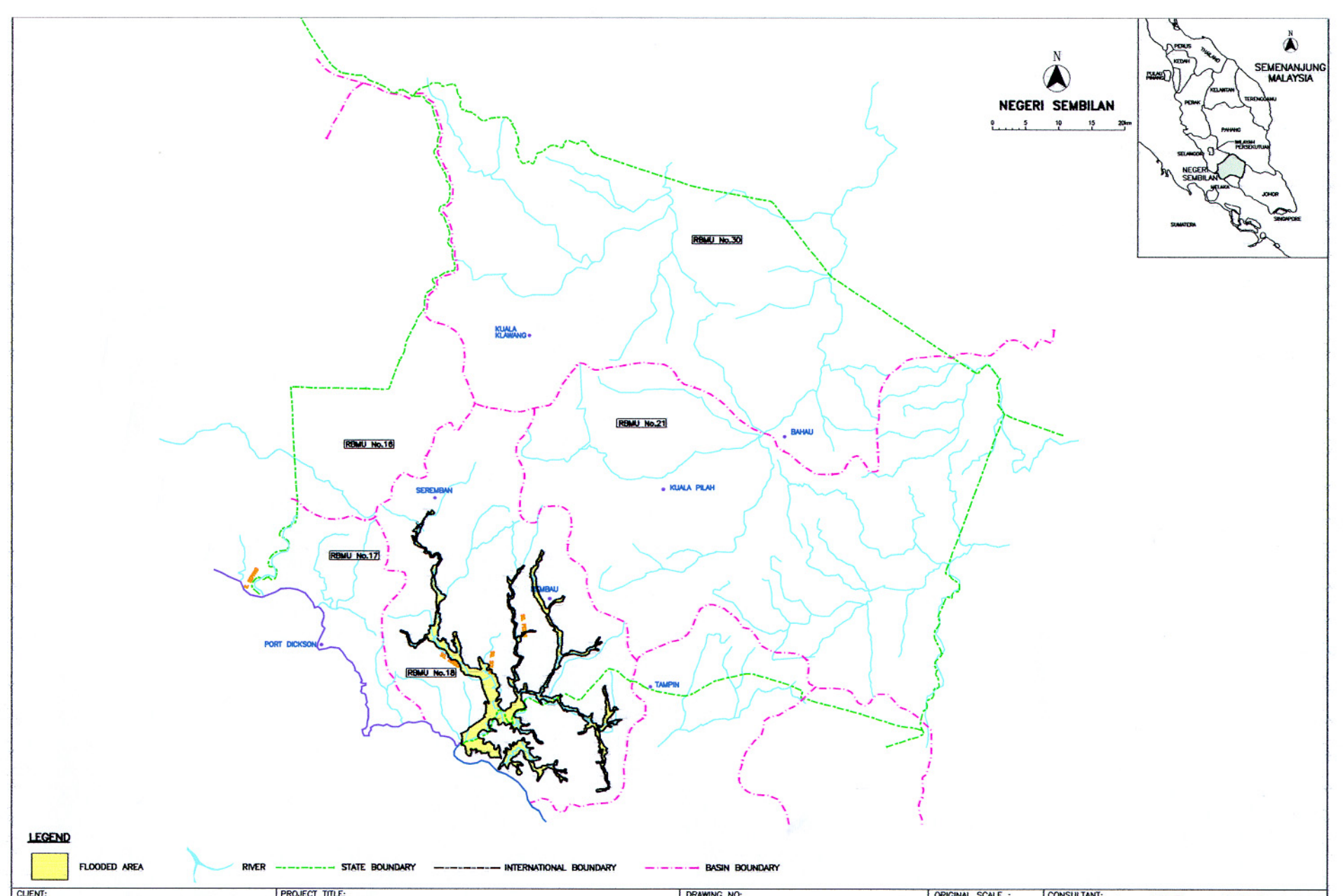
FLOOD AREA

RIVER

STATE BOUNDARY

INTERNATIONAL BOUNDARY

CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\W\WILAYAH	ORIGINAL SCALE : 1: 50000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS – JURUTERA PERUNDING Company No: 239199-V BANGUNAN KTA TENAGA D1-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : FLOOD MAP OF WILAYAH PERSEKUTUAN.	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\WILAYAH\W\WILAYAH.DWG	ORIGINAL SIZE : A1	



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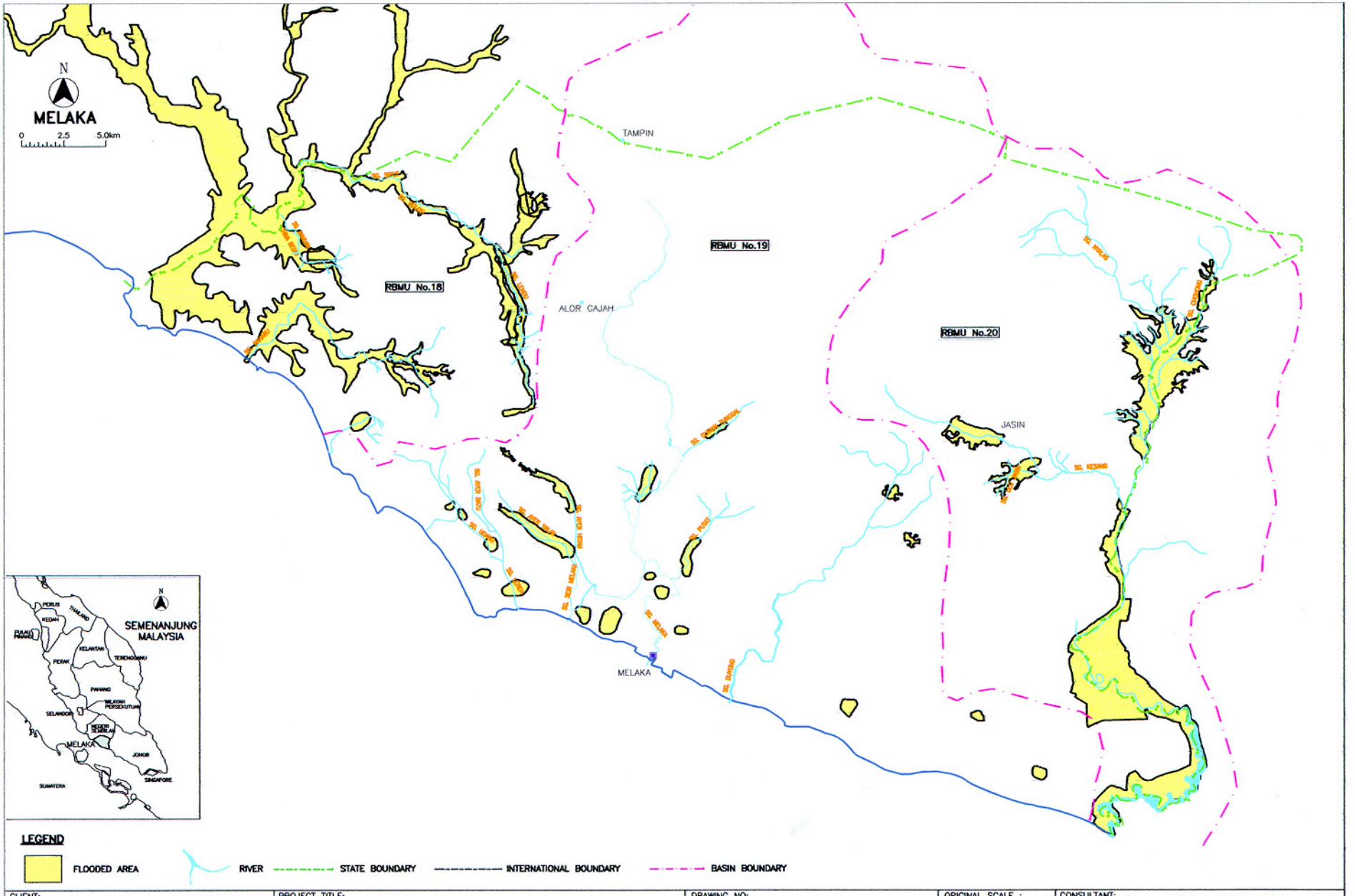

CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\M\MELAKA	ORIGINAL SCALE : 1: 100000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS – JURUTERA PERUNDING Company No: 239199-V PANGUNAN KTA TENAGA, D1-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
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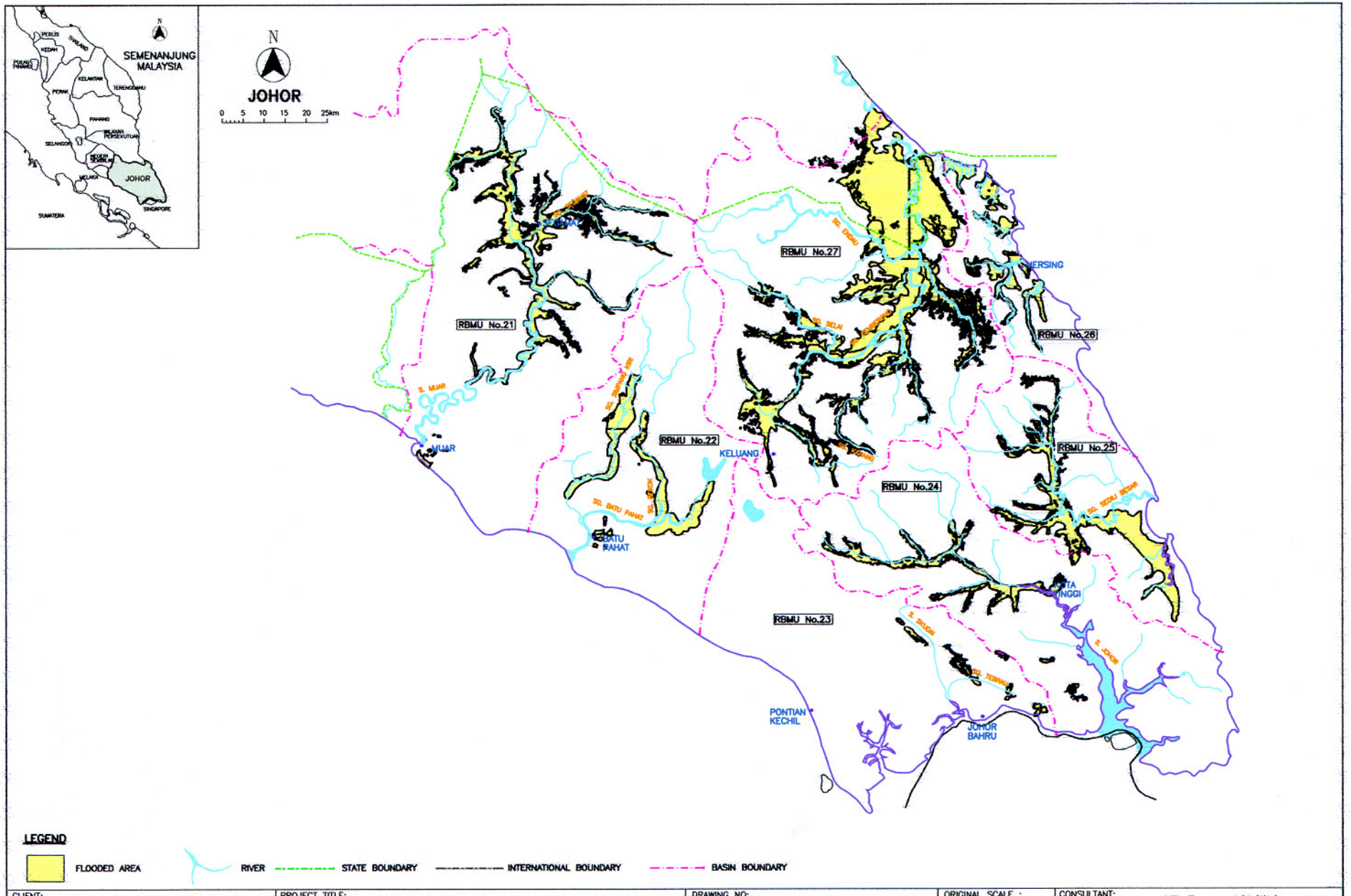
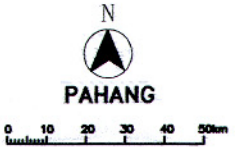
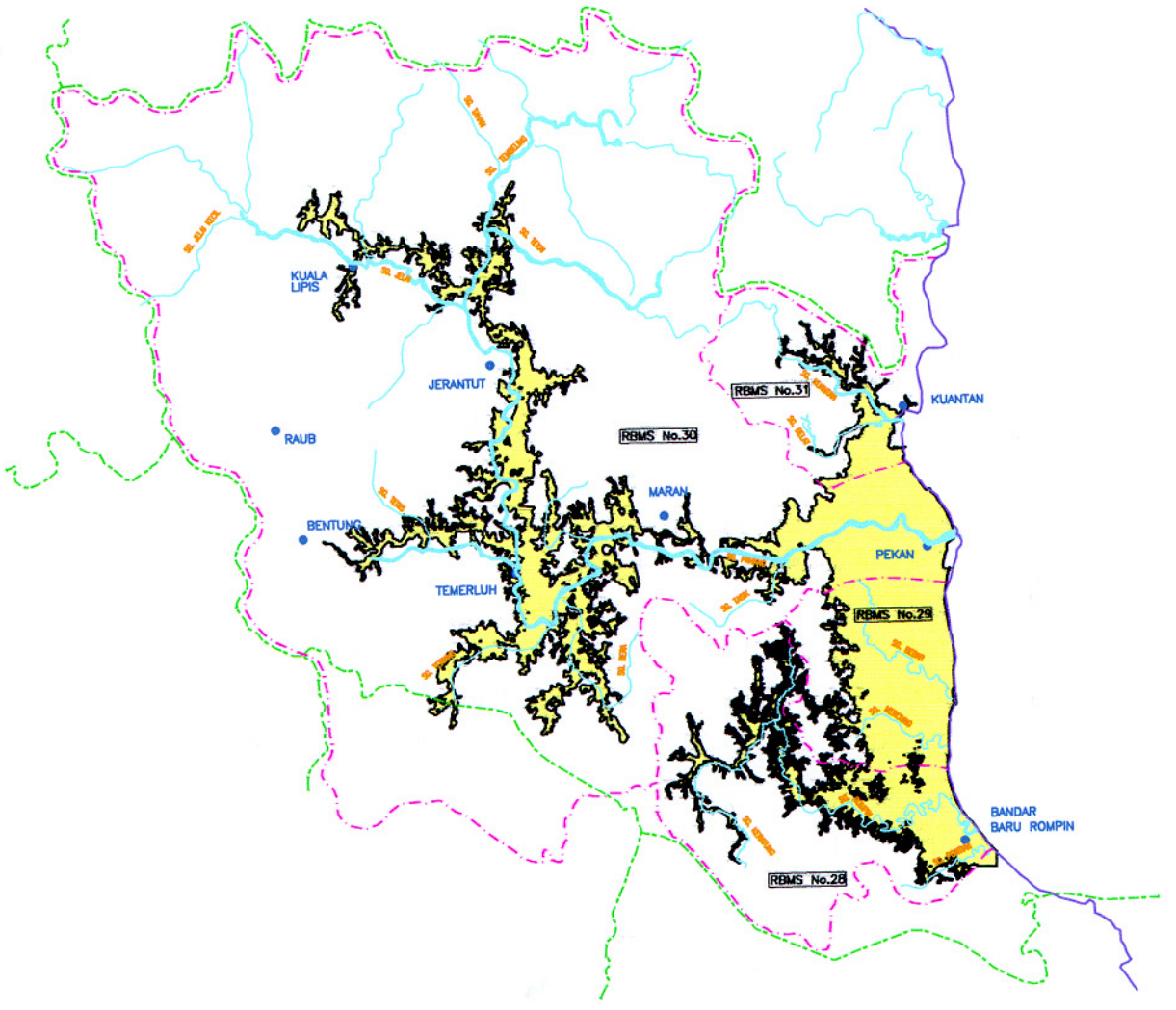


CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\J\JOHOR	ORIGINAL SCALE : 1: 400000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS – JURUTERA PERUNDING Company No: 239199-V BANGUNAN KTA TENAGA, 01-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : FLOOD MAP OF JOHOR.	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\JOHOR\JOHOR_R1.DWG	ORIGINAL SIZE : A1	





LEGEND

FLOODED AREA | RIVER | STATE BOUNDARY | INTERNATIONAL BOUNDARY | BASIN BOUNDARY

CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\C\PAHANG	ORIGINAL SCALE : 1: 600000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS – JURURUTERA PERUNDING Company No: 239198-V BANGUNAN KTA TENAGA, D1-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
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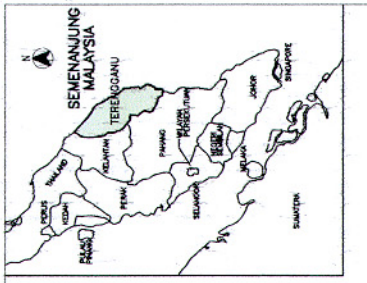
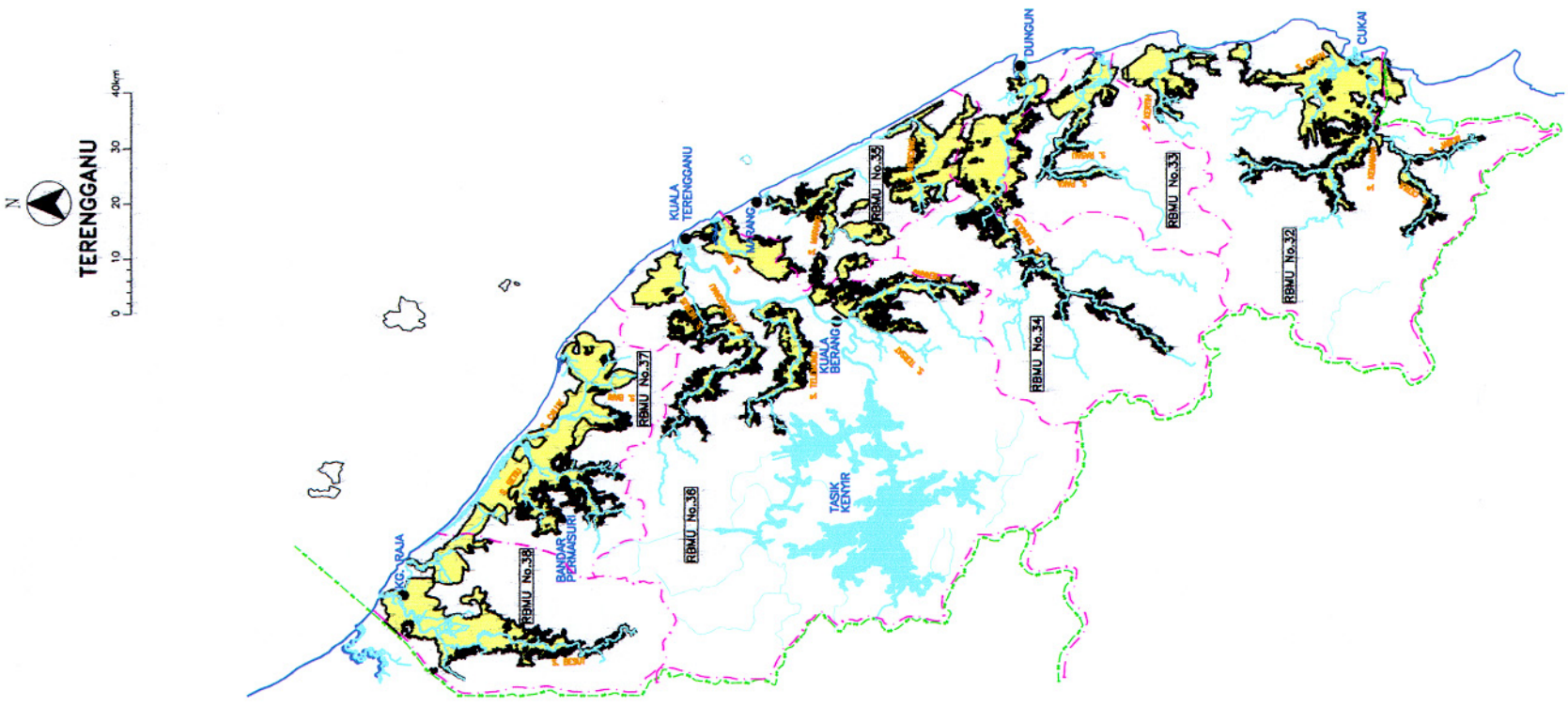
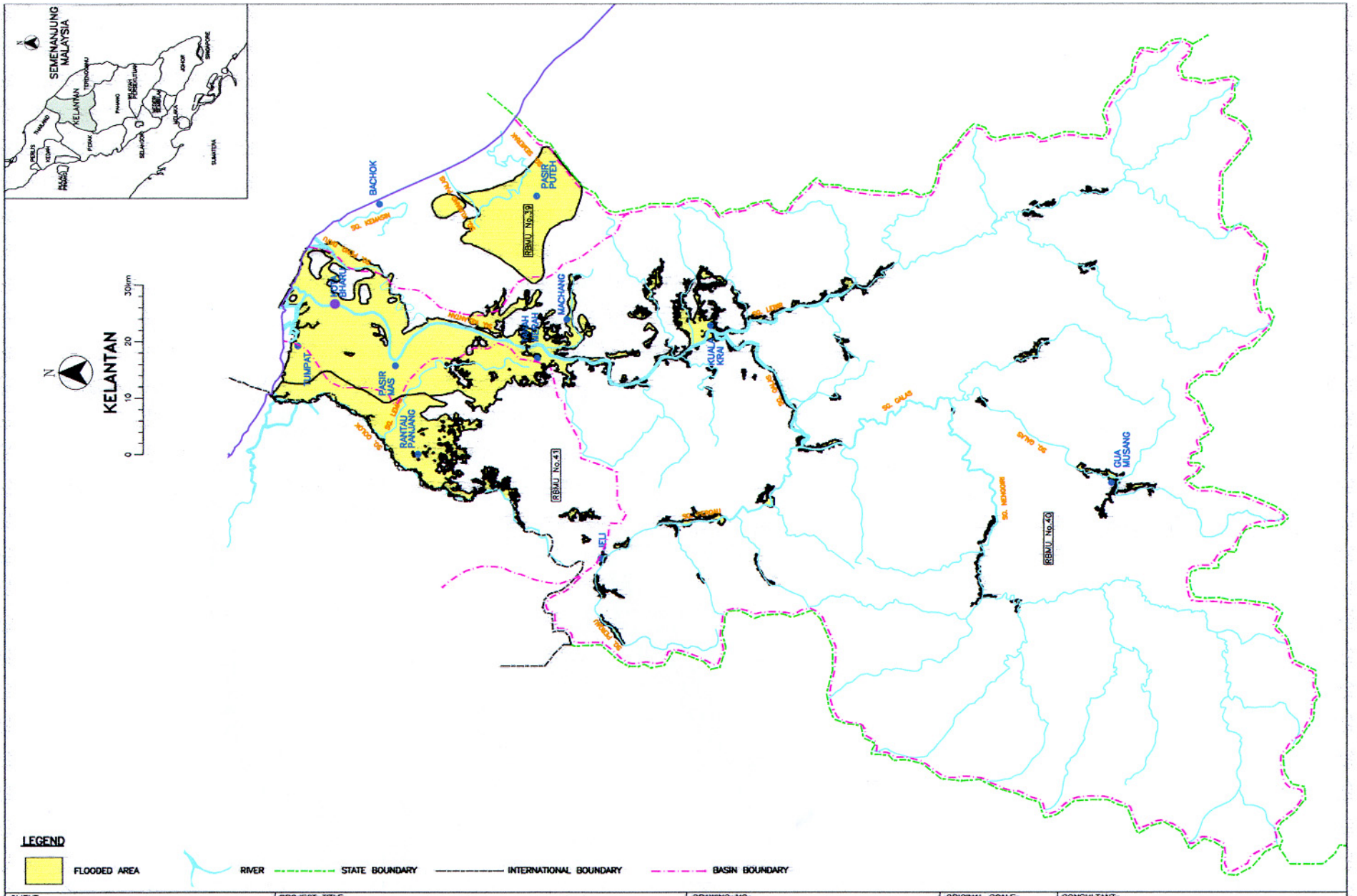




LEGEND

FLOODED AREA | RIVER | STATE BOUNDARY | INTERNATIONAL BOUNDARY | BASIN BOUNDARY

CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\T\TERENGGANU	ORIGINAL SCALE : 1: 400000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS – JURUTERA PERUNDING Company No: 239195-V BANGUNAN KTA TENAGA D1-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : FLOOD MAP OF TERENGGANU	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\TERENGGANU\TERENGGANU_R1.DWG	ORIGINAL SIZE : A1	



CLIENT:
JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
FLOOD MAP OF KELANTAN

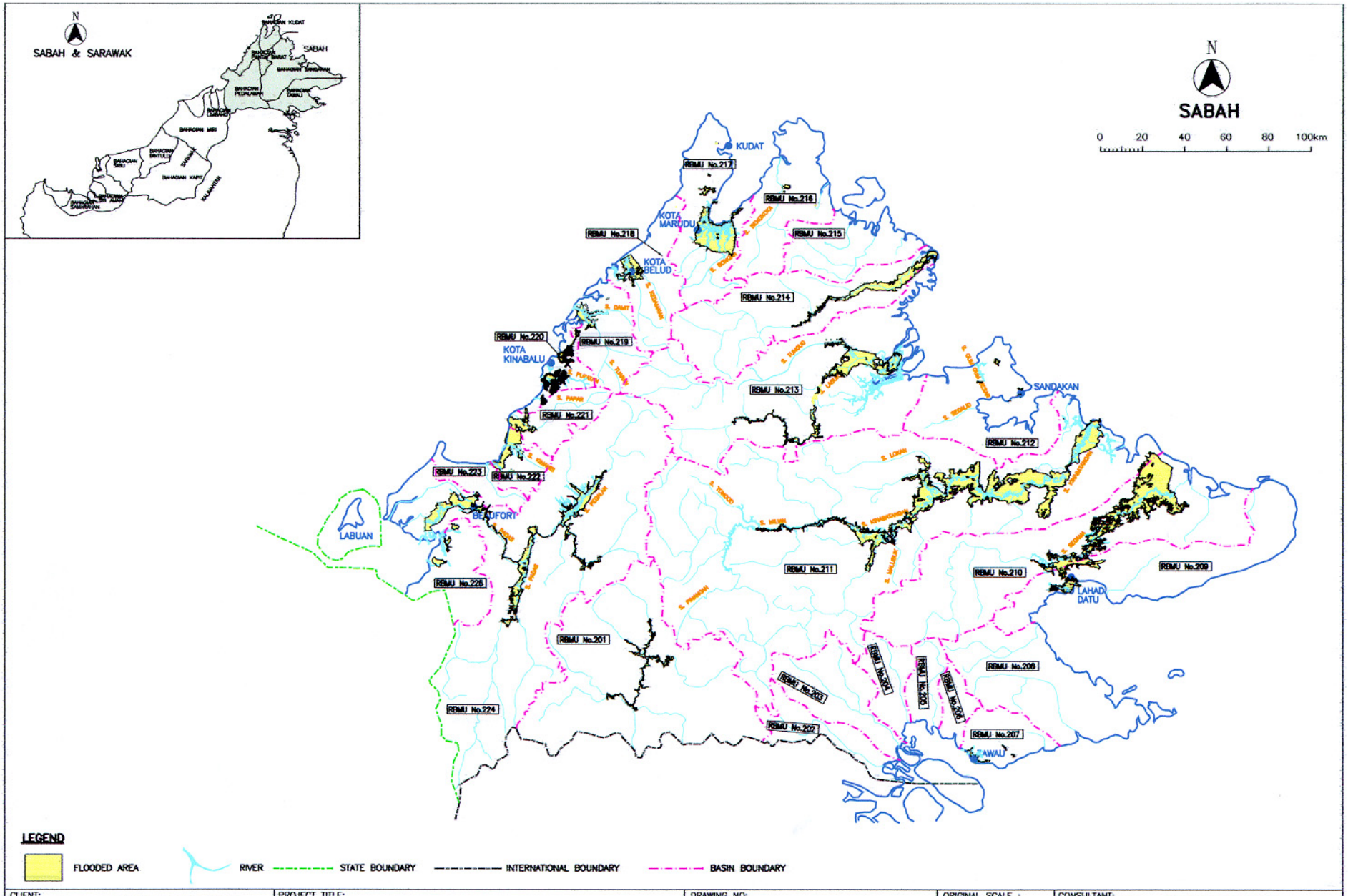
DRAWING NO:
T0036\D\KELANTAN

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\KELANTAN\KELANTAN_R1.DWG

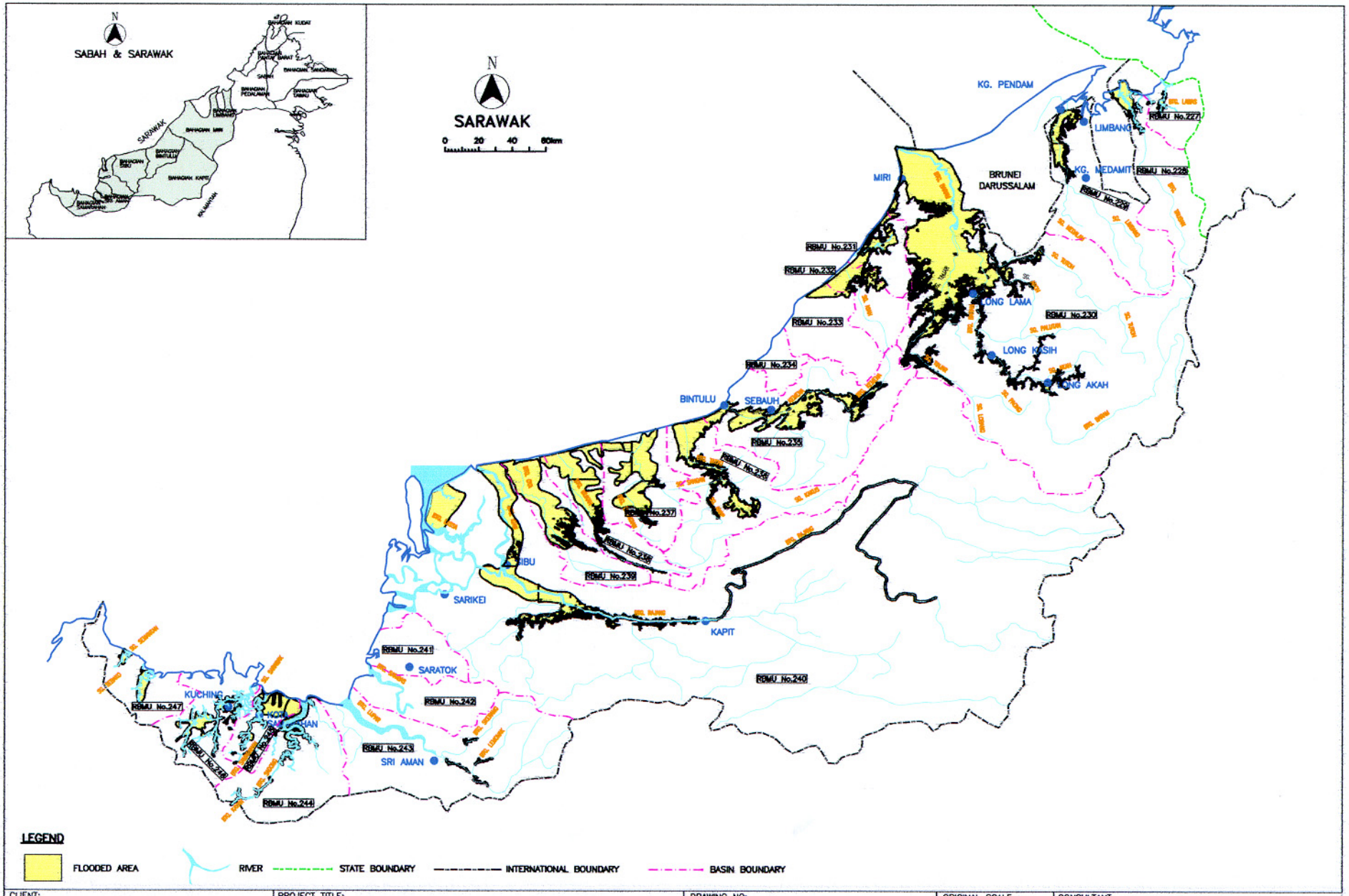
ORIGINAL SCALE :
1: 300000

ORIGINAL SIZE :
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS - JURUTERA PERUNDING
Company No: 239159-V
BANGUNAN KTA TENAGA
01-21, JALAN PJU 1/41,
DATARAN PRIMA, KOTA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



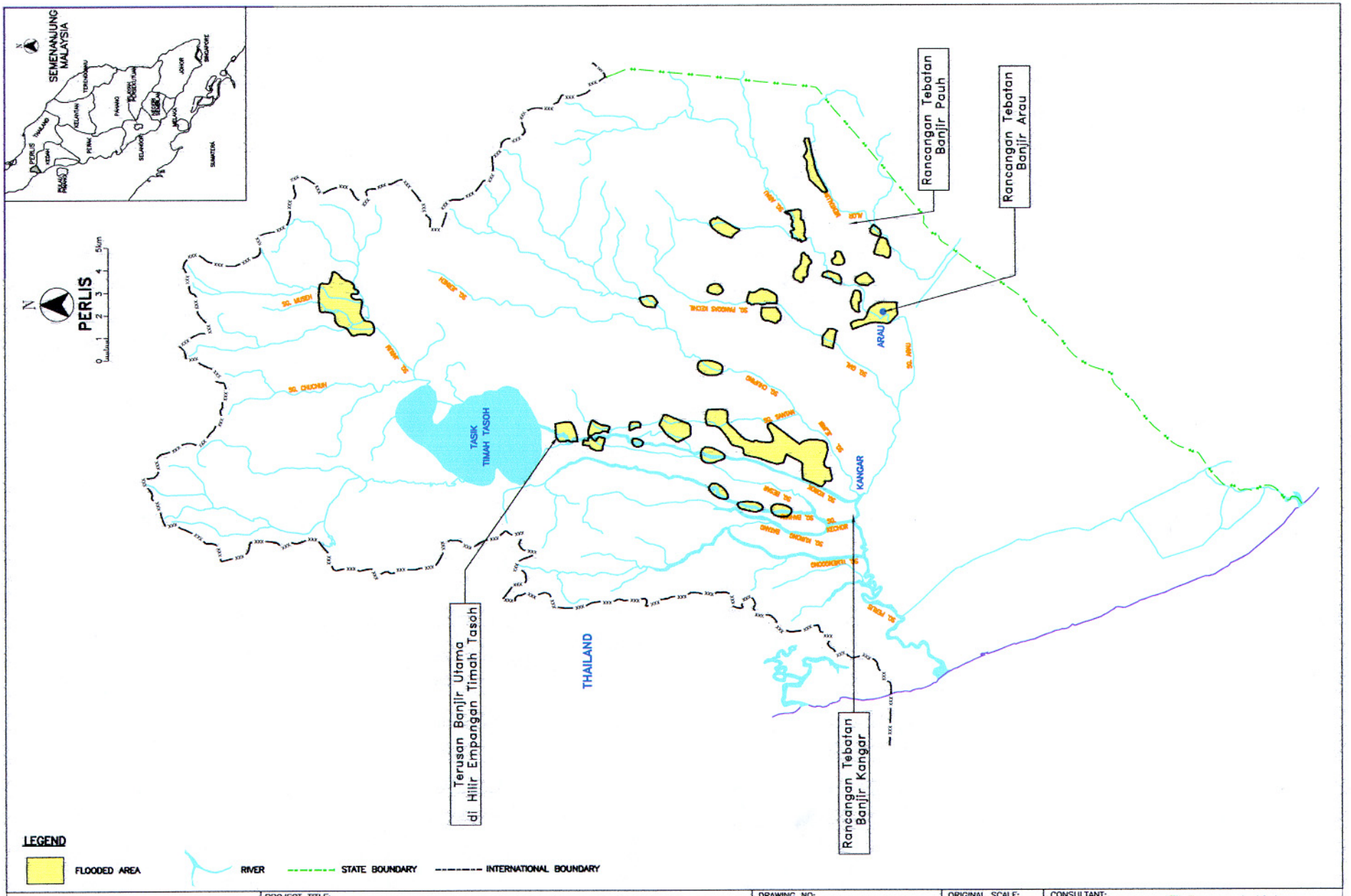
CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\S\SABAH	ORIGINAL SCALE : 1: 800000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS – JURUTERA PERUNDING Company No: 230199-V BANGUNAN KTA TENAGA D1-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : FLOOD MAP OF SABAH	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\SABAH\SABAH_R1.DWG	ORIGINAL SIZE : A1	



CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\Q\SARAWAK	ORIGINAL SCALE : 1:1000000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS – JURUTERA PERUNDING Company No: 239199-V BANGUNAN KTA TENAGA, D1-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : FLOOD MAP OF SARAWAK	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\SARAWAK\SARAWAK_R1.DWG	ORIGINAL SIZE : A1	

APPENDIX 9

LOCATION MAPS FOR PROPOSED MAJOR FLOOD MITIGATION PROJECTS IN RM 8



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP – PERLIS

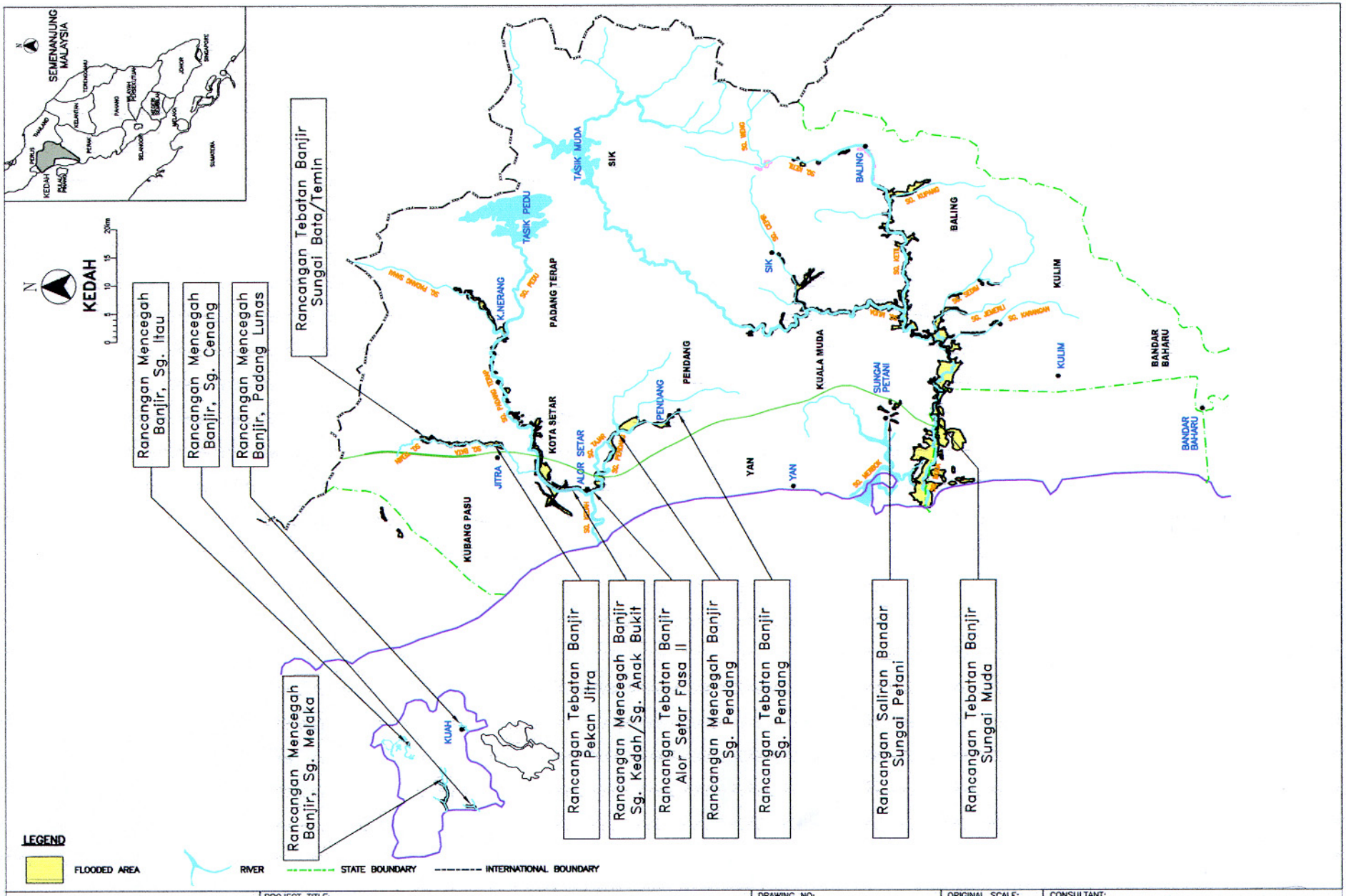
DRAWING NO:
T0036\R\FLOOD MITIGATION

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\PERLIS\FM.DWG

ORIGINAL SCALE:
1 :75000

ORIGINAL SIZE:
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 339199-V
BANGUNAN KTA TENAGA,
01-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP – KEDAH

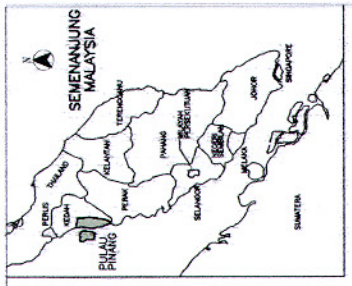
DRAWING NO:
T0036\K\FLOOD MITIGATION

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\KEDAH\FM.DWG

ORIGINAL SCALE:
1 :300000

ORIGINAL SIZE:
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 239199-V
BANGUNAN KTA TENAGA
D1-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



PULAU PINANG

N

0 1 2 3 4km

BUKIT MERTAJAM

GEORGE TOWN

BUTTERWORTH

BALIK PULAU

BANDAR BAHARU

PASIR BUNTAR

NIBONG TEBAL

Rancangan Tebatan Banjir Sg. Perai

Rancangan Tebatan Banjir Sg. Rambai

Rancangan Tebatan Banjir Balik Pulau

Rancangan Tebatan Banjir Bayan Lepas

Rancangan Tebatan Banjir Sg. Junjung

Rancangan Tebatan Banjir Nibong Tebal

Rancangan Tebatan Banjir Perbandaran Pulau Pinang

Rancangan Tebatan Banjir Kawasan Barat

LEGEND

FLOODED AREA

RIVER

STATE BOUNDARY

INTERNATIONAL BOUNDARY

JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MTIGATION PROJECTS LOCATION MAP – PULAU PINANG.

DRAWING NO:
T0036\P\FLOOD MITIGATION

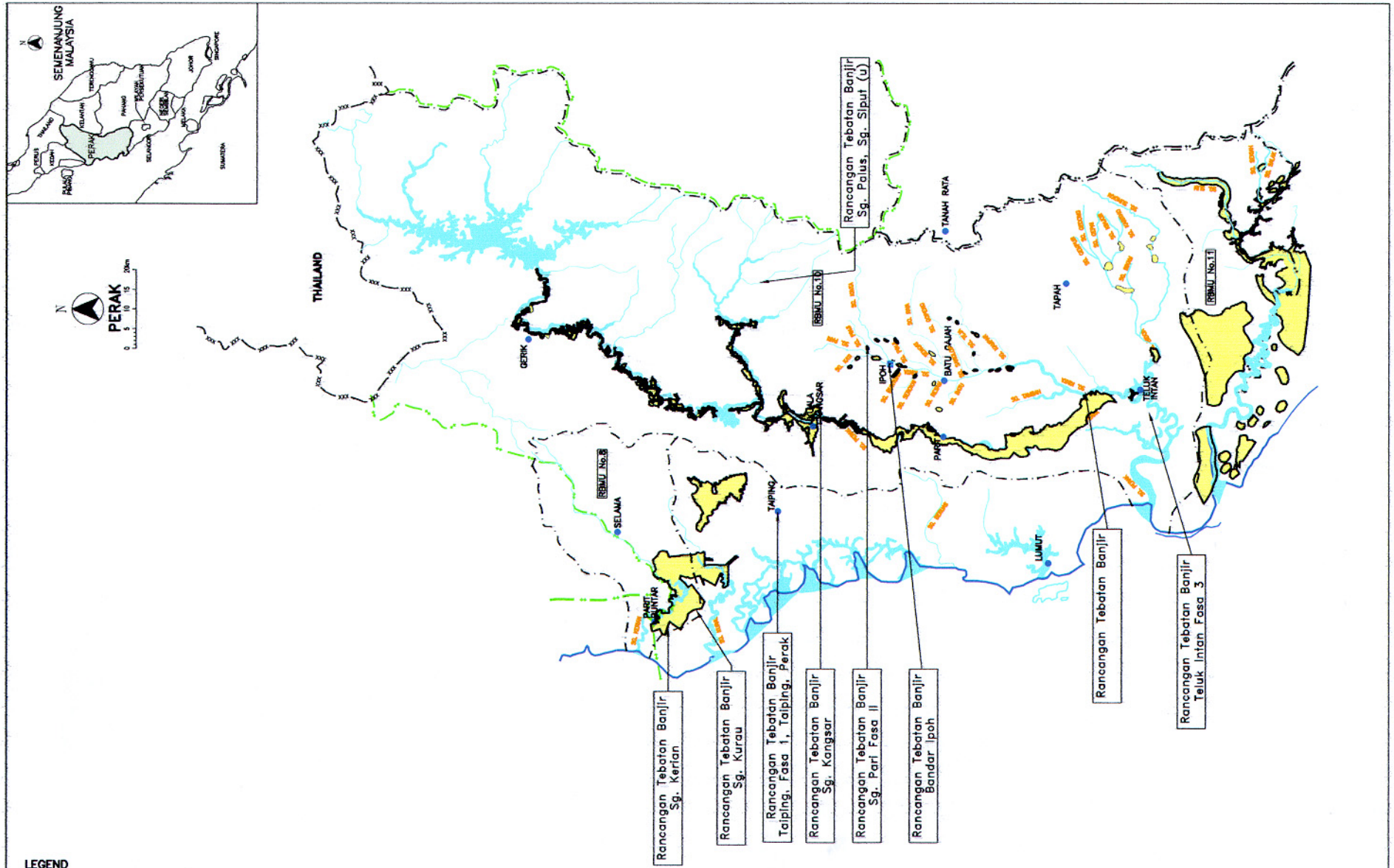
ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\PENANG\FM.DWG

ORIGINAL SCALE:
1 :100000

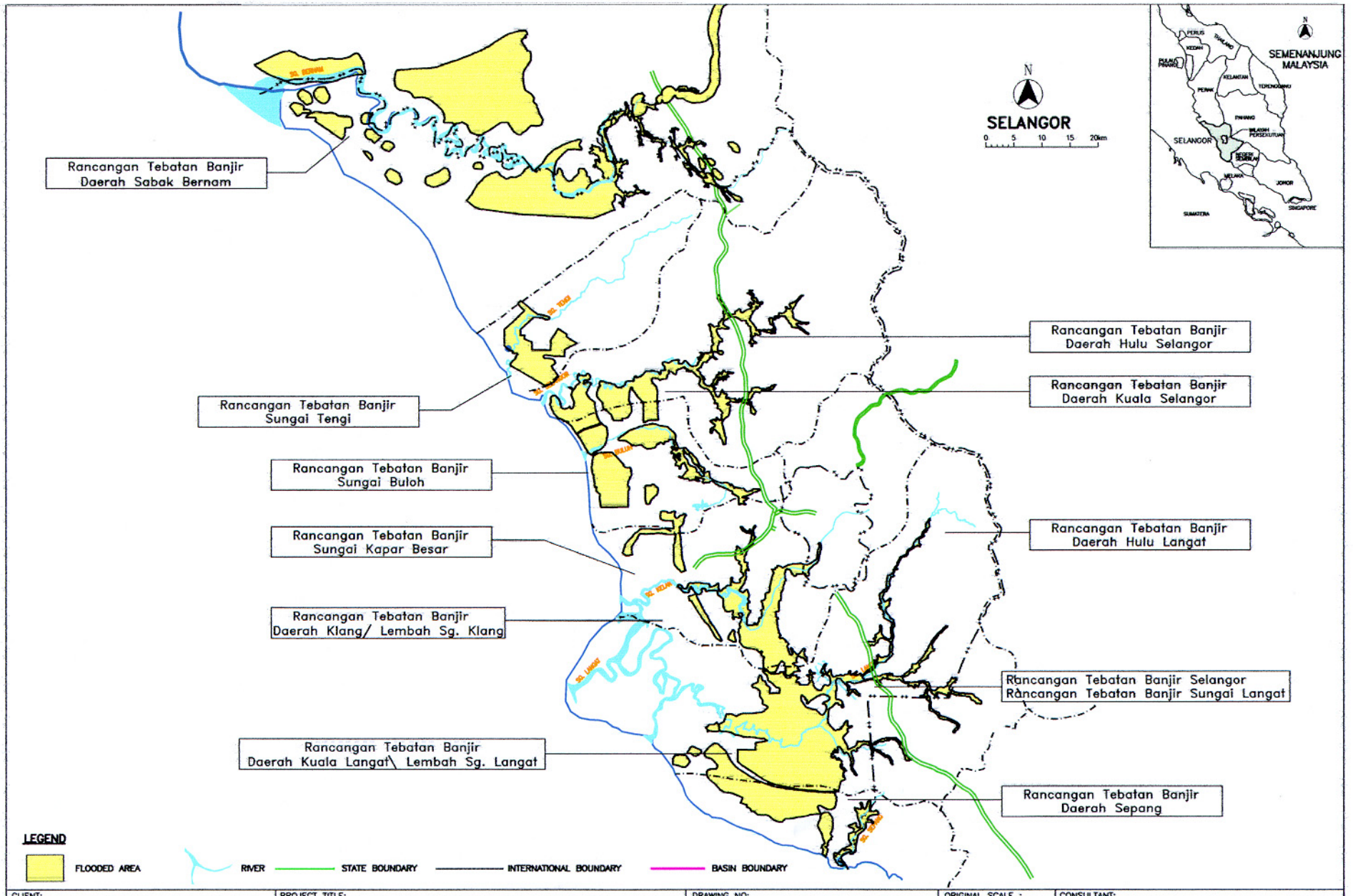
ORIGINAL SIZE:
A1

CONSULTANT:

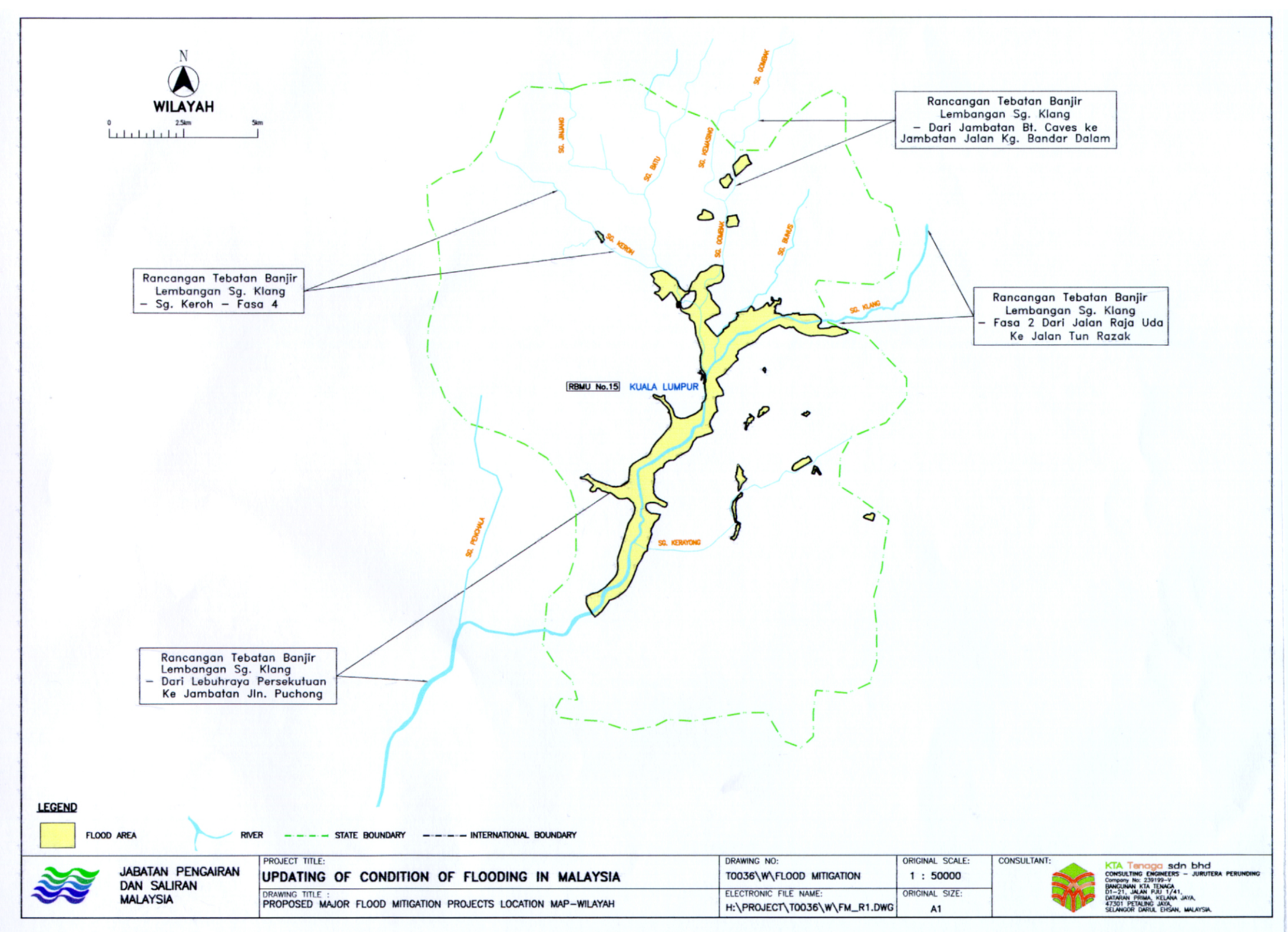
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 230190-V
BANGUNAN KTA TENAGA,
01-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\A\FLOOD MITIGATION	ORIGINAL SCALE : 1 :400000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS - JURUTERA PERUNDING Company No: 230100-V BANGUNAN KTA TENAGA, 01-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP-PERAK	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\PERAK\FM_R2.DWG	ORIGINAL SIZE : A1	



CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\B\FLOOD MITIGATION	ORIGINAL SCALE : 1 :300000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS – JURUTERA PERUNDING Company No: 230199-V BANGUNAN KTA TENAGA, 01-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP–SELANGOR	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\SELANGOR\FM_R2.DWG	ORIGINAL SIZE : A1	



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP–WILAYAH

DRAWING NO:
T0036\W\FLOOD MITIGATION

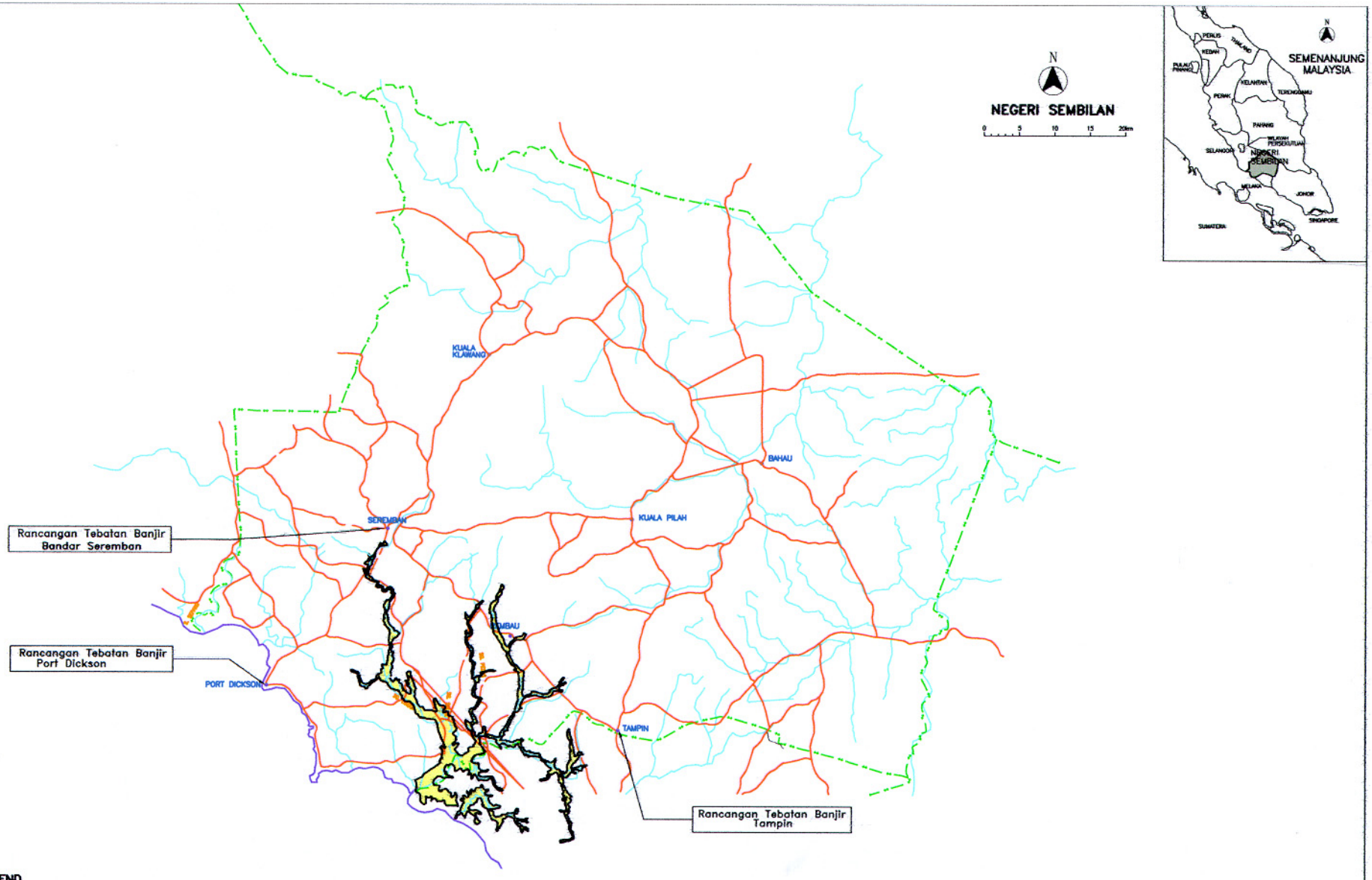
ELECTRONIC FILE NAME:
H:\PROJECT\T0036\W\FM_R1.DWG

ORIGINAL SCALE:
1 : 50000

ORIGINAL SIZE:
A1

CONSULTANT:

KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 239199-V
BANGUNAN KTA TENAGA
D1-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP – NEGERI SEMBILAN

DRAWING NO: T0036\N\FLOOD MITIGATION

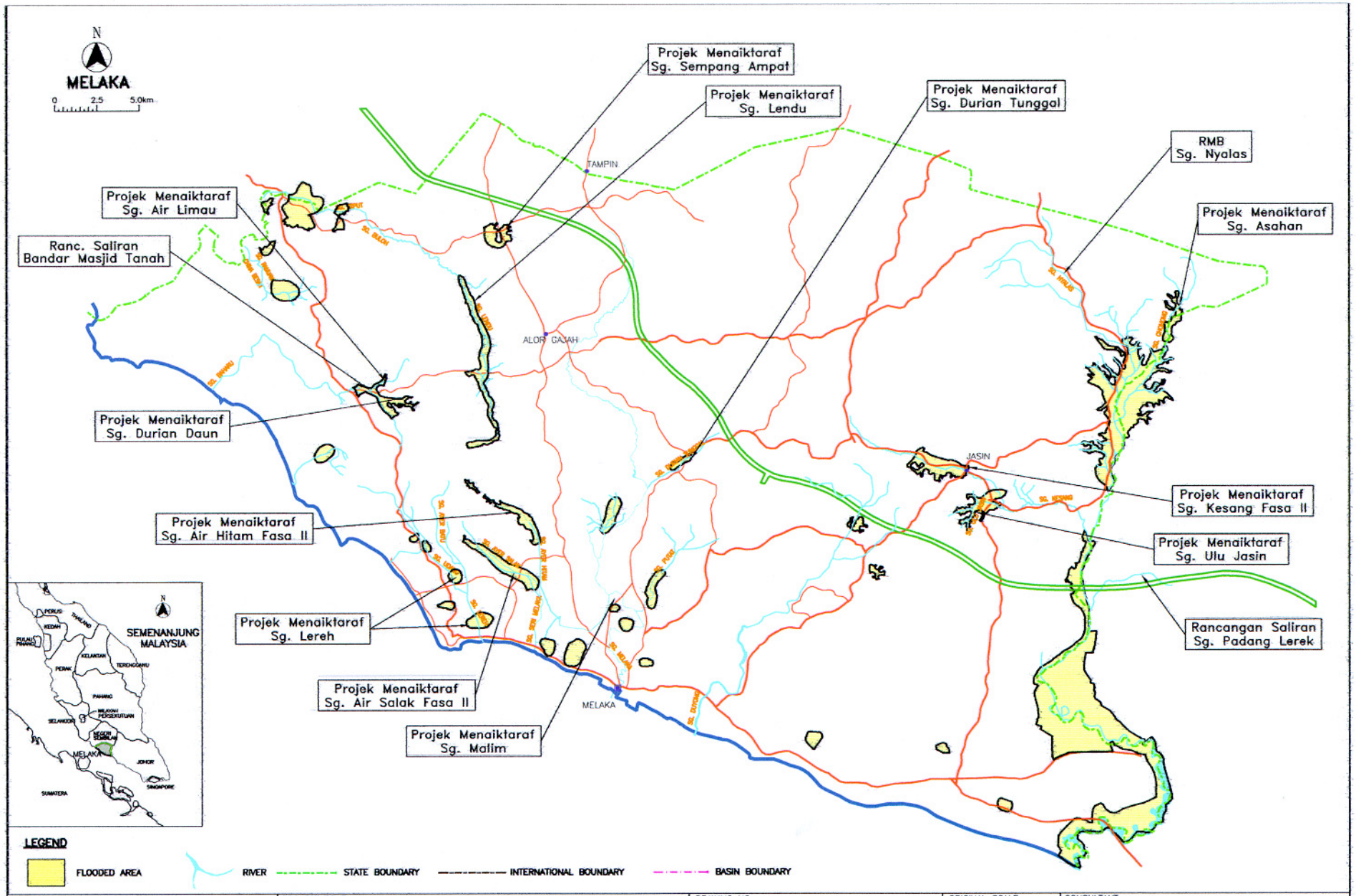
ELECTRONIC FILE NAME: H:\PROJECTS\T0036\N_SEMBILAN\FM.DWG

ORIGINAL SCALE: 1 :250000

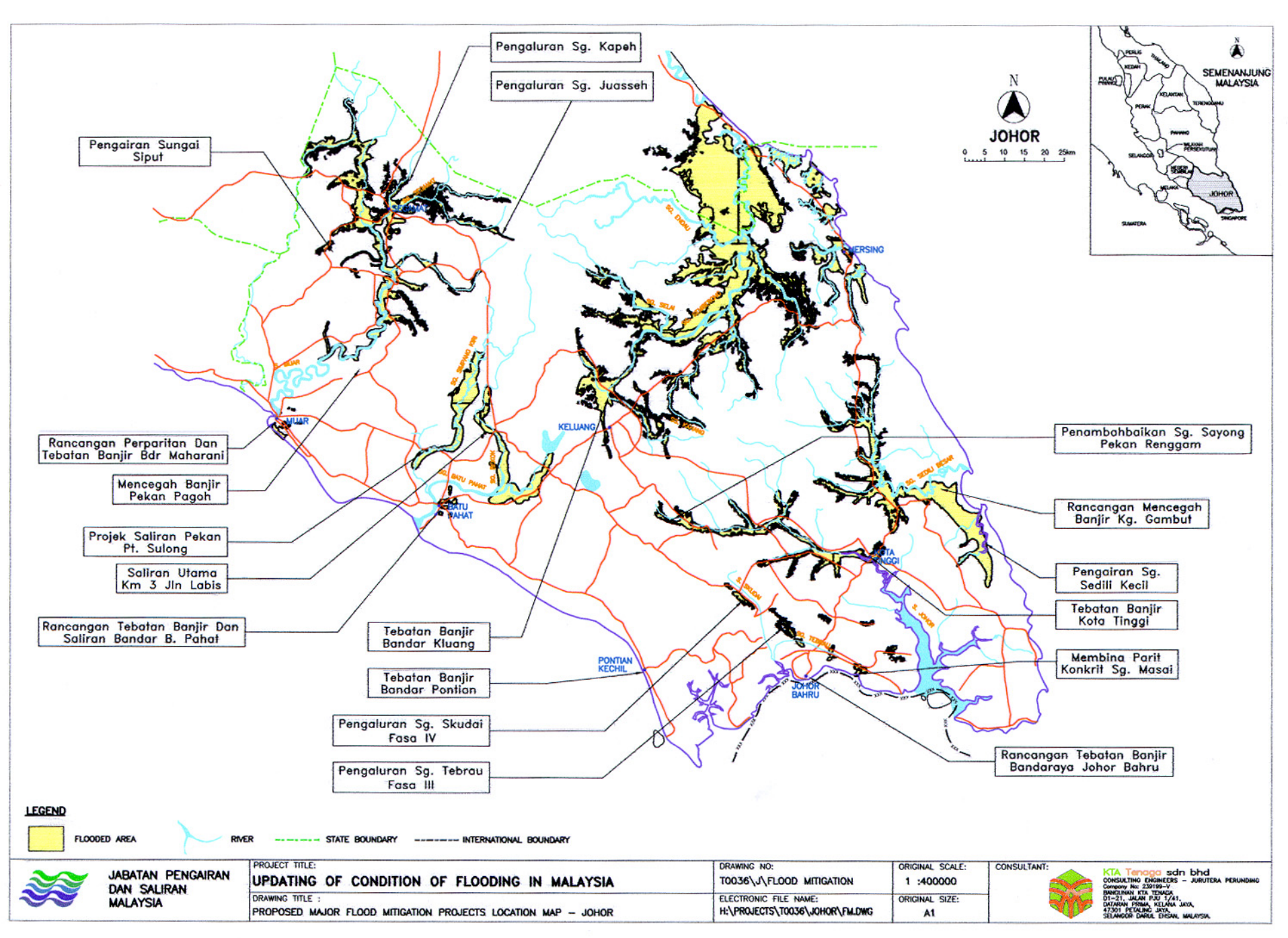
ORIGINAL SIZE: A1

CONSULTANT:

KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No. 239199-V
BANGUNAN KTA TENAGA
01-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\M\FLOOD MITIGATION	ORIGINAL SCALE : 1 :100000	CONSULTANT: KTA Tenaga sdn bhd CONSULTING ENGINEERS - JURUTERA PERUNDING Company No: 230198-V BANGUNAN KTA TENAGA, D1-21, JALAN PJU 1/41, DATARAN PRIMA, KELANA JAYA, 47301 PETALING JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
	DRAWING TITLE : PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP - MELAKA	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\MELAKA\FM.DWG	ORIGINAL SIZE : A1	



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP – JOHOR

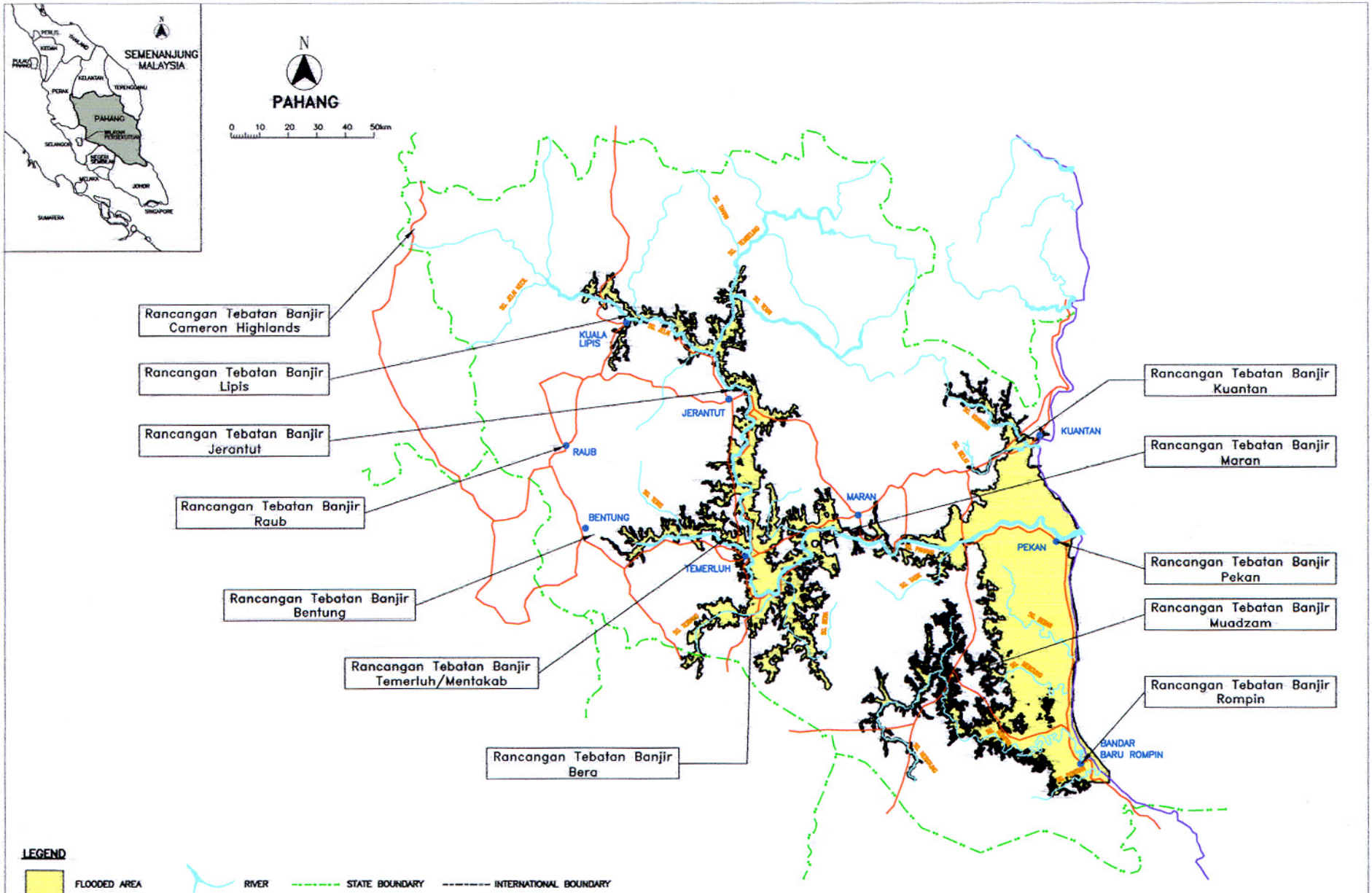
DRAWING NO:
T0036\J\FLOOD MITIGATION

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\JOHOR\FM.DWG

ORIGINAL SCALE:
1 :400000

ORIGINAL SIZE:
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 230199-V
RANCANGAN KTA TENAGA
01-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP – PAHANG.

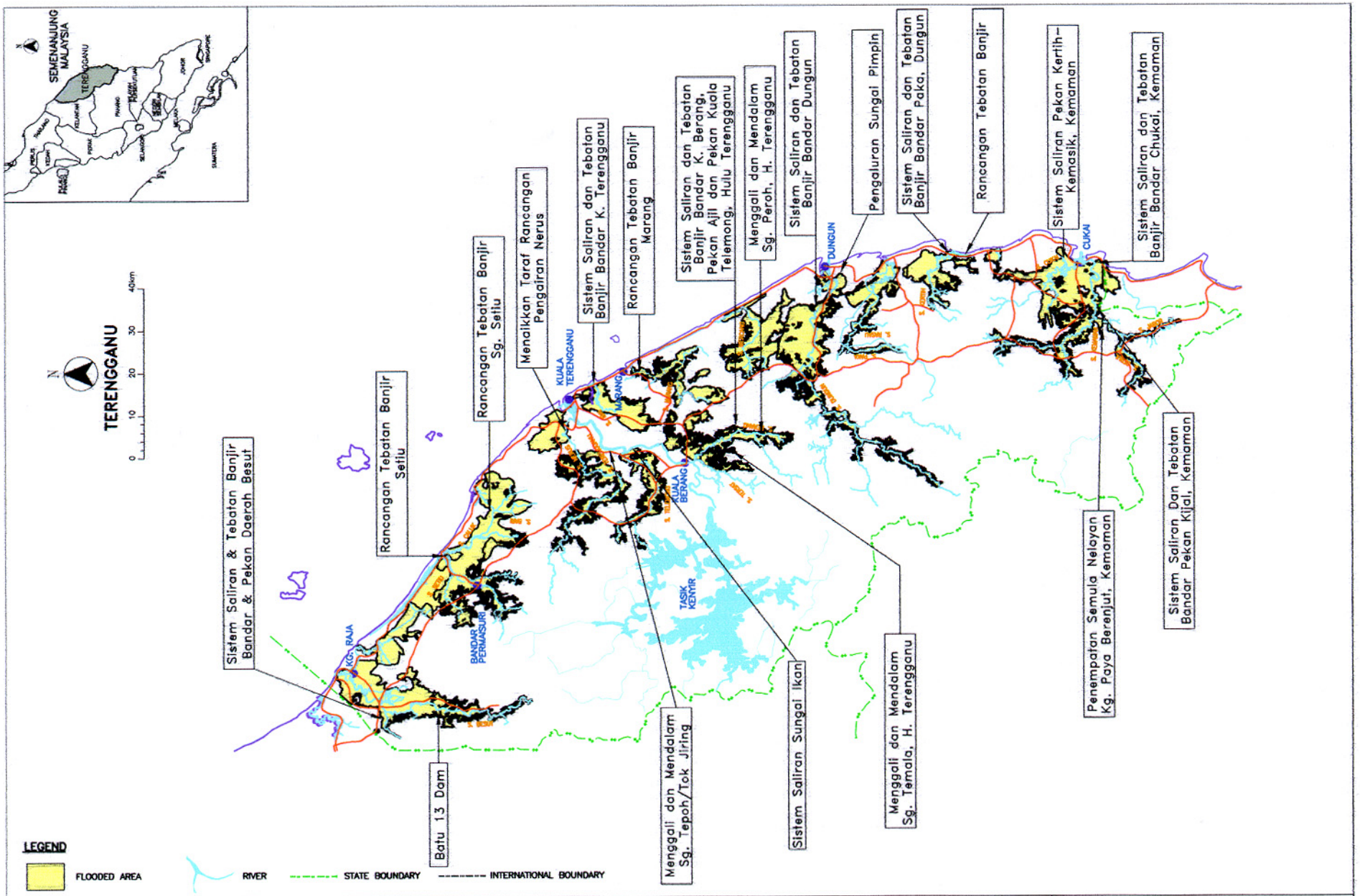
DRAWING NO:
T0036\C\FLOOD MITIGATION

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\PAHANG\FM.DWG

ORIGINAL SCALE:
1 :600000

ORIGINAL SIZE:
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 239199-V
BANGUNAN KTA TENAGA,
01-21, JALAN PJU 1/41,
DATARAN PRIMA, KEJANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP – TERENGGANU

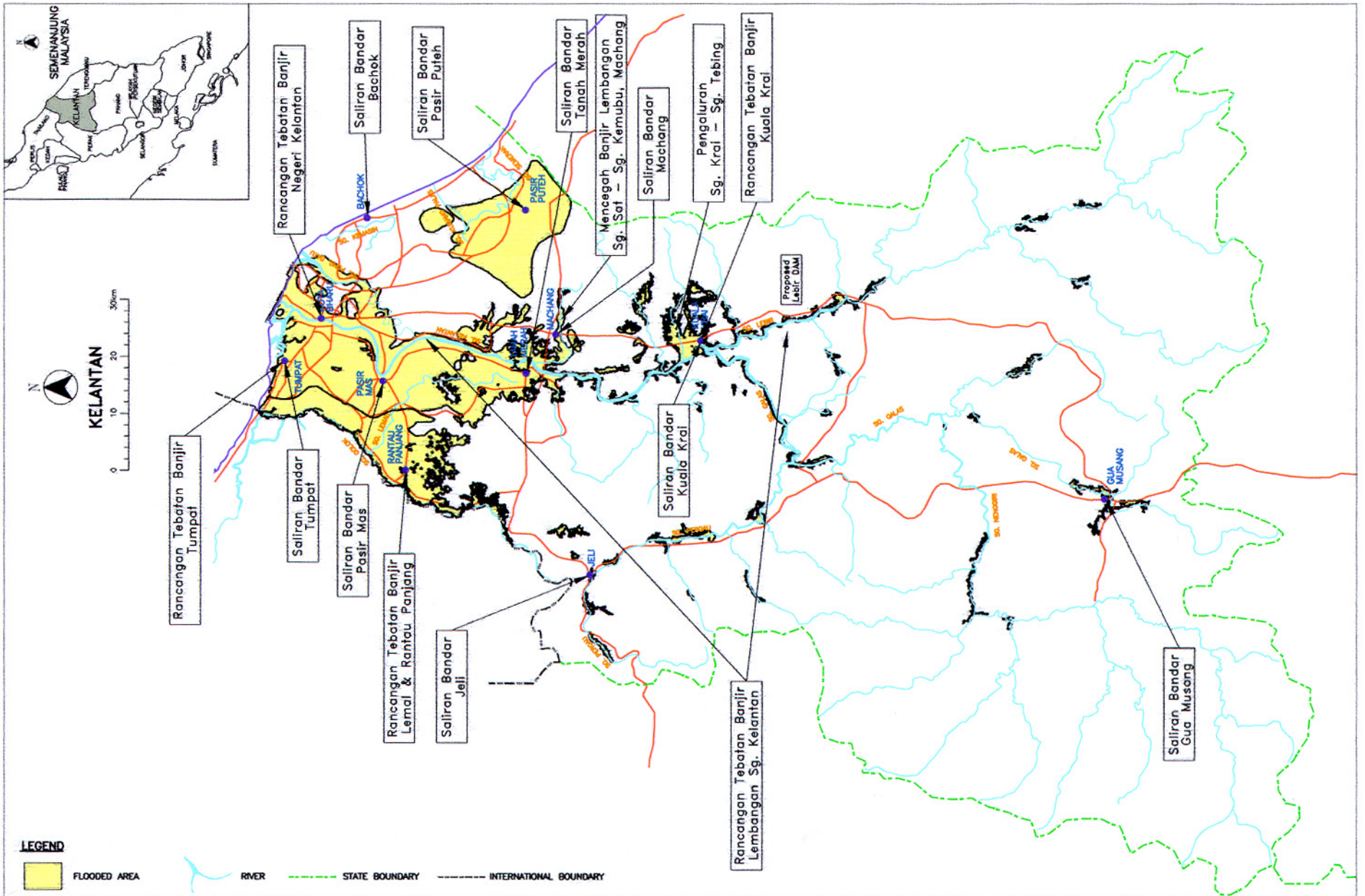
DRAWING NO:
T0036\T\FLOOD MITIGATION

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\TERENGGANU\FM.DWG

ORIGINAL SCALE:
1 :400000

ORIGINAL SIZE:
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No. 239199-V
SINGUNAN KTA TENAGA
D1-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
FLOOD MITIGATION PROJECT LOCATION MAP – KELANTAN

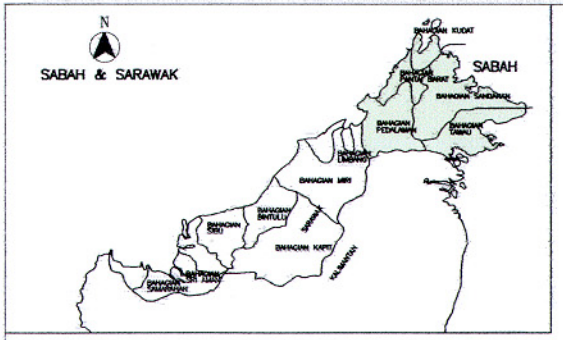
DRAWING NO:
T0036\D\FLOOD MITIGATION

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\KELANTAN\FM_R1.DWG

ORIGINAL SCALE:
1 :300000

ORIGINAL SIZE:
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 239199-V
(BANGUNAN KTA TENAGA,
01-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



N

SABAH

0 20 40 60 80 100km

Rancangan Tebatan Banjir Bandaran Telipok Selatan, K. Kinabalu

Rancangan Tebatan Banjir Sg. Gudon Menggatal Utara

Rancangan Tebatan Banjir Bandaran Sg. Miliwat

Rancangan Tebatan Banjir Bandaran Sg. Menggatal

Rancangan Tebatan Banjir Bandaran Kg. Rampayan

Rancangan Tebatan Banjir Bandaran Pembaikan STM Peparitan KK/Penampang

Rancangan Tebatan Banjir Bandaran Sg. Putatan

Rancangan Tebatan Banjir Bandaran Putatan

Rancangan Tebatan Banjir Pekan Baru Kinarut Selatan

Rancangan Mencegah Banjir Sg. Kinarut

Rancangan Tebatan Banjir Bandaran Parit Jalan Lama, Papar

Rancangan Mencegah Banjir Sg. Papar

Rancangan Tebatan Banjir Bandaran Bunut Drain, Tenom

Rancangan Tebatan Banjir Bandaran Sg. Sibuga

Rancangan Tebatan Banjir Jalan Cecily/Borehole

Rancangan Tebatan Banjir Bandaran BDC

Rancangan Tebatan Banjir Bandaran Jalan Lapangan Terbang

Rancangan Tebatan Banjir Bandaran Sg. Anip

Rancangan Tebatan Banjir Bandaran Sg. Pancuran

Rancangan Tebatan Banjir Bandaran Sg. Tawau

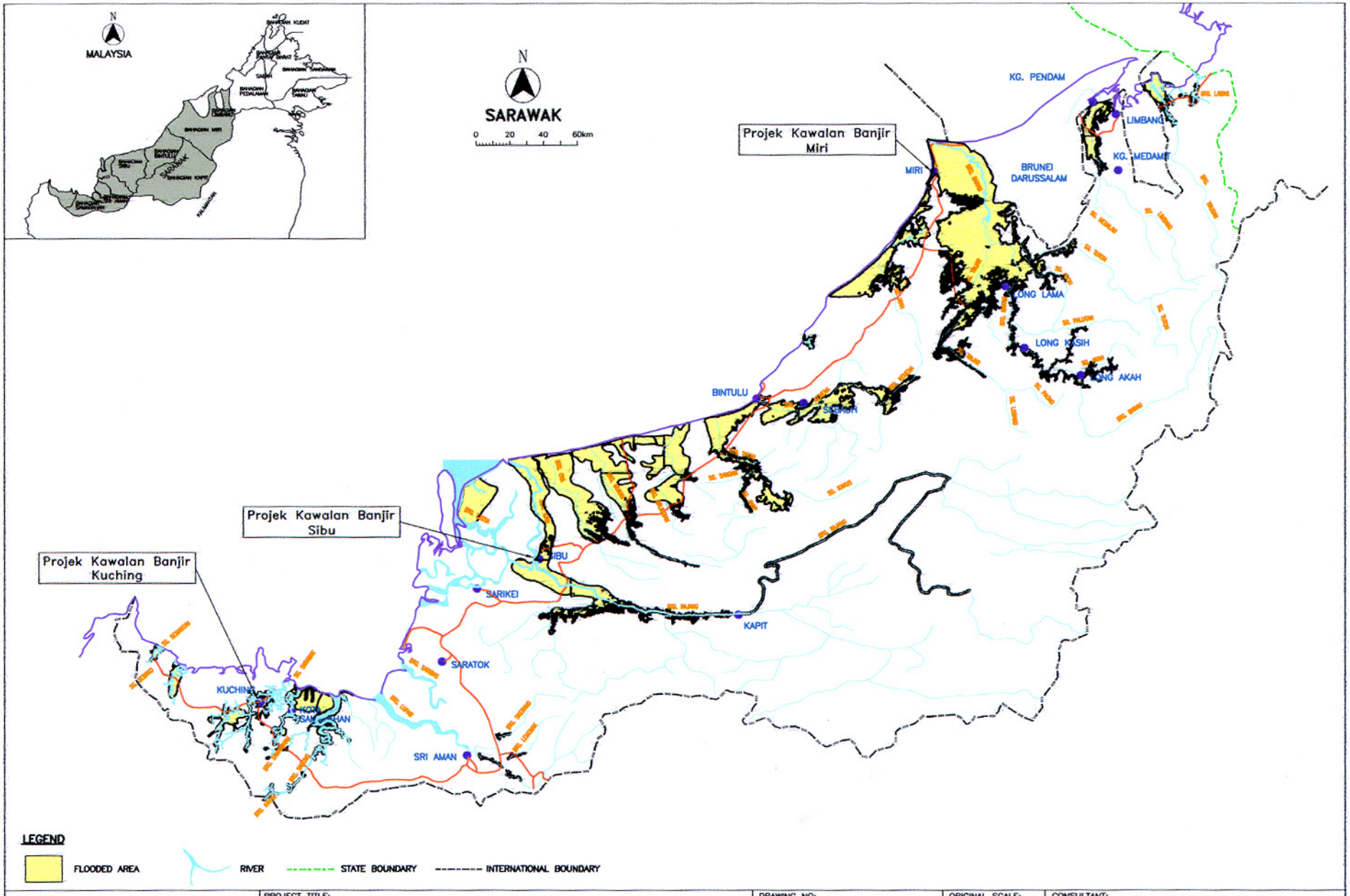
KUDAT
KOTA MARUDU
KOTA BELUD
KOTA KINABALU
BANGGAKAN
LABUAN
BEAUFORT
LAHAD DATU
KUNAK

LEGEND

FLOODED AREA | RIVER | STATE BOUNDARY | INTERNATIONAL BOUNDARY | BASIN BOUNDARY

CLIENT: JABATAN PENGAIRAN DAN SALIRAN MALAYSIA	PROJECT TITLE: UPDATING OF CONDITION OF FLOODING IN MALAYSIA	DRAWING NO: T0036\S\FLOOD MITIGATION	ORIGINAL SCALE: 1 :1000000
	DRAWING TITLE : PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP – SABAH	ELECTRONIC FILE NAME: H:\PROJECTS\T0036\SABAH\FM_R2.DWG	ORIGINAL SIZE: A1

CONSULTANT: KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 239199-V
BANGUNAN KTA TENAGA,
D1-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.



JABATAN PENGAIRAN DAN SALIRAN MALAYSIA

PROJECT TITLE:
UPDATING OF CONDITION OF FLOODING IN MALAYSIA

DRAWING TITLE :
PROPOSED MAJOR FLOOD MITIGATION PROJECTS LOCATION MAP – SARAWAK

DRAWING NO:
T0036\Q\FLOOD MITIGATION

ELECTRONIC FILE NAME:
H:\PROJECTS\T0036\SARAWAK\FM.DWG

ORIGINAL SCALE:
1 :1000000

ORIGINAL SIZE:
A1

CONSULTANT:
KTA Tenaga sdn bhd
CONSULTING ENGINEERS – JURUTERA PERUNDING
Company No: 238198-V
BANGUNAN KTA TENAGA
D1-21, JALAN PJU 1/41,
DATARAN PRIMA, KELANA JAYA,
47301 PETALING JAYA,
SELANGOR DARUL EHSAN, MALAYSIA.