

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DEPARTMENT OF IRRIGATION AND DRAINAGE
MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT
MALAYSIA

**THE PREPARATORY SURVEY
FOR INTEGRATED RIVER BASIN MANAGEMENT
INCORPORATING INTEGRATED FLOOD MANAGEMENT
WITH ADAPTATION OF CLIMATE CHANGE**

FINAL REPORT

Summary

JANUARY 2011

CTI ENGINEERING INTERNATIONAL CO., LTD.
YACHIYO ENGINEERING CO., LTD.

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The Currency Exchange Rate as of September 13, 2010 is as follows:

RM 1.00 = JPY 27.08

List of Reports

Summary

Volume 1: Common Contexts

Volume 2: Muar River Basin

Volume 3: Pahang River Basin



Muar and Pahang River Basins

**The Preparatory Survey
for Integrated River Basin Management incorporating Integrated Flood Management
with Adaptation of Climate Change**

**Final Report
Summary**

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Abbreviations

AMRFF	Atmospheric model-based rainfall and flood forecasting system
AR4	IPCC Fourth Assessment Report
ARI	Average Recurrence Interval
ASMA	Alam Sekitar Malaysia Sdn. Bhd.
B/C	Benefit/Cost
BAKAJ	Johor Water Regulatory Body (<i>Badan Kawalselia Air Johor</i>)
BKSA	Water Regulatory Body (<i>Badan Kawalselia Air</i>)
BOD/BOD5	Biochemical oxygen demand
BORDA	Bremen Overseas Research and Development Association
COD	Chemical oxygen demand
CORPRI Model	Corporatization and Privatization Model
DID	Department of Irrigation and Drainage
DEWATS	Decentralised Wastewater Treatment Solution
DMRC	Disaster Management and Relief Committee
DO	Dissolved oxygen
DOCC	District Disaster Operations Control Center
DOE	Department of Environment
DTGSM	Peninsular Malaysia Geodetic Vertical Datum (<i>Datum Tegak Geodesi Semenanjung Malaysia</i>)
DTM	Digital Terrain Model
DVS	Department of Veterinary Service (<i>Jabatan Perkhidmatan Veterinar</i>)
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EPU	Economic Planning Unit (Unit Perancang Ekonomi)
EQA	Environmental Quality Act 1974
EQR	Environmental Quality Report
ESA	Environmental Sensitive Area
EXCO	Executive Council
GCM	General Circulation Model
GEV	General Extreme Value
GHG	Greenhouse gas
GRDP	Gross Regional Domestic Products
HH	Household
IEE	Initial Environmental Evaluation
IFM	Integrated Flood Management
IPCC	Intergovernmental Panel on Climate Change
IRBM	Integrated River Basin Management
IST	Individual septic tank
IWK	Indah Water Konsortium Sdn. Bhd.
IWRM	Integrated Water Resources Management
JAS	Department of Environment (<i>Jabatan Alam Sekitar</i>)
JBA	Water Supply Department (<i>Jabatan Bekalan Air</i>)
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JKPS	River Management Committee (<i>Jawatankuasa Pengurusan Sungai</i>)
JKR	Public Works Department (<i>Jabatan Kerja Raya</i>)
JMG	Department of Mineral and Geoscience (<i>Jabatan Mineral dan Geosains</i>)
JPBD	Department of Town and Country Planning (<i>Jabatan Perancangan Bandar dan Desa</i>)
JPBB	Disaster Management and Relief Committee (<i>Jawatankuasa Pengurusan dan Bantuan Bencana</i>)
JPBDD	District Disaster Management and Relief Committee (<i>Jawatankuasa Pengurusan dan Bantuan Bencana Daerah</i>)
JPPH	Valuation and Property Services Department (<i>Jabatan Penilaian dan Perkhidmatan Harta</i>)
JUPEM	Department Survey and Mapping Malaysia (<i>Jabatan Ukur dan Pemetaan Malaysia</i>)
Kg.	Village (<i>kampung</i>)
KL	Kuala Lumpur
LA	Local authority
LKIM	Malaysian Fisheries Development Board (<i>Lembaga Kemajuan Ikan Malaysia</i>)
LTFM	Linear Transfer Function Model
LUAN	Kedah Water Management Authority (<i>Lembaga Urus Air Negeri Kedah</i>)
LUAS	Selangor Water Management Authority (<i>Lembaga Urus Air Selangor</i>)
MaCGDI	Malaysian Center for Geospatial Data Infrastructure
MCM	Million cubic meter
Mid	Million liter per day
MMD	Malaysian Meteorological Department
MRSO	Malaysian Rectified Skew Orthomophic
MyGDI	Malaysian Geospatial Data Infrastructure
NAHRIM	National Hydraulic Research Institute of Malaysia
NCLG	National Council for Local Government

NGVD	National Geodetic Vertical Datum
NH3-N	Ammoniacal nitrogen
NPV	Net present value
NRE	Natural Resources and Environment
NRW	Non-Revenue Water
NSC	National Security Council
NWQS	National Water Quality Standard
NWRC	National Water Resources Council
NWRD	National Water Resources Department
NWRS	National Water Resources Study (2000)
NWRS	National Water Resources Study, Malaysia (JICA, 1982)
NWSC	Suruhanjaya Perkhidmatan Air Negara
OJT	On-the-job training
PAAB	Water Asset Management Company (<i>Pengurusan Aset Air Berhad</i>)
PERHILITAN	Department of Wildlife and Natural Park Peninsular Malaysia (<i>Jabatan Perlindungan Hidupan Liar dan Taman Negara, Semenanjung Malaysia</i>)
PFA	Pig farm area
ppm	Part per million
PRECIS	Providing Regional Climate Impact Studies
PTG	Land and Mines Office (<i>Pejabat Tanah dan Galian</i>)
PWCC	PricewaterhouseCoopers Consulting Sdn. Bhd.
RBC	River Basin Committee
RB-DSS	National River Basin Decision Support System
RB-IMS	River Basin Infrastructure Management System
RBMO	River Basin Management Office
RBO	River Basin Organization
RB-SMS	River Basin Geographical Information System
RB-SMS	River Basin Simulation Modeling System
RCM	Regional Climate Model
RegHCM-PM	Regional Hydroclimate Model of Peninsular Malaysia
RM	Ringgit Malaysia
RMK-10	Tenth Malaysia Plan
RMK-8	Eighth Malaysia Plan
RMK-9	Ninth Malaysia Plan
RRB	National Register of River Basin Study
RRB2	Second Phase of the National Register of River Basin Study
RTU	Remote Terminal Unit
SAINS	Syarikat Air Negeri Sembilan Sdn. Bhd.
SAJ	Johor Water Company (<i>Syarikat Air Johor</i>)
SBMO	Sub-Basin Management Office
Sg.	River (<i>sungai</i>)
SPAN	Suruhanjaya Perkhidmatan Air Negara
SS	Suspended solids
st.	Station
STP	Sewage treatment plant
SWM	SWM Environment Sdn. Bhd.
SWRC	State Water Resources Council
TDS	Total dissolved solids
Tg.	Tanjung
TNB	Tenaga Nasional Berhad
TOR	Terms of Reference
TSS	Total suspended solids
UPEN	State Economic Planning Unit (<i>Unit Perancang Ekonomi Negeri</i>)
UPPP	Federal Project Implementation Unit (<i>Unit Pelaksanaan Projek Persekutuan</i>)
USD	US Dollar
USEPA	The United States Environmental Protection Agency
W.L.	Water Level
WRD	Water Resources Department
WQI	Water Quality Index

Measurement Units

(Length)

mm : millimeter(s)
cm : centimeter(s)
m : meter(s)
km : kilometer(s)

(Area)

mm² : square millimeter(s)
cm² : square centimeter(s)
m² : square meter(s)
km² : square kilometer(s)
ha : hectare(s)

(Weight)

g, gr : gram(s)
kg : kilogram(s)
ton : ton(s)

(Time)

s, sec : second(s)
min : minute(s)
h, hr : hour(s)
d, dy : day(s)
y, yr : year(s)

(Volume)

cm³ : cubic centimeter(s)
m³ : cubic meter(s)
l, ltr : liter(s)
mcm : million cubic meter(s)

(Speed/Velocity)

cm/s : centimeter per second
m/s : meter per second
km/h : kilometer per hour

CHAPTER 1 COMMON CONTEXTS

1.1 Introduction

1.1.1 Overall Goal, Objectives, Outputs, Beneficiaries and Implementation Agency

The overall goal, objectives, outputs, beneficiaries and implementation agency of the preparatory survey are tabulated in **Table 1.1.1**:

Table 1.1.1 Summary of the Preparatory Study

Item	Contents
Overall Goal	Flood mitigation projects are implemented, and local and national economies are sustainably developed.
Objectives	To strengthen capacities of River Basin Committees (RBCs) of 2 selected river basins, To support them for elaborating Integrated River Basin Management (IRBM) and Integrated Flood Management (IFM) plans, and To conduct feasibility studies on high-priority flood mitigation projects that should be urgently implemented.
Outputs	Two river basins are selected as target river basins out of four candidate river basins (Muar, Pahang, Sarawak, Kinabatangan), taking into accounts flood risks, etc. Impact of climate change on rainfall patterns (quantity, intensity, etc) are estimated by using existing projection results of Climate Change. The RBCs of the two target river basins are strengthened through elaboration of IRBM and IFM plans that incorporate the estimated impacts of Climate Change. Feasibility studies on high-priority projects of the IFM plans are conducted.
Beneficiaries	Direct beneficiaries: DID staff and members of the two RBCs Indirect beneficiaries: people in the 2 river basins.
Implementation Agency	Department of Irrigation and Drainage (DID).

1.1.2 Survey Schedule

The overall survey schedule is given in **Figure 1.1.1**. The actual duration of the Preparatory Survey is about 12 months from September 2009 to September next year. Five reports are prepared in the course of the Survey.

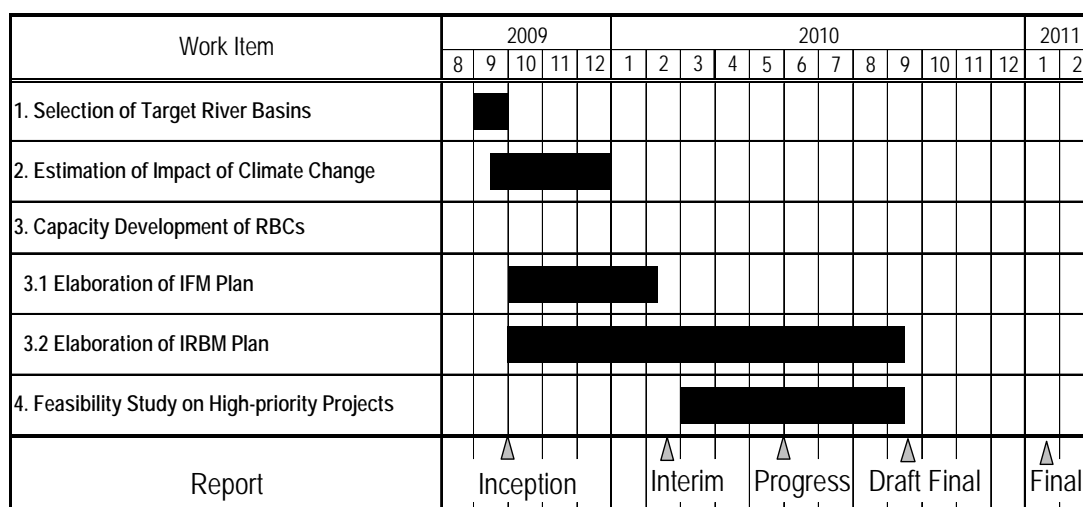


Figure 1.1.1 Project Schedule

1.1.3 Target River Basin

The Muar River Basin is shared by four states, namely Negeri Sembilan, Johor, Melaka and Pahang. The Pahang River Basin is shared by two states, Pahang and Negeri Sembilan. Profiles of the two river basins are summarized in **Table 1.1.2**.

Table 1.1.2 Profiles of the two Target River Basins

Items	Muar	Pahang
Population in 2010*	660, 000	1,190,000
Catchment Area (km ²)	6,595	29,300
River Length (km)	300	420
River gradient	1/4,000	1/6,500

*: Projected by the JICA Study Team

1.1.4 Organization for Implementation of Preparatory Survey

The organization for the implementation of the Preparatory Survey has been established as shown in **Figure 1.1.2**. The JICA Study Team regularly works together with the working groups for elaborating IRBM and IFM plans. Important issues raised in the course of the Preparatory Survey are discussed in the steering committee, of which a meeting is supposed to be held at every occasion of the report submission in principle.

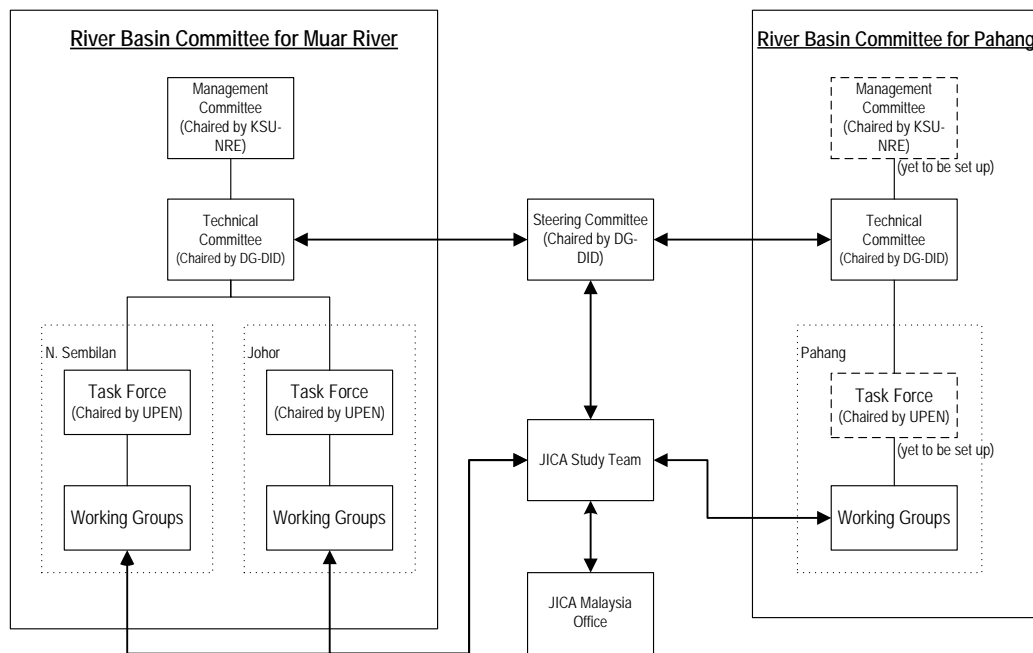


Figure 1.1.2 Organization for Implementation of Preparatory Survey

1.2 National Contexts

1.2.1 Socio-Economy

(1) Population

The national projected population in 2008 is 27,729,000 as shown in **Table 1.2.1**. Those of the related three states are also presented in this table for reference. The annual population growth rate is about 2 %.

Table 1.2.1 Population

(1,000)

Year	Malaysia	State of Pahang	State of N. Sembilan	State of Johor
2000 (Census Data)	23,275	1,296	866	2,763
2008 (Mid-term Projection)	27,729	1,513	996	3,312
Average Annual Increase Rate (2000 to 2008)	2.2%	2.0%	1.8%	2.3%

Source: Department of Statistics, Malaysia

(2) Economic Profile

(a) Gross Domestic Product (GDP)

The gross domestic product of Malaysia at the current price reached RM 640,844 million in 2008, growing at 3.13% during the last 5 years from 2004 to 2008. The share rate of the GDP in 2008 by economic activity is 36% for services, 30% for manufacturing, 19% for mining and quarrying and 12% for agriculture.

(b) Labor and Employment

The total labor force in Malaysia is 10,890,000 persons in 2007, sharing about 40% of the total population. The unemployment rate has been kept at a level of 3% for the last five years from 2003 to 2007. Manufacturing, wholesale and retailing, and agriculture and forestry are three major industries in terms of labor force, occupying 19%, 16% and 14% respectively.

(c) Federal Government Finance

The total current revenue of the Federal Government was about RM 160 billion in 2008, accounting for 25% of GDP. The current budget almost tripled in the 9 years from 1999 and 2008 with an average annual increase rate of 12%.

The total expenditure consisting of operating and development expenditures also increased considerably during the same period, and amounted to RM 196 billion (RM 153 billion for the operation one and RM 43 billion for the development one) in 2008, accounting for 31% of GDP.

(d) DID Budget

The amount of development budget in 9th Malaysia Plan in DID is a sum of around RM 7,324 million in total. In this development budget, the actual amount paid out for flood mitigation projects shares at 68 % to the total amount of expenditure since 2006 till 2008. In the case of the expenditure for river works to be added, it has occupied 79 % of the expenditure in total.

1.2.2 Legislation

The river basin management is essentially related to the conservation, development and utilization of water resources, land use and environment within and surrounding of the river basin in a sustainable manner. Through the enforcement of legal measures, it is important to regulate and minimize negative impacts and optimize benefits from the river basin. Major relevant legislation to the river basin management is mentioned in **Table 1.2.2**.

Table 1.2.2 Summary of Relevant Legislatives

Name of Law	Issues related to IRBM
1. Federal Constitution	Government Function
2. Ministerial Functions Act 1969 (Act 2)	
3. Waters Act 1920 (Act 418)	Water Resources Management
4. National Land Code 1965 (Act 56)	Land Development
5. Drainage Works Act 1954 (Act 354)	Urban Drainage
6. Street, Drainage and Building Act 1974 (Act 133)	
7. Local Government Act 1976 (Act 171)	Government Function
8. Town and Country Planning Act 1976 (Act 172)	Land Use
9. Environmental Quality Act 1974 (Act 127)	Environmental Management
10. Protection of Wildlife Act 1972 (Act 76)	Wildlife Conservation
11. Land Conservation Act 1960 (Act 385)	Catchment Erosion
12. Geological Survey Act 1974	Ground Water
13. Irrigation Areas Act 1953	Water Utilization
14. National Forestry Act 1984 (Act 313)	Forest Conservation
15. The Merchant Shipping Ordinance 1952 (Act 70)	Navigation
16. The Port Authority Act 1963	
17. Fisheries Act 1985 (Act 317)	Fishery/Coastal Development
18. National Water Services Commission Act 2006 (Act 654)	Water Supply/Sewerage
19. Water Services Industry Act 2006 (Act 655)	
20. Solid Waste and Public Cleansing Management Act 2007 (Act 672)	Solid Waste Management
21. Solid Waste and Public Cleansing Management Corporate Act 2007 (Act 673)	
22. Animal Act 1953	Livestock Management

National Security Council Directive No. 20 stipulates the mechanism for the natural disaster management. Under this integrated emergency management system in the Directive, the functions and responsibilities of various relevant agencies are defined for the smooth and practical implementation of disaster relief.

1.2.3 Institution

There are various institutions involved in river basin management in Malaysia. As stipulated in the Ministerial Functions Act 1969 (Act 2), these substantial government agencies and other institutions involved have their own goals and targets to be achieved under their policies. The major relevant institutions involved in river basin management are listed in **Table 1.2.3**.

Table 1.2.3 Roles and Responsibilities in Relevant Government Agencies

Government Agencies	Role and Responsibilities	Issues related to IRBM
National Council		
National Water Resources Council (NWRC)	<ul style="list-style-type: none"> To facilitate harmonious and synergistic cooperation between Federal and State Governments To facilitate development, allocation and management of the national water resources 	<ul style="list-style-type: none"> Policy and Strategy
Federal Institution		
a) National Security Council	<ul style="list-style-type: none"> To formulate national security policies and coordination of national security measures 	<ul style="list-style-type: none"> Policy on Disaster Management
b) Economic Planning Unit (EPU)	<ul style="list-style-type: none"> To prepare medium and long term development plans, and to monitor and evaluate their achievement 	<ul style="list-style-type: none"> Development Plan
c) Ministry of Natural Resources and Environment (NRE)		
Department of Irrigation and Drainage	<ul style="list-style-type: none"> To provide advices to local authorities on drainage planning To implement flood mitigation, drainage, irrigation and river works 	<ul style="list-style-type: none"> Flood Mitigation River Management Urban Drainage Coastal Management
Department of Environment	<ul style="list-style-type: none"> To monitor and control industrial discharge of sewerage To regulate EIA process To enforce EQA 	<ul style="list-style-type: none"> Water Quality Monitoring
Forestry Department	<ul style="list-style-type: none"> To manage, conserve and protect biological diversity, water and soil, and their utilization 	<ul style="list-style-type: none"> Forest Conservation
Department of Wildlife and National Parks	<ul style="list-style-type: none"> To protect, manage and preserve protected areas 	<ul style="list-style-type: none"> Flora and Fauna Conservation
Department of Director General of Lands and Mines	<ul style="list-style-type: none"> To manage and control mining activities in safety, efficient and systematic manner 	<ul style="list-style-type: none"> River Sand Mining
Department of Minerals and Geoscience	<ul style="list-style-type: none"> To manage, conserve and protect groundwater resources 	<ul style="list-style-type: none"> Ground Water
d) Ministry of Energy, Green Technology and Water (MEGTW, KeTTHA)		
Department of Water Supply	<ul style="list-style-type: none"> To implement construction works of water supply 	<ul style="list-style-type: none"> Water Supply Services
Department of Sewerage Services	<ul style="list-style-type: none"> To implement construction works of sewerage systems 	<ul style="list-style-type: none"> Sewerage Services
National Water Services Commission (NWSC or SPAN)	<ul style="list-style-type: none"> To enforce, supervise and regulate water supply services and sewerage services activities under the Water Services Industry Act 2006 and National Water Services Commission Act 2006f 	<ul style="list-style-type: none"> Regulation of Water Service Industry
Water Asset Management Company (WAMCO or PAAB)	<ul style="list-style-type: none"> To construct, refurbish, improve, upgrade, maintain and repair water infrastructure and all other assets in relation to the water systems 	<ul style="list-style-type: none"> Water Supply Services
Indah Water Konsortium Sdn. Bhd. (IWK)	<ul style="list-style-type: none"> To construct and operate and maintain the public sewage treatment plants and network of underground sewerage pipelines 	<ul style="list-style-type: none"> Sewerage Services
e) Ministry of Housing and Local Government (MHLG)		
Town and Country Planning Department	<ul style="list-style-type: none"> To organize, regulate and coordinate land development, usage and conservation through the implementation of the Town and Country Planning Act and other related acts 	<ul style="list-style-type: none"> Land Use
Department of National Solid Waste Management	<ul style="list-style-type: none"> To implement solid waste management policy To regulate and issue solid waste management licenses 	<ul style="list-style-type: none"> Solid Waste
f) Ministry of Agriculture and Agro-Based Industries (MAAI)		
Department of Fisheries	<ul style="list-style-type: none"> To develop and manage fishing industries in a sustainable manner 	<ul style="list-style-type: none"> Fishing/Navigation/ Aquaculture
Department of Agriculture	<ul style="list-style-type: none"> To determine and advise on soil and land utilization for agricultural development 	<ul style="list-style-type: none"> Irrigation Development
Department of Veterinary Services	<ul style="list-style-type: none"> To control the production of livestock, livestock products and animal feed 	<ul style="list-style-type: none"> Livestock
g) Ministry of Science, Technology and Innovation (MAAI)		
Malaysia Meteorological Department	<ul style="list-style-type: none"> To provide climatological services To provide early warnings on dangerous climatological conditions to public, media and government for disaster mitigation 	<ul style="list-style-type: none"> Construction and Analysis of Climate Change Model
h) Ministry of Works		
Public Works Department	<ul style="list-style-type: none"> To plan, design, manage and supervise infrastructure projects (road, government building, airport, port and jetty projects) 	<ul style="list-style-type: none"> Infrastructure
State Institution		
Water Regulatory Body (BKSA: <i>Badan Kawal Selia Air</i>)	<ul style="list-style-type: none"> Issuance of licenses Regulation of water supply services Regulation of licensed companies Law enforcement 	<ul style="list-style-type: none"> Regulation of Raw Water Abstraction
Land Office	<ul style="list-style-type: none"> To regulate the land and river use To gazette the river reserve To approve plantation development To issue license for river sand dredging 	<ul style="list-style-type: none"> Land Use
Local Authority	<ul style="list-style-type: none"> To provide the social services in the local authority area To construct and maintain the urban drainage To control all the places in local authority area for public use 	<ul style="list-style-type: none"> Urban Drainage

1.3 Guidelines for Introducing IRBM

1.3.1 Backgrounds

According to the 10th Malaysia Plan, the IWRM approaches will be continued to be encouraged in planning, managing, protecting and rehabilitating water resources. In line with this national policy, IRBM will be continued to be promoted and introduced to other river basins. When diffusing IRBM to the other river basins in Malaysia, the above-said experiences of the Preparatory Survey are very useful. Therefore, the experiences for preparing IRBM and IFM plans for the Muar and Pahang River Basins are definitely worth recording as Guidelines for Introducing IRBM.

1.3.2 Objective of Guidelines

Based on the above backgrounds, the objective of the guidelines is set up as follows:

Objective: To describe methodologies and lessons learnt in the course of the Preparatory Survey, which will be referred to when IRBM is introduced in the other river basins, especially for preparation of an IRBM and/or an IFM plan.

1.3.3 Contents of Guidelines

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CHAPTER 2 MUAR RIVER BASIN

2.1 IRBM Plan

2.1.1 Objective and Target Completion Year

The objective of the IRBM Plan is “to provide a road map for realization of sustainable management of land and water in the Muar River Basin, focusing on water utilization, river environment and flood management”. The target completion year of the IRBM and IFM plans for the Muar River Basin is 2025, covering the 10th, 11th and 12th Malaysia Plans.

2.1.2 Core Issues and Proposed Policies

Through referring to lots of previous study reports, interviews to officials concerned and discussions at the working group meetings and site visits, a lot of IRBM issues were identified. Out of the identified issues, four core issues that could cover almost all of the significant issues were extracted as shown in **Table 2.1.1**.

Proposed policies can be obtained by transforming each of the four core issues into a positive statement. Moreover, special attention is paid to the wording of the policies, so that broad implications covering almost all the significant issues could be included in the policies. The core issues and their corresponding policies for the Muar River Basin are presented in **Table 2.1.1**. All the policies comply with the federal and state policies.

Table 2.1.1 Core Issues and Proposed Policies

No.	Core Issues	Proposed Policies
1	Weak institutional framework	Strengthen Institutional Setup
2	Insufficient Water Utilization	Ensure Sustainable Water Utilization
3	Deterioration of water Quality	Create a Sustainable and Pleasant River Environment
4	Flood damage.	Build a Resilient Society to Floods

2.1.3 Proposed Strategies and Measures

In order to clarify the cause-effect relationship hierarchy among issues, a problem analysis was made for each of the four core issues. Once the problem tree is prepared, strategies and measures are easily set up. Proposed strategies are positive statements of the direct causes of the core issues. In the same way proposed measures are positive statements of issues at the lower levels. The proposed strategies and measures for the Muar Basin are presented in **Table 2.1.2**.

Table 2.1.2 Proposed Policies, Strategies and Measures for Muar River Basin

Policies	Strategies	Measures	
Strengthen Institutional Setup	I-1 Establish Coordination Framework	I-1.1 Enhance RBC (River Basin Committee) I-1.2 Formulate National Water Policy & Nation Water Resources Law	
	I-2 Implement Proper River Management	I-2.1 Authorize River Management Agency I-2.2 Determinate River Management Area	
	I-3 Integrate River Basin Information	I-3.1 Establish Integrated Information System for River Basin Management	
Ensure sustainable water utilization	W-1: Ensure sufficient water resources	W-1.1: Monitor impact of Climate Change W-1.2: Review water resources development plan W-1.3: Incorporate environmental flow with water resources development plan W-1.4: Establish response and coordination mechanism to droughts W-1.5: Explore alternative water resources	
		W-2: Ensure sustainable water services industry	W-2.1: Complete restructuring of water services industry W-2.2 Reduce Non Revenue Water (NRW)
			W-3: Ensure sufficient irrigation water
		W-4: Ensure safe navigation	W-4.1 Manage river course properly

Policies	Strategies	Measures
Create a sustainable and pleasant river environment	E-1: Reduce pollution load to ensure achievement of at least NWQS Class II water quality.	E-1.1: Reduce wastewater discharge
		E-1.2: Implement integrated waste management by reducing waste as source, increasing recycling rate and ensuring efficient and clean disposal.
		E-1.3: Minimize siltation of river by reducing erosion at source and controlling runoff of eroded soil particles into rivers.
		E-1.4: Minimize runoff of agrochemicals into rivers.
	E-2: Maintain the natural biodiversity of Basin.	E-2.1: Control large scale agricultural development
		E-2.2: Control logging activities
		E-2.3: Proper planning and management of Environmental Sensitive Areas.
	E-3: Protect the catchment areas for water intake to avoid contamination and reduction of water resource.	E-3.1: Proper management of all catchment areas for water intake.
E-4: Make use of river as an asset for townscape and recreational activities.	E-4.1: Integrate rivers into the townscape and recreational facilities.	
Build a resilient society to floods	F-1: Manage flood water	F-1.1: Implement appropriate structural measures
		F-1.2: Upgrade data management procedures
		F-1.3: Monitor and review impacts of climate change
		F-1.4: Conserve forests
	F-2: Create flood-flexible land use	F-2.1: Prepare flood hazard maps
		F-2.2: Promote gazettement of river reserve
	F-3: Ensure safe evacuation	F-3.1: Upgrade flood forecasting and warning system
		F-3.2: Prepare community-based flood management plan

2.1.4 Proposed IRBM Roadmap

Specific projects/actions were further proposed for strategies that hardly have been implemented so far or are necessary to be drastically strengthened. A roadmap for the implementation of the projects/actions with their responsible agencies was prepared for the Muar River Basin as shown in **Table 2.1.3**.

Most of the proposed projects/actions were fixed in the first five years until 2015. Based on the project results, the IRBM plan should be reviewed and updated at least every five years. Depending upon the project outputs, if necessary, new projects/actions should be proposed for the next five years. In this way, as likened to an upward spiral process, the IRBM for the Muar River Basin will be continuously improved.

Table 2.1.3 Proposed Roadmap for IRBM for Muar River Basin

Sector	Project/Action	Main Agencies	Cost (RM million)	Schedule			
				10 th MP	11 th MP	12 th MP	
				2015	2020	2025	
Institution Setup	I-1.1: Enhancement of River Basin Committee (RBC)	RBC		●			
	I-2.1.1: Establishment of Federal and State Water Resources Department (WRD)	NRE			●		
	I-2.1.2: Establishment of River Basin Management Office (RBMO)	NRE				●	
	I-3.2: Establishment of integrated information system	DID, MaCGDI		●●●			
	I-2.2: Determination of river management area (River Reserve)	DID, Land Office		●●●●●●●●	●●●●●●●●	●●●●●●●●	
	Review and Updating of IRBM plan	RBC			●	●	●
Water Utilization	W-1.1.1: Monitoring of impact of climate change	BKSA, BAKAJ			●	●	●
	W-1.3.1: Study on environmental flow	BKSA, BAKAJ, DID, DOE	1-2	●●			
	W-1.4.1: Study on groundwater potential	BKSA, BAKAJ, JMG	3-4	●●			
	W-2.2.1: Reduction of Non-revenue Water (NRW)	SAJH, SAINS, SPAN, PAAB		●●●●●●●●	●●●●●●●●	●●●●●●●●	
Environment Management	E-1.1.1: Capacity development for establishment of a mechanism for developing and maintaining pollution load inventory	DOE	2-4	●●			
	E-1.1.2: Study on drinking water treatment sludge	Water Services Dept.	2-4		●●		
	E-1.1.3: Feasibility study and pilot project for wastewater treatment system for wet-markets	Dept. of local government	1-2	●●			
	E-1.4.1: Monitoring of agrochemicals	DOE		●●●●●●●●	●●●●●●●●	●●●●●●●●	
Flood Management	Implementation of structural measures of IFM plan (Refer to Table S.2.4)	DID	530	●●●●●●●●	●●●●●●●●	●●●●●●●●	
	Implementation of non-structural measures of IFM plan (Refer to Table S.2.4)	DID and others	17	●●●●●●●●	●●●●●●●●	●●●●●●●●	

2.2 IFM Plan

2.2.1 Core Issues and Proposed Policies

In the Preparatory Survey the IFM plan for the Muar River Basin was prepared in the framework of the proposed IRBM Plan. Namely flood issues were identified and analyzed very closely, and a policy for the flood sector, ‘**build a resilient society to floods**’ was proposed in conclusion. This policy implies the **IFM concept** that aims to make a shift from conventional flood management of ‘controlling’ floods to trying to achieve sustainable development of the basin while maximizing the net benefit from flood plains by appropriately ‘managing’ floods.

The policy is further supported by following three strategies for the Muar River Basin, which are specified to concrete structural and nonstructural measures:

Strategy F-1: Manage Flood Water

Strategy F-2: Create Flood-flexible Land Use

Strategy F-3: Ensure Safe Evacuation

2.2.2 Basic Conditions

As the target completion year is 2025, the IFM plan was elaborated under the physical and social conditions at 2025, as presented in **Table 2.2.1**.

Table 2.2.1 Determination of Future Conditions at 2025

Item	Way of Determination	Remarks
Population	Population at 2025 is projected under this survey.	Basin population increases by 17 % from 660,000 at 2010 to 770,000 at 2025.
Land use	Land use zone map of 2020 is substituted for that of 2025.	Build-up areas increases by 4.4% from 2.7% at 2000 from to 7.1% at 2025.
Impact of Climate Change	Increment of rainfall intensity and sea level rise is considered.	100-year ARI 3-day rainfall increases by 20% from 339.7 mm to 407.6 mm. The sea level rise is 12 cm.

The design scale of structural measures is in principle set at 100 years of ARI for urban areas, although this might be lowered depending upon the local conditions.

2.2.3 Proposed Structural Measures

There is an antecedent master plan study by a local consultant firm. This study titled “Rancangan Tebatan Banjir Bagi Lembangan Sungai Muar, Johor” started in 2008 and is still on-going.

Taking into consideration the interim results of the antecedent master study, conceivable structural measures are selected as presented in **Table 2.2.2**. The location of the proposed measures is also presented in **Figure 2.2.1**. Regarding the short-cuts, effectiveness was confirmed through hydraulic simulation and economic analysis.

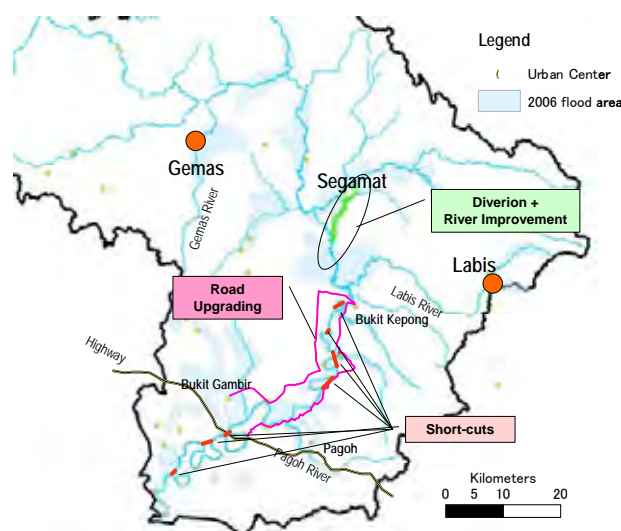


Figure 2.2.1 Location of Conceivable Measures

Table 2.2.2 Conceivable Structural Measures for Muar River Basin

Project	Contents	Remarks
Segamat-Genuang Diversion and River Improvement of Genuang and Chodan Rivers	1.5 km Diversion Channel, + 1.2 km River Improvement for Genuang River and + 8.5 km River Improvement for Chodan River	DID intends to implement this project in 10 th Malaysia Plan
Short-cuts of river loops (Bypass channels)	7 candidate sites are identified between the river mouth and Bukit Kepong..	
Road Upgrading	Heightening and strengthening of main roads to prevent traffic communication cuts during floods	
Protection of Urban Centers	Labis and Gemas Towns are identified as candidate urban centers.	

2.2.4 Proposed Non-Structural Measures

The existing non-structural measures have been already developed to some extent. Institutional frameworks for implementing them have been also generally established. Therefore, the JICA Study Team firstly recommends that efforts should be continued to enforce or operate the existing non-structural measures effectively. In addition, the Team also specially proposes to implement three projects in **Table 2.2.3** that aim to strengthen the existing non-structural measures.

Table 2.2.3 Proposed Specific Non-structural Measure Projects

Project	Contents
Capacity Development of District DIDs and Local Government agencies for Flood Management	Capacity development of District DIDs and local government agencies (Flood Management and Disaster Committee for flood) for flood management, especially preparation and dissemination of hazard maps.
Improvement of Flood Forecasting and Warning System	Strengthening of Flood Forecasting and Warning System with additional telemetry stations for the Muar River Basin
Updating of Projection of Impact of Climate Change	Updating of projection of impact of climate change based on IPCC's assessment reports.

2.2.5 Proposed IFM Plan

The IFM Plan is formulated as a combination of the proposed structural and non-structural measures, and a tentative implementation program is proposed in **Table 2.2.4**.

Since the antecedent master plan study is still on-going, all the components tentatively proposed in the master plan study have not been incorporated in this IFM plan. The JICA Study Team recommends that DID finalizes the master plan in due consideration of the recommendations made by the Preparatory Survey.

Table 2.2.4 Tentative Implementation Plan of IFM Plan

Structural/ Nonstructural	Project	Cost (10 ⁶ RM)	10th MP		11th MP		12th MP	
			2011	2015	2020	2025		
Structural	Segamat-Genuang Diversion and River Improvement for Genuang and Chodan	178	█					
	Sungai Sendok Short-cut	45	█					
	Belemang Short-cut	83	█					
	Olak Short-cut	90			█			
	Kundang Short-cut	27				█		
	Penchu Short-cut	26					█	
	Bkt. Serampang Short-cut	5						█
	Bkt. Kepong Short-cut	14						█
	Road Upgrading	n/a		█	█			
	Flood Mitigation Project for Labis Town	n/a			█			
	Flood Mitigation Project for Gemas Town	62*		█				
	Non-structural	Capacity Development of District DIDs and Local Government Agencies for Flood Management	5	█				
Flood Forecasting and Warning System Project		11			█			
Updating of Projection of Impact of Climate Change		1		█		█		█
Total		547	373		32		142	

*: Estimated in the feasibility study.

2.3 Feasibility Study

2.3.1 Objectives of Feasibility Study

Feasibility Study is carried out for “Gemas Flood Mitigation Project”. The project includes components of structural measures and non-structural measures for protection of Gemas town in Tampin, Negeri Sembilan and Gemas Baru in Segamat, Johor that are facing each other across the Gemas River.

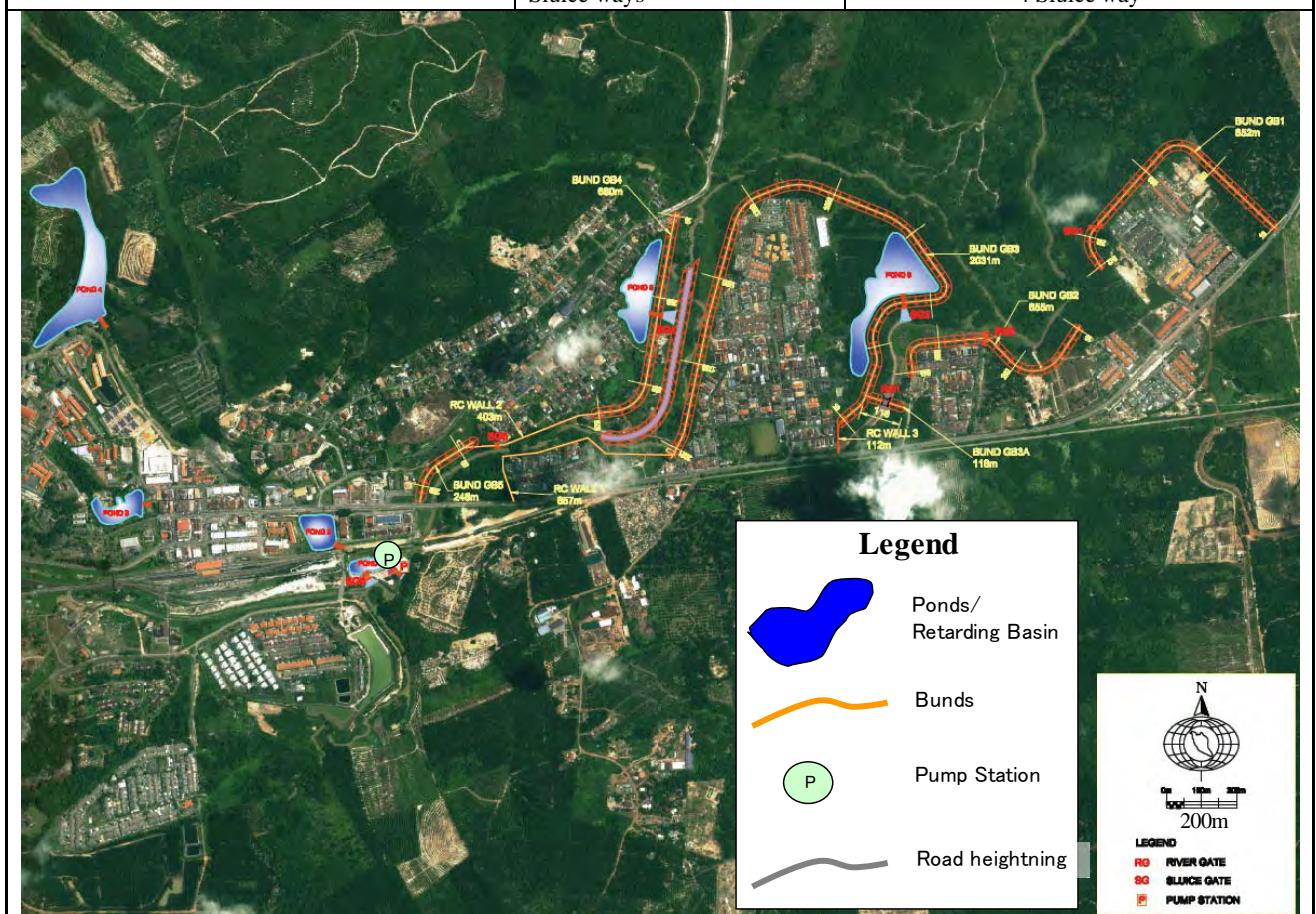
2.3.2 Component and Feasibility of Structural Measure

Ring bunds are constructed to surround the urban areas against overflow of the Gemas River. Several retention ponds and a pump station are also constructed to prevent inland floods. This project is feasible from the viewpoint of the investment efficiency as shown in **Table 2.3.1**.

Table 2.3.1 Component and Feasibility of Project

Feasibility of Project		Structures	Qty
		Ring bunds	4,500 m
		Road heightening	1,060 m
		Pump Stations	1 Pump Stations Total pump capacity: 1.0m ³ /s
		Regulation ponds	10.7 ha
		River Gate	1 Gate
		Sluice ways	4 Sluice way

Criteria	Value
Cost (RM mil.)	62
EIRR (%)	10.7
B/C	1.09
NPV (RM '000)	3,755



2.3.3 Implementation Schedule for Structural Measure

The implementation schedule for the major structural measure components of the Gemas Flood Mitigation Project is summarized as shown in **Table 2.3.2**.

Table 2.3.2 Implementation Schedule for Structural Measure

Gemas			Year 1		Year 2				Year 3				Year 4				Year 5																
Working Item	unit	Quantity	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	
Mobilization & Preparatory Work	L.S		■																														
(1)Embankment	m3	372,677	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
(2)RC Wall	m3	1,060							■	■	■	■	■	■	■	■	■	■															
(3)Regulation Pond-1																																	
①Excavation	m3	12,630																						■	■	■	■	■	■	■			
②Outlet Structure	nos	1																						■	■	■	■	■	■	■			
③Pump Station	nos	1																						■	■	■	■	■	■	■			
(4)Regulation Pond-2																																	
①Excavation	m3	17,520																															
②Outlet Structure	nos	1																															
(5)Regulation Pond-3																																	
①Excavation	m3	4,000																															
②Outlet Structure	nos	1																															
(4)Regulation Pond-4																																	
①Excavation	m3	4,000																															
②Outlet Structure	nos	1																															
(5)Regulation Pond-5																																	
①Excavation	m3	52,500																															
②Outlet Structure	nos	1																															
(6)Regulation Pond-6																																	
①Excavation	m3	91,500																															
②Outlet Structure	nos	1																															
(7)River Gate	nos	1																															
(8)Drainage Structure																																	
(9)Site Clearance/Cleaning	L.S																																
Demobilization	L.S																																
Completion	L.S																																☆

2.3.4 Non-Structural Measure

Proposed non-structural measure components are summarized in **Table 2.3.3**. The proposed non-structural measures basically aim to support the existing legal arrangement and to complement the existing measures.

Table 2.3.3 Proposed Non-Structural Project Components

Project Components	No.	Non-Structural Measures	Organizations/Agencies
I. Capacity Development for flood management	1	Flood risk management 1) Forward base should be opened in Gemas 2) Seating capacity should be upgraded	National Security Council
	2	Flood fighting activities along Gemas River	National Security Council
II. Upgrading flood forecasting and warning system	3	Upgrading warning system by instillation of water level recorder at Gemas River Bridge	DID
	4	Dissemination of flood information by utilization of monitoring system	DID
III. Preparation of hazard maps and guidelines	5	Preparation of hazard maps and sharing the information among the local authorities and communities	DID
	6	Preparation of guidelines/manuals for flood fighting activities	DID
IV. Control and management of land use	7	Preservation of low land areas for the retention of water	DTCP and Local Authority
	8	Flood proofing by construction of stilt house	-

CHAPTER 3 PAHANG RIVER BASIN

3.1 IRBM Plan

3.1.1 Objective and Target Completion Year

The objective of the IRBM Plan is “to provide a road map for realization of sustainable management of land and water in the Pahang River Basin, focusing on water utilization, river environment and flood management”. The target completion year of the IRBM and IFM plans for the Pahang River Basin is 2025, covering the 10th, 11th and 12th Malaysia Plans.

3.1.2 Core Issues and Proposed Policies

Through referring to lots of previous study reports, interviews to officials concerned and discussions at the working group meetings and site visits, a lot of IRBM issues were identified. Out of the identified issues, four core issues that could cover almost all of the significant issues were extracted as shown in **Table S.1.1**.

Proposed policies can be obtained by transforming each of the four core issues into a positive statement. Moreover, special attention is paid to the wording of the policies, so that broad implications covering almost all the significant issues could be included in the policies. The core issues and their corresponding policies for the Pahang River Basin are presented in **Table 3.1.1**. All the policies comply with the federal and state policies.

Table 3.1.1 Core Issues and Proposed Policies

No.	Core Issues	Proposed Policies
1	Weak institutional framework	Strengthen Institutional Setup
2	Insufficient Water Utilization	Ensure Sustainable Water Utilization
3	Deterioration of water Quality	Create a Sustainable and Pleasant River Environment
4	Flood damage.	Build a Resilient Society to Floods

3.1.3 Proposed Strategies and Measures

In order to clarify the cause-effect relationship hierarchy among issues, a problem analysis was made for each of the four core issues. Once the problem tree is prepared, strategies and measures are easily set up. Proposed strategies are positive statements of the direct causes of the core issues. In the same way proposed measures are positive statements of issues at the lower levels. The proposed strategies and measures for the Pahang Basin are presented in **Table 3.1.2**.

Table 3.1.2 Proposed Policies, Strategies and Measures for Pahang River Basin

Policies	Strategies	Measures
Strengthen Institutional Setup	I-1 Establish Coordination Framework	I-1.1: Enhance RBC (River Basin Committee) I-1.2: Formulate National Water Policy & Nation Water Resources Law
	I-2 Implement Proper River Management	I-2.1: Authorize River Management Agency I-2.2: Determinate River Management Area
	I-3 Integrate River Basin Information	I-3.1: Establish Integrated Information System for River Basin Management
Ensure sustainable water utilization	W-1: Ensure sufficient water resources	W-1.1: Monitor impact of Climate Change
		W-1.2: Review water resources development plan
		W-1.3: Incorporate environmental flow with water resources development plan
		W-1.4: Establish response and coordination mechanism to droughts
		W-1.5: Explore alternative water resources
	W-2: Ensure sustainable water services industry	W-2.1: Complete restructuring of water services industry W-2.2: Reduce Non Revenue Water (NRW)
W-3: Ensure sufficient irrigation water	W-3.1: Manage irrigation facilities properly	

Policies	Strategies	Measures
Create a sustainable and pleasant river environment	E-1: Reduce pollution load to ensure achievement of at least NWQS Class II water quality.	E-1.1: Reduce wastewater discharge
		E-1.2: Implement integrated waste management by reducing waste as source, increasing recycling rate and ensuring efficient and clean disposal.
		E-1.3: Minimize siltation of river by reducing erosion at source and controlling runoff of eroded soil particles into rivers.
		E-1.4: Minimize runoff of agrochemicals into rivers.
	E-2: Maintain the natural biodiversity of Basin.	E-2.1: Control large scale agricultural development
		E-2.2: Control logging activities
		E-2.3: Proper planning and management of Environmental Sensitive Areas.
	E-3: Protect the catchment areas for water intake to avoid contamination and reduction of water resource.	E-3.1: Proper management of all catchment areas for water intake.
E-4: Make use of river as an asset for townscape and recreational activities.	E-4.1 Integrate rivers into the townscape and recreational facilities.	
Build a resilient society to floods	F-1: Manage flood water	F-1.1: Implement appropriate structural measures
		F-1.2: Upgrade data management procedures
		F-1.3: Monitor and review impacts of climate change
		F-1.4: Conserve forests
	F-2: Create flood-flexible land use	F-2.1: Prepare flood hazard maps
		F-2.2: Promote gazettement of river reserve
	F-3: Ensure safe evacuation	F-3.1: Upgrade flood forecasting and warning system
		F-3.2: Prepare community-based flood management plan

3.1.4 Proposed IRBM Roadmap

Specific projects/actions were further proposed for strategies that hardly have been implemented so far or are necessary to be drastically strengthened. A roadmap for the implementation of the projects/actions with their responsible agencies was prepared for the Pahang River Basin as shown in **Table 3.1.3**.

Most of the proposed projects/actions were fixed in the first five years until 2015. Based on the project results, the IRBM plan should be reviewed and updated at least every five years. Depending upon the project outputs, new projects/actions should be added for the next five years if necessary. In this way, as likened to an upward spiral process, the IRBM for the Pahang River Basin will be continuously improved.

Table 3.1.3 Proposed Roadmap for IRBM for Pahang River Basin

Sector	Project/Action	Agencies	Cost (RM million)	Schedule		
				10 th MP	11 th MP	12 th MP
				2015	2020	2025
Institution Setup	I-1.1: Enhancement of River Basin Committee (RBC)	RBC		●		
	I-2.1.1: Establishment of Federal and State Water Resources Department (WRD)	NRE			●	
	I-2.1.2: Establishment of River Basin Management Office (RBMO)	NRE				●
	I-3.2: Establishment of integrated information system	DID, MaCGDI		●●●		
	I-2.2: Determination of river management area (River Reserve)	DID, Land Office		●●●●●●●●	●●●●●●●●	●●●●●●●●
	Review and Updating of IRBM plan	RBC			●	●
Water Utilization	W-1.1.1: Monitoring of impact of climate change	BKSA			●	●
	W-1.3.1: Study on environmental flow	BKSA	1-2	●●		
	W-1.4.1: Study on groundwater potential	BKSA, JMG	3-4	●●		
	W-2.2.1: Reduction of Non-revenue Water (NRW)	JBA, SAINS, SPAN, PAAB		●●●●●●●●	●●●●●●●●	●●●●●●●●
Environment Management	E-1.1.1: Capacity development for establishment of a mechanism for developing and maintaining pollution load inventory	DOE	2-4	●●		
	E-1.1.2: Study on drinking water treatment sludge	Water Services Dept.	2-4		●●	
	E-1.1.3: Feasibility study and pilot project for wastewater treatment system for wet-markets	Dept. of local government	1-2	●●		
	E-1.3.1: Monitoring of sand dredging activities	DID		●●●●●●●●	●●●●●●●●	●●●●●●●●
	E-1.4.1: Monitoring of agrochemicals	DOE		●●●●●●●●	●●●●●●●●	●●●●●●●●
	E-2.3.1: Study on integrated ESA management plan	UPEN	2-4	●●		
Flood Management	Implementation of structural measures of IFM plan (Refer to Table S.2.3)	DID	701	●●●●●●●●	●●●●●●●●	●●●●●●●●
	Implementation of non-structural measures of IFM plan (Refer to Table S.2.3)	DID and others	39	●●●●●●●●	●●●●●●●●	●●●●●●●●

3.2 IFM Plan

3.2.1 Core Issues and Proposed Policies

In the Preparatory Survey the IFM plan for the Pahang River Basin was prepared in the framework of the proposed IRBM Plan. Namely flood issues were identified and analyzed very closely, and a policy for the flood sector, ‘**build a resilient society to floods**’ was proposed in conclusion. This policy implies the **IFM concept** that aims to make a shift from conventional flood management of ‘controlling’ floods to trying to achieve sustainable development of the basin while maximizing the net benefit from flood plains by appropriately ‘managing’ floods.

The policy is further supported by following three strategies for the Pahang River Basin, which are specified to concrete structural and nonstructural measures:

Strategy F-1: Manage Flood Water

Strategy F-2: Create Flood-flexible Land Use

Strategy F-3: Ensure Safe Evacuation

3.2.2 Basic Conditions

As the target completion year is 2025, the IFM plan was elaborated under the physical and social conditions at 2025, as presented in **Table 3.2.1**.

Table 3.2.1 Determination of Future Conditions at 2025

Item	Way of Determination	Remarks
Population	Population at 2025 is projected under this Survey.	Basin population increases from 1,190,000 at 2010 to 1,480,000 at 2025.
Land use	Land use zone map of 2020 is substituted for that of 2025.	Build-up areas increases by 4.3% from 0.8 % at 2000 to 5.1% at 2025.
Impact of Climate Change	Increment of rainfall intensity and sea level rise is considered as described in Chapter 3 .	100 year ARI 8 day rainfall increases by 10% from 527.5 mm to 580.3 mm. The sea level rise is 12 cm.

The design scale of structural measures is in principle set at 100 years of ARI for urban areas, although this might be lowered depending upon the local conditions.

3.2.3 Proposed Structural Measures

The measures for reduction on extensive flood inundation are all large-scale measures such as river improvement, dam reservoirs, retarding basins, diversion channels, etc. They can reduce flood inundation very much but require huge financial and environmental costs at the same time. Considering the less populated flood plains along the Pahang River, their economical justification might be questionable. As DID is going to implement the protection works for Pekan, Bentong and Cameron Highlands, localized protection works for urban centers seem more realistic. It is deemed that the present vast flood plains should be maintained as natural retarding basins by enforcing land use control without providing any large-scale protection measures.

Three flood control dams, the Jengka Diversion and protection of urban centers, Temerloh, Mentakab, Kuala Lipis and Teriang were examined through flood simulation and economic analysis. The results show that the dams and the diversion are definitely infeasible, and that the protection work for Temerloh and Mentakab are economically feasible, while economic effectiveness of those for Kuala Lipis and Teriang is low. Six urban centers including additional two urban centers, Maran and Jerantut that were strongly recommended at the Steering Committee Meeting in February 2010 are incorporated into the IFM plan together with the above-mentioned projects for Pekan, Bentong and Cameron Highlands.

3.2.4 Proposed Non-Structural Measures

The existing non-structural measures have been already developed to some extent. Institutional frameworks for implementing them have been also generally established. Therefore, the JICA Study Team firstly recommends that efforts should be continued to enforce or operate the existing non-structural measures effectively. In addition, the Team also specially proposes to implement three projects in **Table 3.2.2** that aim to strengthen the existing non-structural measures.

Table 3.2.2 Proposed Specific Non-structural Measure Projects

Project	Contents
Capacity Development of District DIDs and Local Government agencies for Flood Management	Capacity development of District DIDs and local government agencies (Flood Management and Disaster Committee for flood) for flood management, especially preparation and dissemination of hazard maps.
Improvement of Flood Forecasting and Warning System	Strengthening of Flood Forecasting and Warning System with additional telemetry stations for Pahang River Basin
Updating of Projection of Impact of Climate Change	Updating of projection of impact of climate change based on IPCC's assessment reports.

3.2.5 Proposed IFM Plan

The IFM Plan is formulated as a combination of the proposed structural and non-structural measures, and a tentative implementation program is proposed in **Table 3.2.3**. The three projects that were previously studied and are nearly ready for implementation are also included in the IFM Plan.

Table 3.2.3 Tentative Implementation Program of IFM Plan

Structural/ Nonstructural	Project	Cost (10 ⁶ RM)	10th MP	11th MP	12th MP
			2011	2015	2020
Structural	Flood Mitigation Project for Pekan Town	280	██████████		
	Flood Mitigation Project for Sungai Bentong Basin	250		██████████	██████████
	Flood Mitigation Project for Cameron Highland	3			██████
	Flood Mitigation Project for Temerloh and Mentakab Towns	72	██████		
	Flood Mitigation Project for Maran Town	50		██████	
	Flood Mitigation Project for Teriang Town	19		██████	
	Flood Mitigation Project for Jerantut Town	20			██████
	Flood Mitigation Project for Kuala Lipis Town	7			██████
Non-structural	Capacity Development of District DIDs and Local Government Agencies for Flood Management	12	██████████		
	Flood Forecasting and Warning System Project	26		██████████	
	Updating of Projection of Impact of Climate Change	1		██	██
	Total	740	282	302	156

3.3 Feasibility Study

3.3.1 Objectives of Feasibility Study

Feasibility Study is carried out for “Temerloh Flood Mitigation Project”. The project includes components of structural measures and non-structural measures. Feasibility Study is made on several cases of combinations of components.

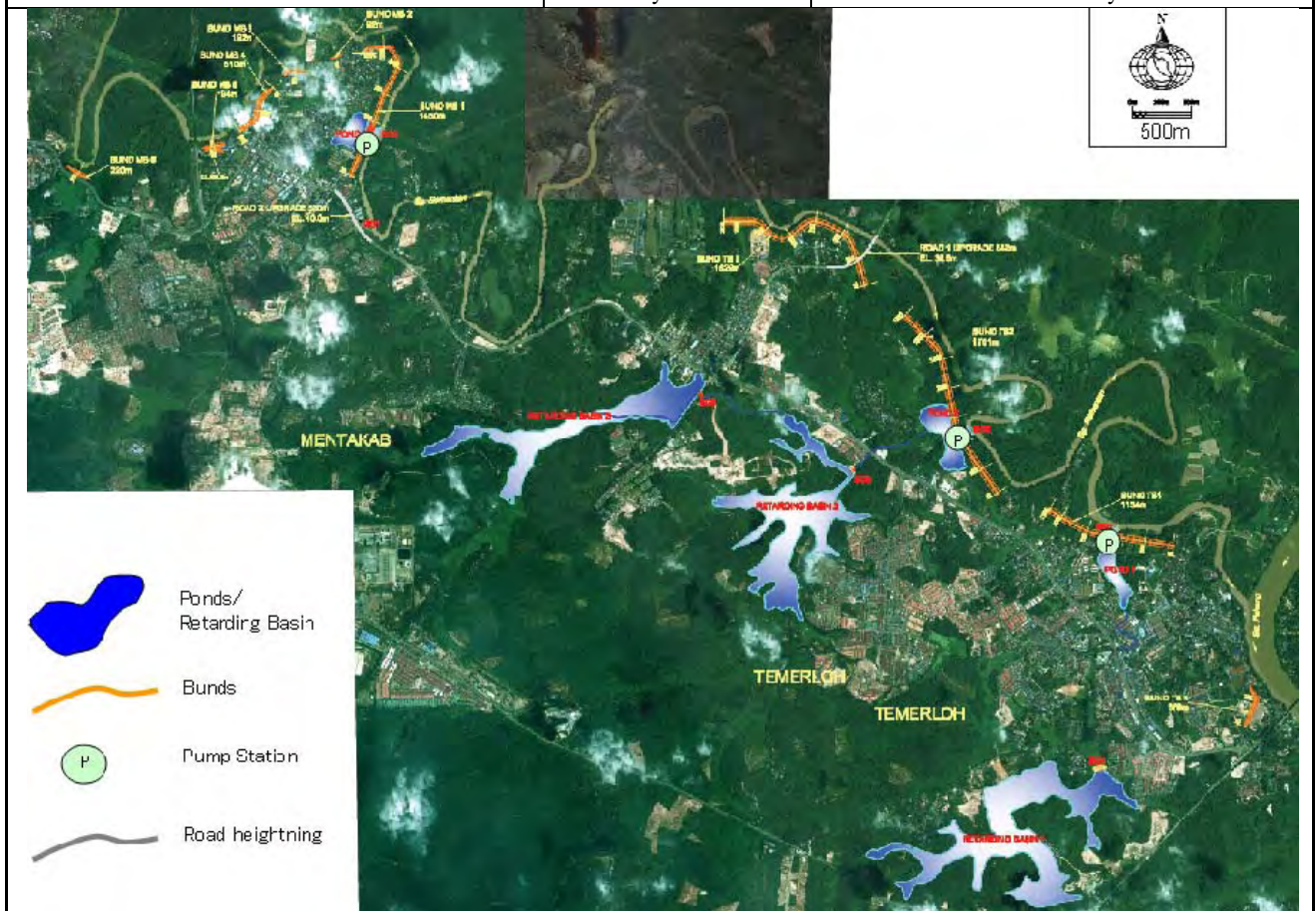
3.3.2 Component and Feasibility of Structural Measure

To protect from Temerloh and Mentakab towns from Semantan River overflow flood by ring bunds, the runoff discharge inside the ring bunds is reserved in retarding basin and is forced to drain through 3 pumping stations. This project is feasible from the viewpoint of the investment efficiency as shown in Table 3.3.1.

Table 3.3.1 Component and Feasibility of Project

Feasibility of Project		Structures	Qty
		Ring bunds	7,542 m
		Road heightening	793 m
		Retarding Basin	Area: 167 ha
		Pump Stations	3 Pump Stations Total pump capacity: 18.5m ³ /s
		Regulation ponds	21 ha
		Sluice ways	4 Sluice ways

Criteria	Value
Cost (RM mil.)	108.8
EIRR (%)	14.7
B/C	1.6
NPV (RM '000)	50,328



3.3.3 Implementation Schedule for Structural Measure

The implementation schedule for the major work components of Temerloh Flood Mitigation Project is summarized as shown in **Table 3.3.2**.

Table 3.3.2 Implementation Schedule for Structural Measure

Temerloh & Mentakab			Year 1		Year 2				Year 3				Year 4				Year 5															
Working Item	unit	Quantity	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60
Mobilization & Preparatory Work	L.S		■																													
Temerloh																																
(1) Embankment	m3	617,017	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
(2) Upgrading Existing Road	m3	41,544							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
(3) Regulation Pond-1																																
① Excavation	m3	33,900							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
② Outlet Structure	nos	1																														
③ Pump Station	nos	1																														
(4) Regulation Pond-2																																
① Excavation	m3	283,200							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
② Outlet Structure	nos	1																														
③ Pump Station	nos	1																														
Mentakab																																
(1) Embankment	m3	271,316	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
(2) Upgrading Existing Road	m3	33,920																														
(3) Regulation Pond-3																																
① Excavation	m3	157,500							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
② Outlet Structure	nos	1																														
③ Pump Station	nos	1																														
(4) River Gate	nos	1																														
(5) Site Clearance/Cleaning	L.S																															
Demobilization	L.S																															
Completion	L.S																														★	

3.3.4 Non-Structural Measure

Project Components for non-structural measures in Temerloh and Mentakab are summarized in **Table 3.3.3**. Non-structural Projects basically cover to support existing legal arrangement and to complement existing non-structural measures.

Table 3.3.3 Project Component of Proposed Non-Structural

Project Components	No.	Non-Structural Measures	Organizations/Agencies
I. Capacity Development for flood management	1	Flood management with hazard maps	National Security Council
	2	Flood fighting activities along the Semantan River	National Security Council
II. Upgrading flood forecasting and warning system	3	Upgrading flood forecast and warning system by radar rain gauge system	DID
	4	Dissemination of flood information by utilization of monitoring system	DID
	5	Installation of warning system such as warnings siren in and around the project area	DID
III. Preparation of hazard maps and guidelines	6	Preparation of hazard maps and sharing the information among the local authorities and communities	DID
	7	Preparation of guidelines/manuals for flood fighting activities	DID
IV. Control and management of land use	8	Preservation of low land areas for the retention of water	DTCP and Local Authority
	9	Flood proofing by construction of stilt house	-

ANNEX

Presentation Material of the Final Steering
Committee Meeting



The Preparatory Survey for Integrated River Basin Management incorporating Integrated Flood Management with Adaptation of Climate Change

Final Report (Part 1)



Contents of Presentation

1. Outlines of Preparatory Survey
2. Contents of Final Report
3. Preparation of Guidelines for Introducing IRBM
4. Preparation of IRBM Plan
5. Feasibility Studies on:
 - Gemas Flood Mitigation Project
 - Temerloh Flood Mitigation Project

Summary of the Survey

Item	Contents
Overall Goal	Flood mitigation projects are implemented, and local and national economies are sustainably developed.
Objectives	<ol style="list-style-type: none"> To strengthen capacities of River Basin Committees (RBCs) of 2 selected river basins, To support them for elaborating Integrated River Basin Management (IRBM) and Integrated Flood Management (IFM) plans, and To conduct feasibility studies on high-priority flood mitigation projects that should be urgently implemented.

3

Survey Schedule

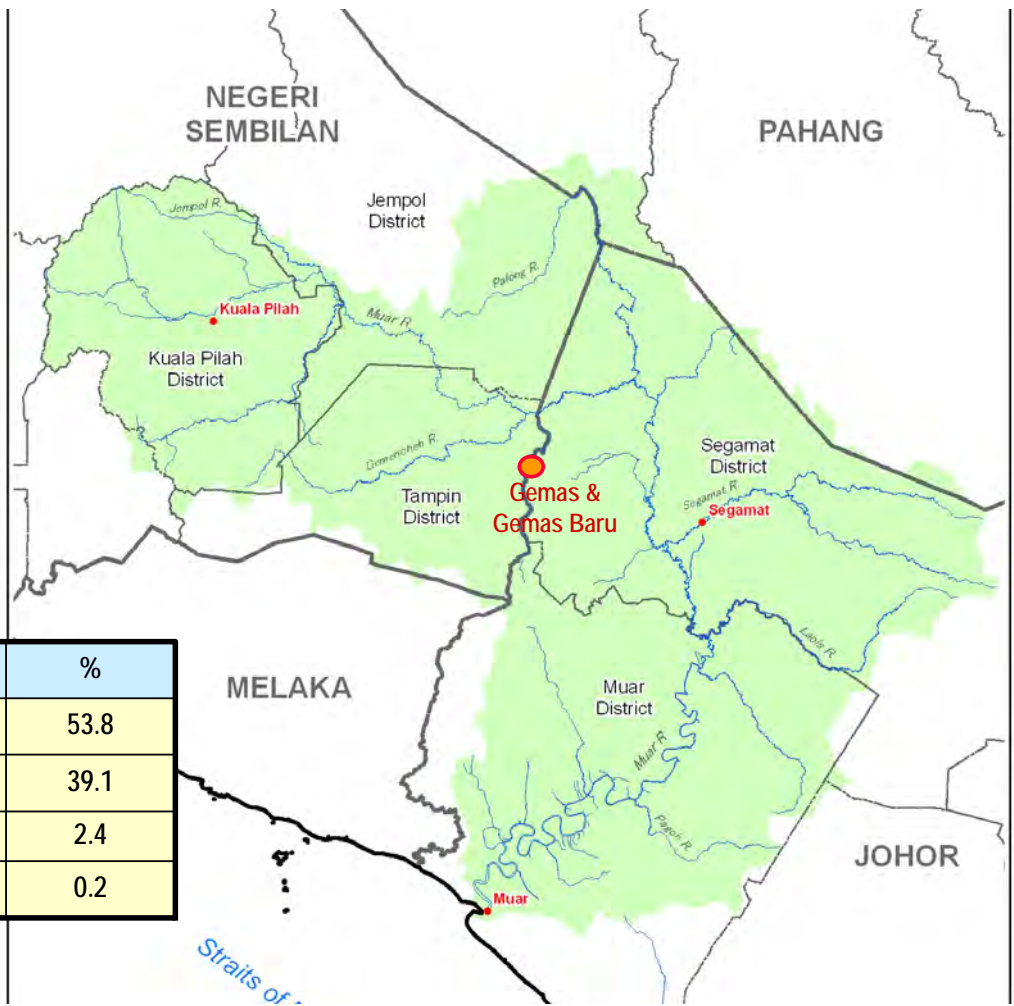
Assignment	2009					2010												2011		
	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
1. Selection of Target River Basins		■																		
2. Estimation of Impact of Climate Change		■	■	■	■															
3. Capacity Development of RBCs																				
3.1 Elaboration of IFM Plan			■	■	■	■	■													
3.2 Elaboration of IRBM Plan			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			
4. Feasibility Study on High-priority Projects									■	■	■	■	■	■	■					
Report		▲					▲			▲			▲					▲		
		Inception					Interim			Progress			Draft Final					Final		

4

Muar River Basin

Basin	Muar
Catchment Area (km ²)	6,140
River length (km)	310
River Gradient	1/4,000
Population (2010)	660,000

State	%
Johor	53.8
N. Sembilan	39.1
Pahang	2.4
Melaka	0.2



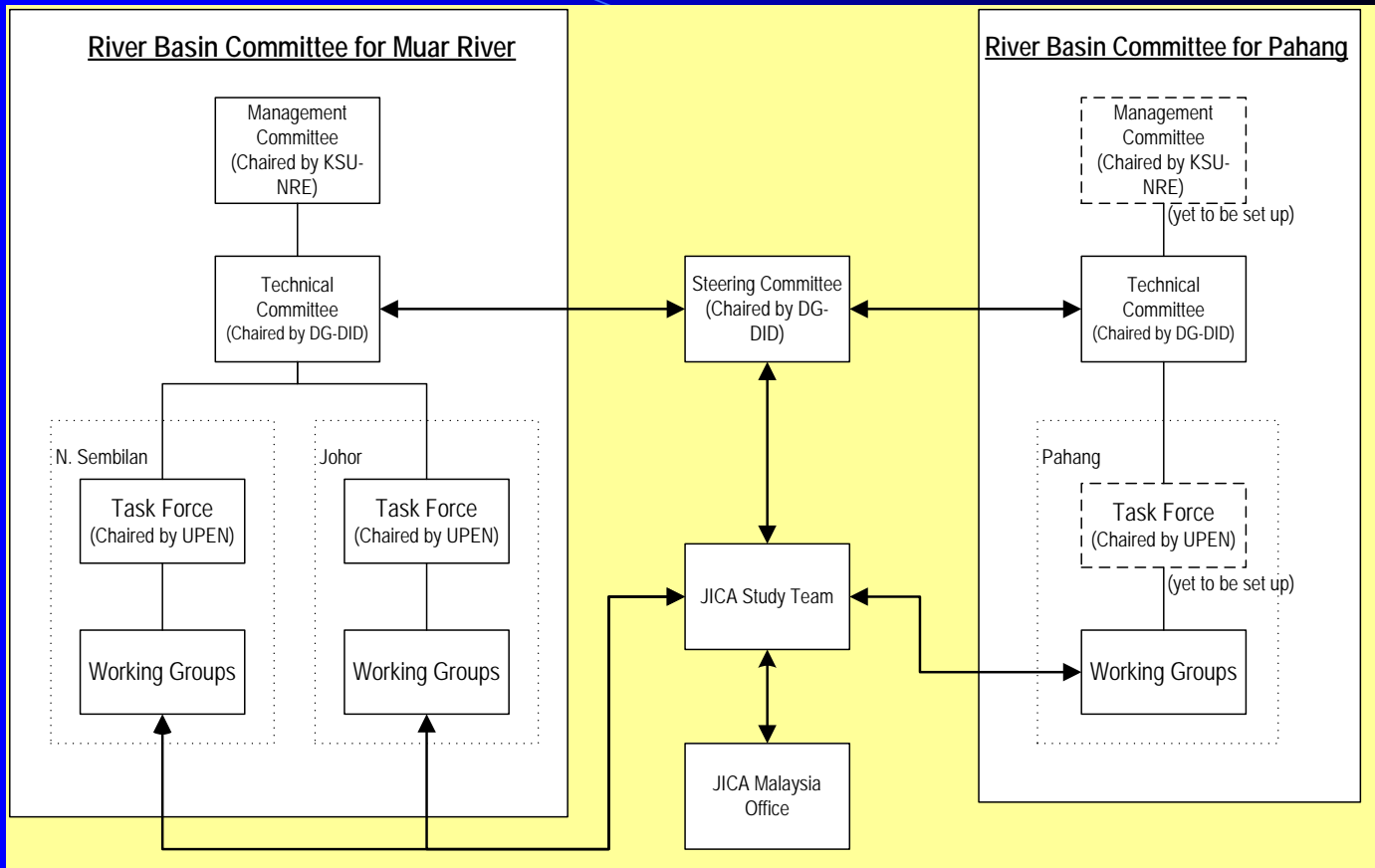
Pahang River Basin

Basin	Pahang
Catchment Area (km ²)	28,770
River length (km)	530
River Gradient	1/6,500
Population (2010)	1,190,000

State	%
Pahang	92.4
N. Sembilan	7.6



Organization of Project Implementation



Stakeholder Meeting for Pahang River Basin in Temerloh on August 23, 2010



Stakeholder Meeting for Muar River Basin at Alor Gajah on August 25, 2010



Contents of Final Report

Common Contexts Volume 1:

1. Introduction
2. National Contexts
3. Guidelines for Introducing IRBN

Muar River Basin Volume 2:

1. Physical and Biological Conditions
2. Socioeconomic Conditions
3. Climate Change Impact Analysis
4. Basic Analysis and Survey for IRBM and IFM Planning
5. Preparation of IRBM Plan
6. Formulation of IFM Plan
7. Basic Studies for Feasibility Study
8. Feasibility Study on Gemas Flood Mitigation Project

Pahang River Basin Volume 3:

1. Physical and Biological Conditions
2. Socioeconomic Conditions
3. Climate Change Impact Analysis
4. Basic Analysis and Survey for IRBM and IFM Planning
5. Preparation of IRBM Plan
6. Formulation of IFM Plan
7. Basic Studies for Feasibility Study
8. Feasibility Study on Temerloh Flood Mitigation Project

Preparation of Guidelines for Introducing IRBM

The objective of the guidelines is to describe methodologies and lessons learnt in the course of the Preparatory Survey, which will be referred to when IRBM is introduced in the other river basins, especially for preparation of an IRBM and/or an IFM plan.

Guidelines for Introducing IRBM

Table of Contents

1. Introduction

1. Backgrounds
2. Objective of Guidelines

2. Necessity of IRBM

1. Current Fragmental River Basin Management
2. Needs for Integrated Approach
3. Definition of IWRM, IRBM and IFM
4. Federal Policies on IRBM
5. Current Situation of IRBM
6. Spiral Evolution of IRBM

3. Setup of River Basin Committee

1. Introduction
2. Creation of River Basin Committees
3. Setting-up of Working Groups

4. Impact of Climate Change

1. Introduction
2. Availability of Climate Change Projection Data
3. Estimation of Impact of Climate Change
4. Adaptation Measures

5. IRBM Planning

1. Procedures of Planning
2. Core Issues and Problem Analysis
3. Setup of Proposed Policies, Strategies and Measures
4. Preparation of Roadmap

6. IFM Planning

1. Policy, Strategies and Measures
2. Planning Conditions
3. IFM Plan

Preparation of IRBM Plan for Muar River Basin

Procedure for Preparation of IRBM

1. Data/Information Collection
2. Identification of Issues for IRBM
3. Problem Analysis (Problem Tree) on Core Issues
4. Confirmation of National, State Policies on IRBM
5. Formulation of Proposed Policies, Strategies and Measures
6. Preparation of Roadmap

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Basic Conditions for Preparation of IRBM

1. Objective

to provide a road map for realization of sustainable management of land and water in the Pahang River Basin, focusing on water utilization, river environment and flood management.

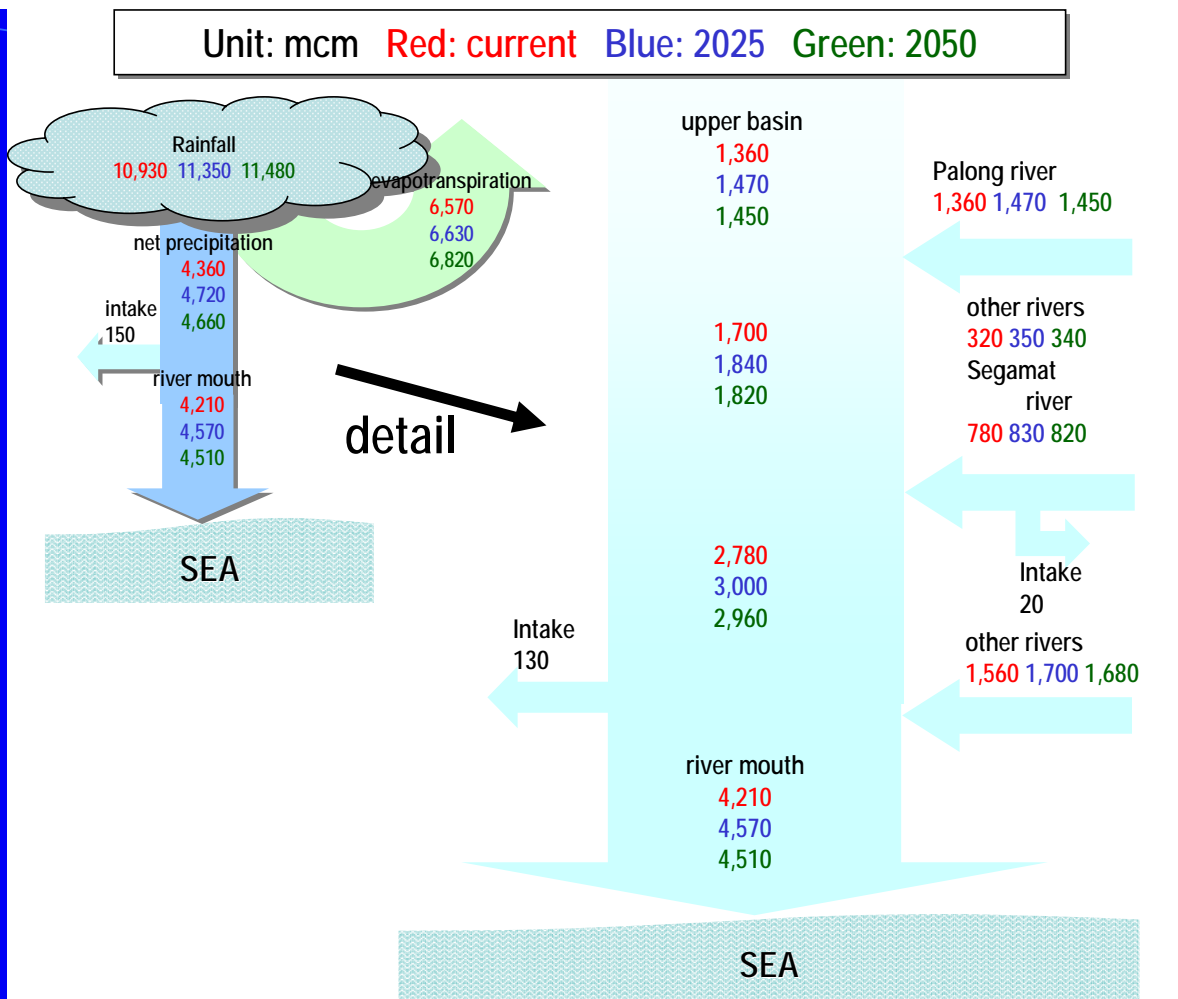
2. Planning Term (Target Year)

2011- 2025

(10th, 11th and 12th Malaysia Plan Periods)

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Abundant River Water of Muar River Basin (Annual Water Balance)



Institutional Arrangement

Function	Responsible Agency
River basin planning	UPEN, DID and JPBD
Water abstraction	State Authority (regulator) JMG (technical advisor on groundwater)
Water supply services	Provider: SAJH, Regulator: SPAN
Irrigation services	DID(MoA)
Flood mitigation	DID(MNRE)
Storm water management, urban drainage	Local authority DID (Technical advisor)
Effluent management	Large industrial outlets: DOE Sewerage treatment plants: DOE Discharge to sewerage services: DSS
Sewerage services	Provider: IWK Technical regulator: DSS Economic regulator: SPAN
Hydropower*	Operator: TNB Regulator: MEGTW
Fishery/Aquaculture	Regulator: DOFi
Inland/Navigation	Regulator: DOFi

IRBM Issues for Muar River Basin (Institution)

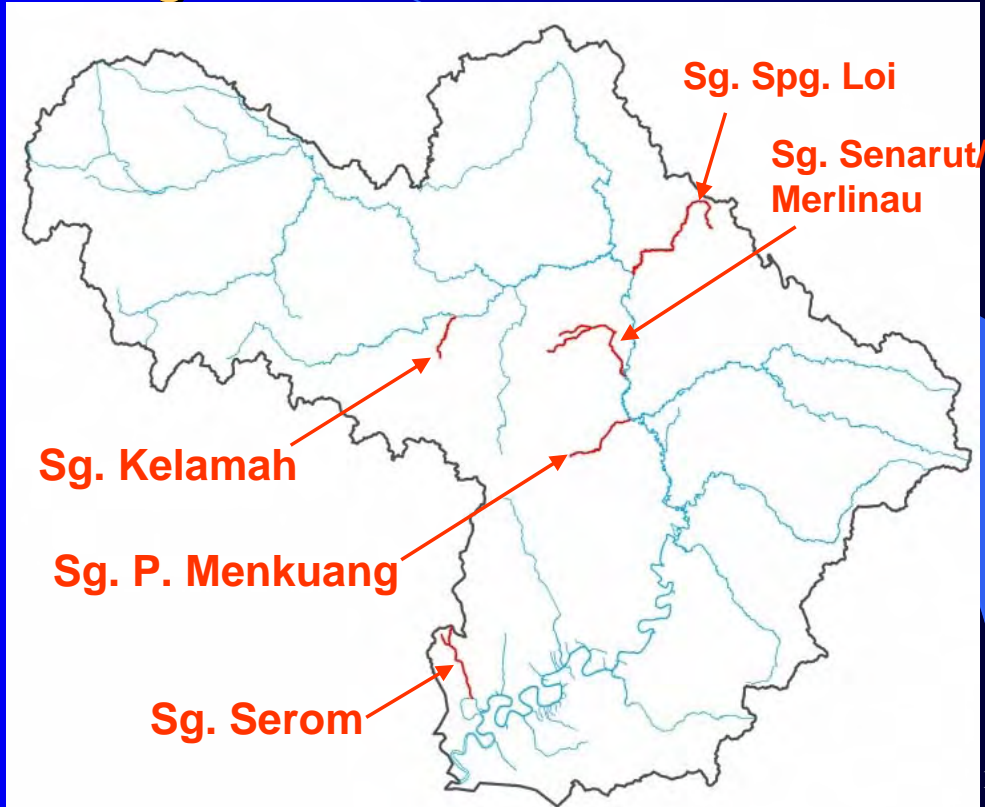
Issues	Related Issues
Insufficient coordination among relevant institutions	<ul style="list-style-type: none"> •Insufficient coordination framework for river basin management •No national policy for IRBM •No integrated water law
Insufficient river management	<ul style="list-style-type: none"> •Jurisdiction for river administration is not properly allocated •Administrative control is not suitably conducted
Insufficient river information management	<ul style="list-style-type: none"> •No integrated river information system

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IRBM Issues for Muar River Basin (Water Utilization)

- Possibility of reduction of river water in dry season and intrusion of seawater by Climate Change
- Tightness of capacity of water supply against increasing demands
- Insufficient consideration of environmental flow
- No alternative water sources to river flow
- Restructuring of water service industry is delayed.
- High Non Revenue Water (Johor:31%, N Sembilan:53%)
- Poor canal maintenance (Irrigation)
- Obstacles against safe navigation (Garbage)

IRBM Issues for Muar River Basin (Possible Agrochemical Pollution Rivers)



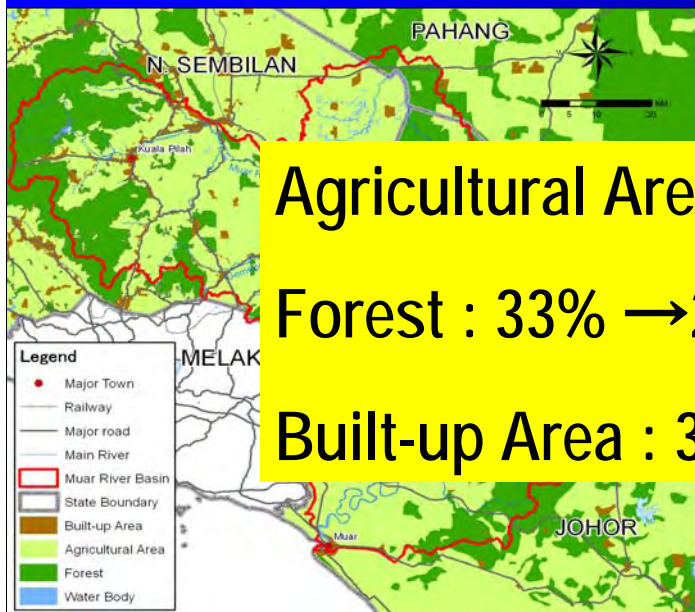
IRBM Issues for Muar River Basin (Wet Market)



Pasar Labis



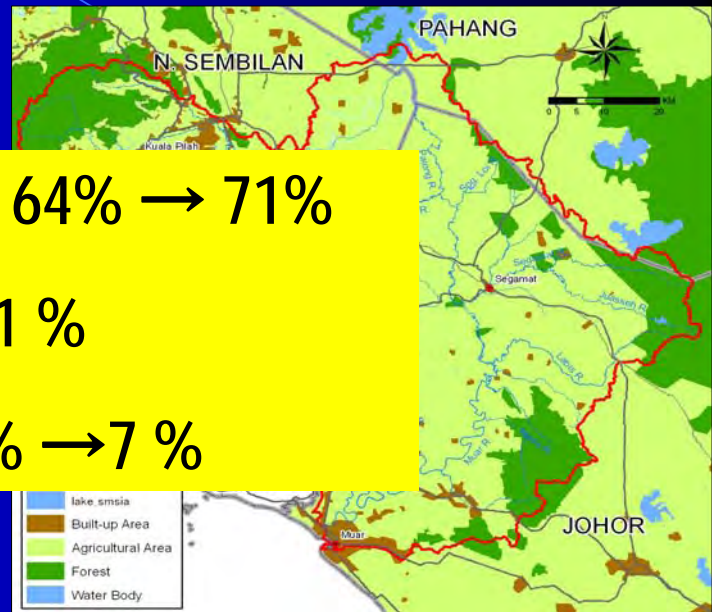
IRBM Issues of Muar River Basin (Increase of Soil Erosion by Land Use Change)



Agricultural Area 64% → 71%

Forest : 33% → 21 %

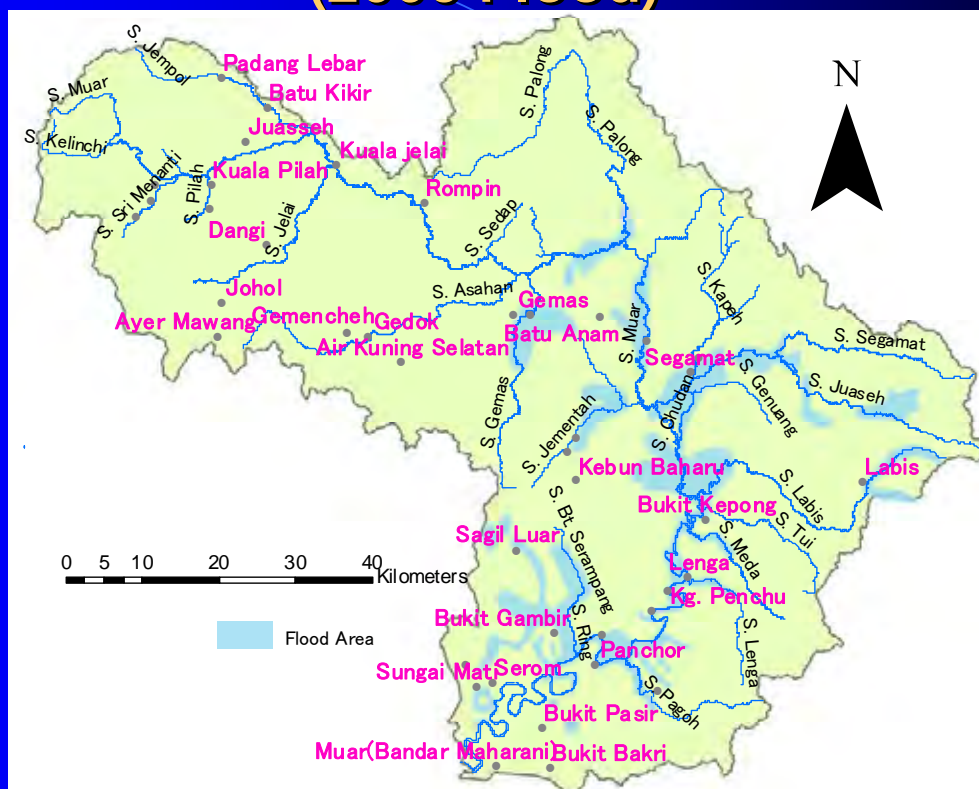
Built-up Area : 3% → 7 %



Present Land (2000)

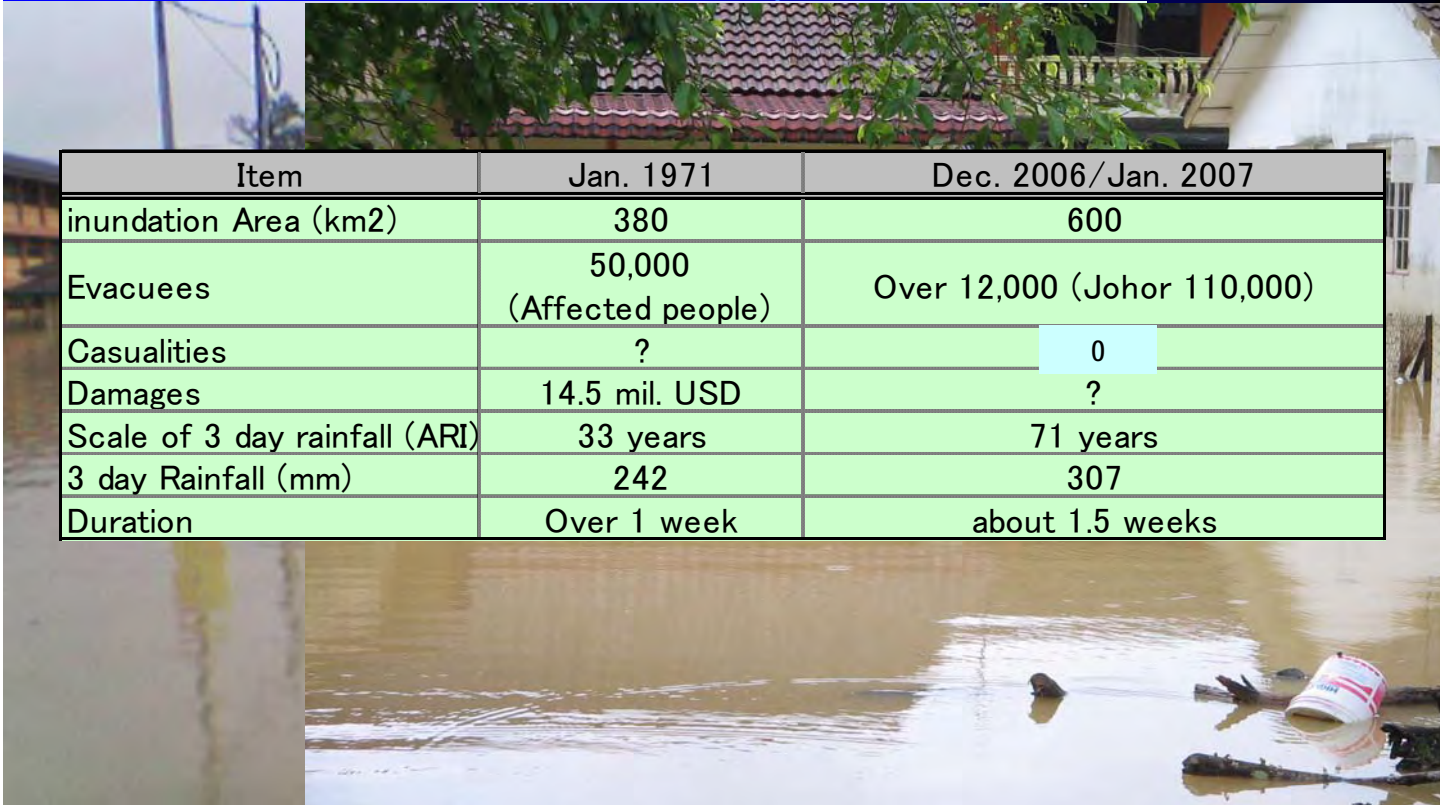
Land use in 2020

IRBM Issues for Muar River Basin (2006 Flood)



IRBM Issues for Muar River Basin (Flood)

Item	Jan. 1971	Dec. 2006/Jan. 2007
Inundation Area (km ²)	380	600
Evacuees	50,000 (Affected people)	Over 12,000 (Johor 110,000)
Casualties	?	0
Damages	14.5 mil. USD	?
Scale of 3 day rainfall (ARI)	33 years	71 years
3 day Rainfall (mm)	242	307
Duration	Over 1 week	about 1.5 weeks



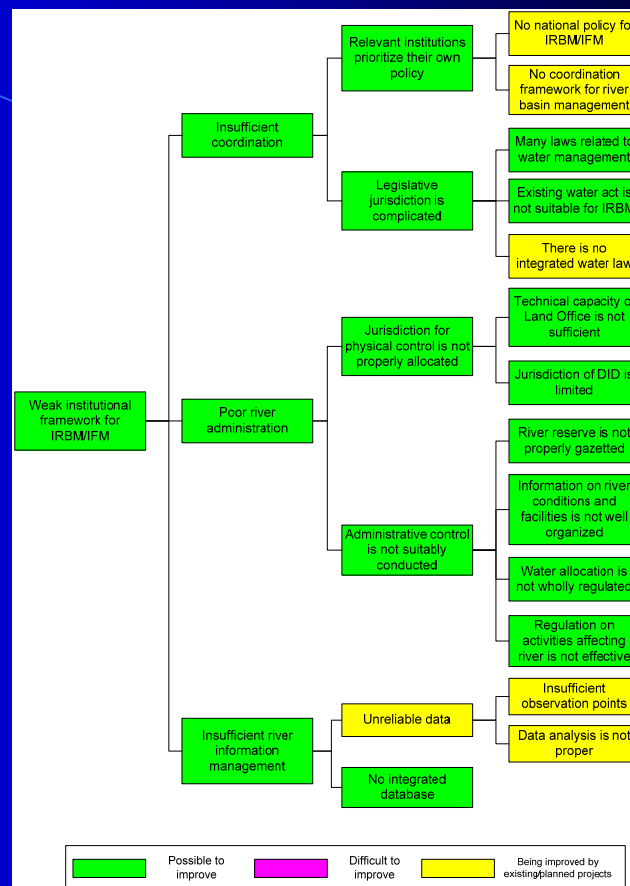
IRBM Issues for Muar River Basin (Bank failure at Panchor)



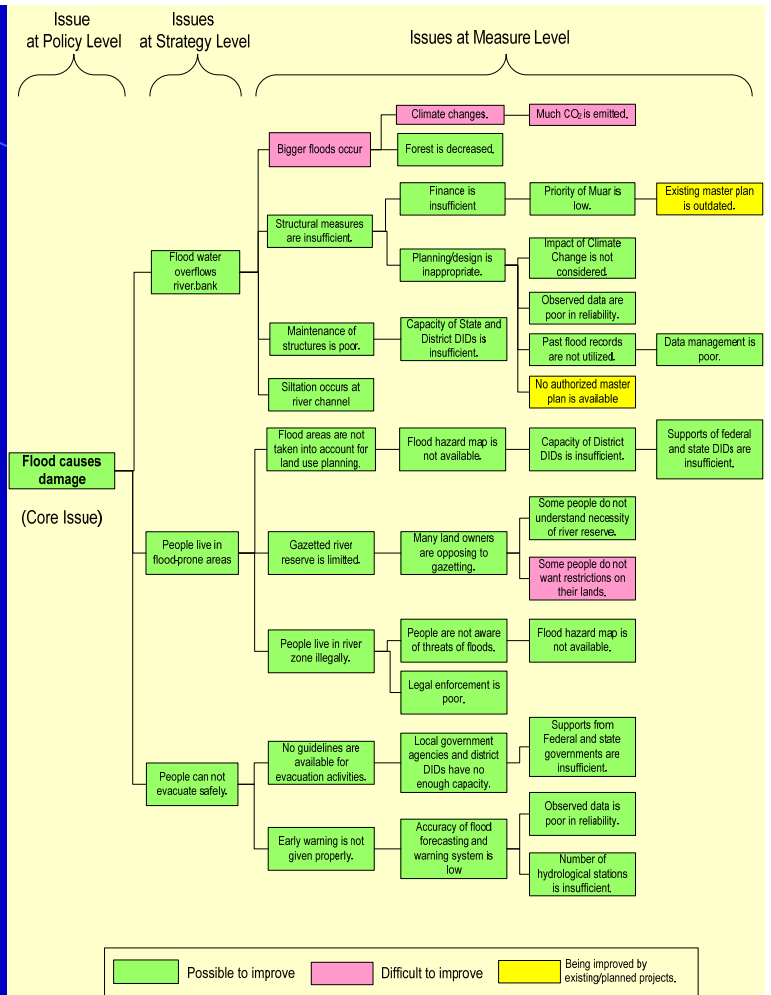
Identified Four Core Issues

1. Institutional Framework for IRBM is weak.
2. Water utilization will be insufficient.
3. Water quality is deteriorated.
4. Flood causes damage.

Problem Analysis (Institutional Setup)



Problem Analysis (Flood Issue)



National Policies

10th Malaysia Plan

Policy	Strategies	Measures
Provide efficient public utilities and services (Public Utilities)	Manage water endowment and supply.	Develop a long term strategy
		Restructure the water service industry
		Protect rivers from pollution
	Restructure Solid waste management	Relive Local Authorities
		Manage concessionaires
		Promote 3Rs
Value the nation's environmental endowment (Environment)	Develop a climate resilient growth strategy	Protect the nation from climate change.
		Reduce Carbon Footprint
	Enhance conservation of ecological assets	Enhance conservation efforts
		Ensure sustainable and safe utilization

RM 5 billion for Flood Mitigation

Nation Physical Plan (NPP 2020)

Number	Policies
NPP 18	Environmentally Sensitive Areas (ESA) shall be integrated in the planning and management of land use and natural resources to ensure sustainable development.
NPP 19	A Central Forest Spine (CFS) shall be established to form the backbone of the Environmentally Sensitive Area network.
NPP 21	Land development in the highlands shall be strictly controlled to safeguard human safety and environmental quality.
NPP 22	All surface and ground water resources are strategic assets to be safeguarded and used optimally.
NPP 30	The supply and projected demand for water by quantity and location should guide the planning of water resource areas.
NPP 31	Ground water resources and recharge areas shall be identified and protected from activities that cause pollution and reduce yield.
NPP 32	All urban settlements shall be serviced by a centralised sewerage treatment system.
NPP 33	All urban settlements shall be serviced by an integrated network of solid waste disposal and/or recovery facilities.
NPP 34	Land utilised for main drains, streams and rivers shall be designated as drainage or river reserves.

State Policies

N. State Structural Plan 2020

Sector	Policies
Land use	Regulate and protect main agricultural areas.
	Development of urban settlements are concentrated in strategic growth nodes.
Environment	State government will practice sustainable development with attention to the environmental protection and natural resources conservation.
Agriculture	Increase production of high quality foods in environmentally friendly manner.
Forestry	Preserve permanent reserve forest areas for production revenue; protect diversified forests, water and land; improve research and education; and make forests as economic resources and human well-being.
Infrastructure and utilities	Provide adequate quality of economic and integrated infrastructure and utilities facilities in all districts to accommodate the needs of communities and developments.

Johor State Structural Plan 2020

Sector	Policies
Land use	Direct urbanization development strategy based on scatter strategy focused on conurbation urban, main growth center and corridor development
Infrastructure and utilities	The state government, local authorities and agencies should be responsible to ensure the provision infrastructure and utilities that are available and complete for the current and future needs.
Environment	Plan, control and monitor land use activities comprehensively to minimize negative effects on the environment.

Proposed Policies

No.	Core Issues	Proposed Policies
1	Weak institutional framework	Strengthen Institutional Setup
2	Insufficient Water Utilization	Ensure Sustainable Water Utilization
3	Deterioration of water Quality	Create a Sustainable and Pleasant River Environment
4	Flood damage.	Build a Resilient Society to Floods

Proposed IRBM Policies, Strategies and Measures (Muar 1/2)

Policies	Strategies	Measures
Strengthen Institutional Setup	I-1 Establish Coordination Framework	I-1.1: Enhance RBC (River Basin Committee)
		I-1.2: Formulate National Water Policy & Nation Water Resources Law
	I-2 Implement Proper River Management	I-2.1: Authorize River Management Agency
		I-2.2: Determinate River Management Area
I-3 Integrate River Basin Information	I-3.1: Establish Integrated Information System for River Basin Management	
Ensure sustainable water utilization	W-1: Ensure sufficient water resources	W-1.1: Monitor impact of Climate Change
		W-1.2: Review water resources development plan
		W-1.3: Incorporate environmental flow with water resources development plan
		W-1.4: Establish response and coordination mechanism to droughts
		W-1.5: Explore alternative water resources
	W-2: Ensure sustainable water services industry	W-2.1: Complete restructuring of water services industry
		W-2.2 Reduce Non Revenue Water (NRW)
	W-3: Ensure sufficient irrigation water	W-3.1 Manage irrigation facilities properly
W-4: Ensure safe navigation	W-4.1 Manage river course properly	

Proposed IRBM Policies, Strategies and Measures (Muar 2/2)

Policies	Strategies	Measures
Create a sustainable and pleasant river environment	E-1: Reduce pollution load to ensure achievement of at least NWQS Class II water quality.	E-1.1 Reduce wastewater discharge
		E-1.2: Implement integrated waste management by reducing waste as source, increasing recycling rate and ensuring efficient and clean disposal.
		E-1.4: Minimize runoff of agrochemicals into rivers.
		E-2.1: Control large scale agricultural development
	E-1.2: Implement integrated waste management by reducing waste as source, increasing recycling rate and ensuring efficient and clean disposal.	E-2.2: Control logging activities
		E-2.3: Proper planning and management of Environmental Sensitive Areas.
	E-1.3: Minimize siltation of river by reducing erosion at source and controlling runoff of eroded soil particles into rivers.	E-3.1: Proper management of all catchment areas for water intake.
		E-4.1 Integrate rivers into the townscape and recreational facilities.
E-1.4: Minimize runoff of agrochemicals into rivers.	E-1.4: Minimize runoff of agrochemicals into rivers.	
Build a resilient society to floods	F-1: Manage flood water	F-1.1: Implement appropriate structural measures
		F-1.2: Upgrade data management procedures
		F-1.3: Monitor and review impacts of climate change
		F-1.4: Conserve forests
	F-2: Create flood-flexible land use	F-2.1: Prepare flood hazard maps
		F-2.2: Promote gazettement of river reserve
F-3: Ensure safe evacuation	F-3.1: Upgrade flood forecasting and warning system	
	F-3.2: Prepare community-based flood management plan	

Proposed Roadmap for IRBM (Muar)

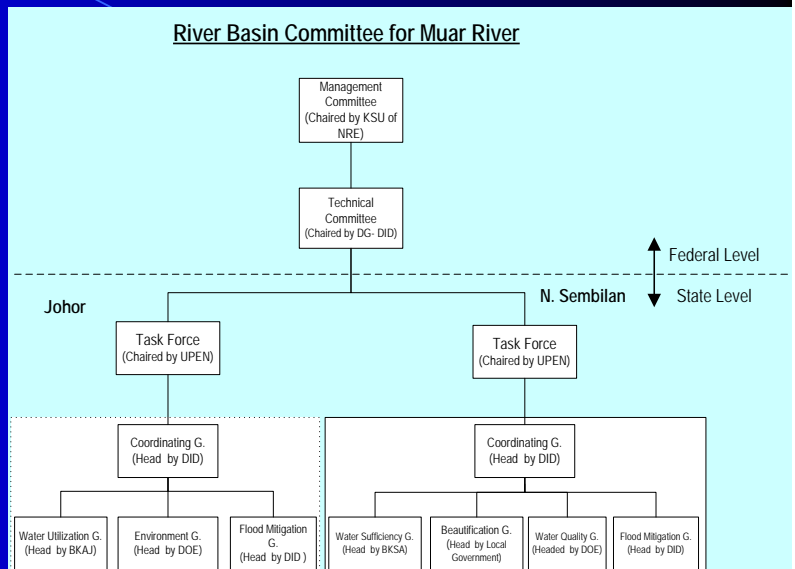
Sector	Project/Action	Main Agencies	Cost (RM million)	Schedule		
				10 th MP	11 th MP	12 th MP
				2015	2020	2025
Institution Setup	I-1.1: Enhancement of River Basin Committee (RBC)	RBC		●		
	I-2.1.1: Establishment of Federal and State Water Resources Department (WRD)	NRE			●	
	I-2.1.2: Establishment of River Basin Management Office (RBMO)	NRE				●
	I-3.2: Establishment of integrated information system	DID, MaCGDI		●●●●		
	I-2.2: Determination of river management area (River Reserve)	DID, Land Office		●●●●●●●●	●●●●●●●●	●●●●●●●●
	Review and Updating of IRBM plan	RBC		●	●	●
Water Utilization	W-1.1.1: Monitoring of impact of climate change	BKSA, BAKAJ		●	●	●
	W-1.3.1: Study on environmental flow	BKSA, BAKAJ, DID, DOE	1-2	●●		
	W-1.4.1: Study on groundwater potential	BKSA, BAKAJ, JMG	3-4	●●		
	W-2.2.1: Reduction of Non-revenue Water (NRW)	SAJH, SAINS, SPAN, PAAB		●●●●●●●●	●●●●●●●●	●●●●●●●●
Environment Management	E-1.1.1: Capacity development for establishment of a mechanism for developing and maintaining pollution load inventory	DOE	2-4	●●		
	E-1.1.2: Study on drinking water treatment sludge	Water Services Dept.	2-4	●●		
	E-1.1.3: Feasibility study and pilot project for wastewater treatment system for wet-markets	Dept. of local government	1-2	●●		
	E-1.4.1: Monitoring of agrochemicals	DOE		●●●●●●●●	●●●●●●●●	●●●●●●●●
Flood Management	Implementation of structural measures of IFM plan	DID	530	●●●●●●●●	●●●●●●●●	●●●●●●●●
	Implementation of non-structural measures of IFM plan	DID and others	17	●●●●●●●●	●●●●●●●●	●●●●●●●●

Proposed Projects/Actions for Istitutional Setup (1/4)

1. Establishment of Coordination Body (Enhancement of River Basin Committee)

Carried out by : RBC
 Duration : 1 years
 Main scope :

- Existing River Basin Committee (RBC) shall be enhanced in consideration of additional participation of other agencies, such as National Security Council (flood & drought), Dept. of Wildlife & National Parks (biodiversity protection), MMD (meteorology) for IFM & IRBM



Proposed Projects/Actions for Istitutional Setup (2/4)

Main tasks of each Committee in RBC:

1) Management Committee:

- to act as a discussion platform on the implementation of IFM and IRBM in Pahang river basin
- to approve IFM and IRBM plan
- to coordinate and approve relevant policies on river basin management, water allocation, flood mitigation measures, river reserve, river environmental management

2) Technical Committee:

- to accelerate the implementation of IFM and IRBM

3) Tasks Forces:

- to act as technical secretariat to arrange and coordinate working groups

Proposed Projects/Actions for Istitutional Setup (3/4)

Creation of Water Resources Department

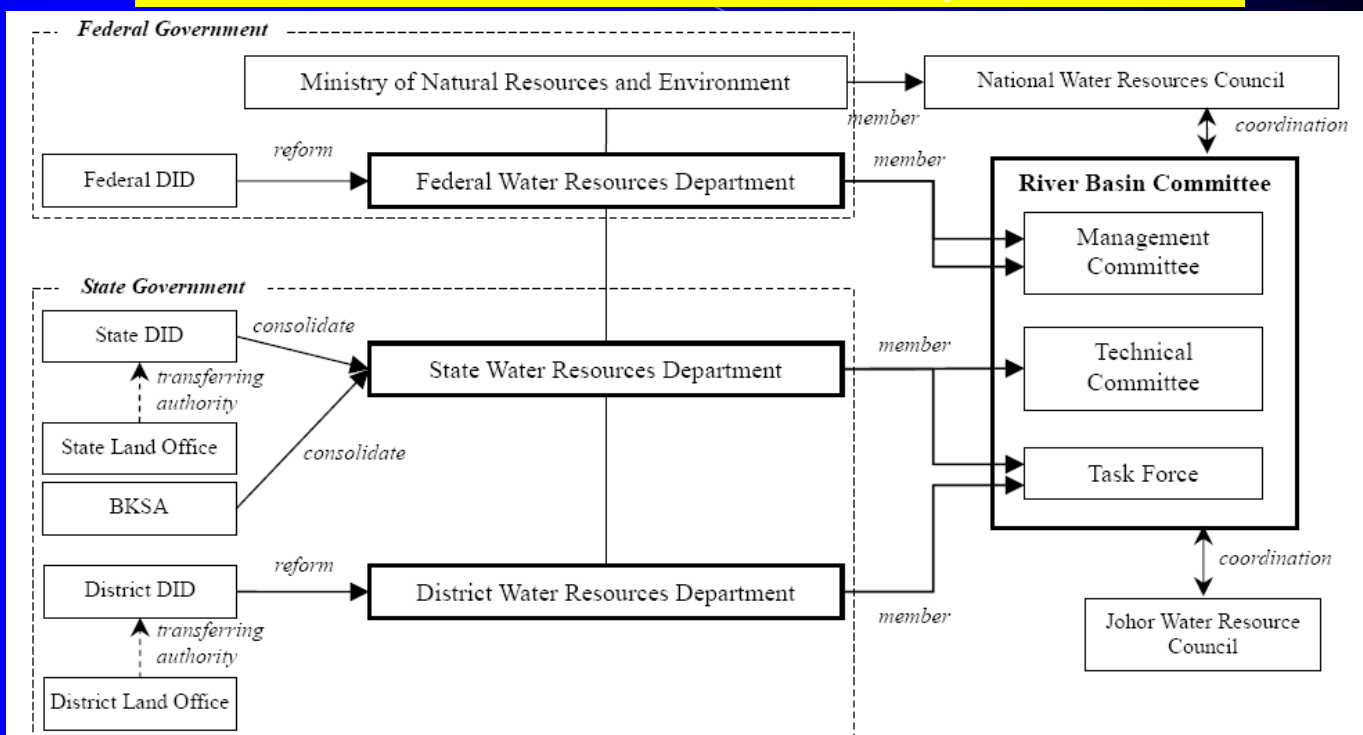


Figure 5.5.2

Proposed Framework of Water Resources Department

Proposed Projects/Actions for Institutional Setup (4/4)

Creation of River Basin Management Office

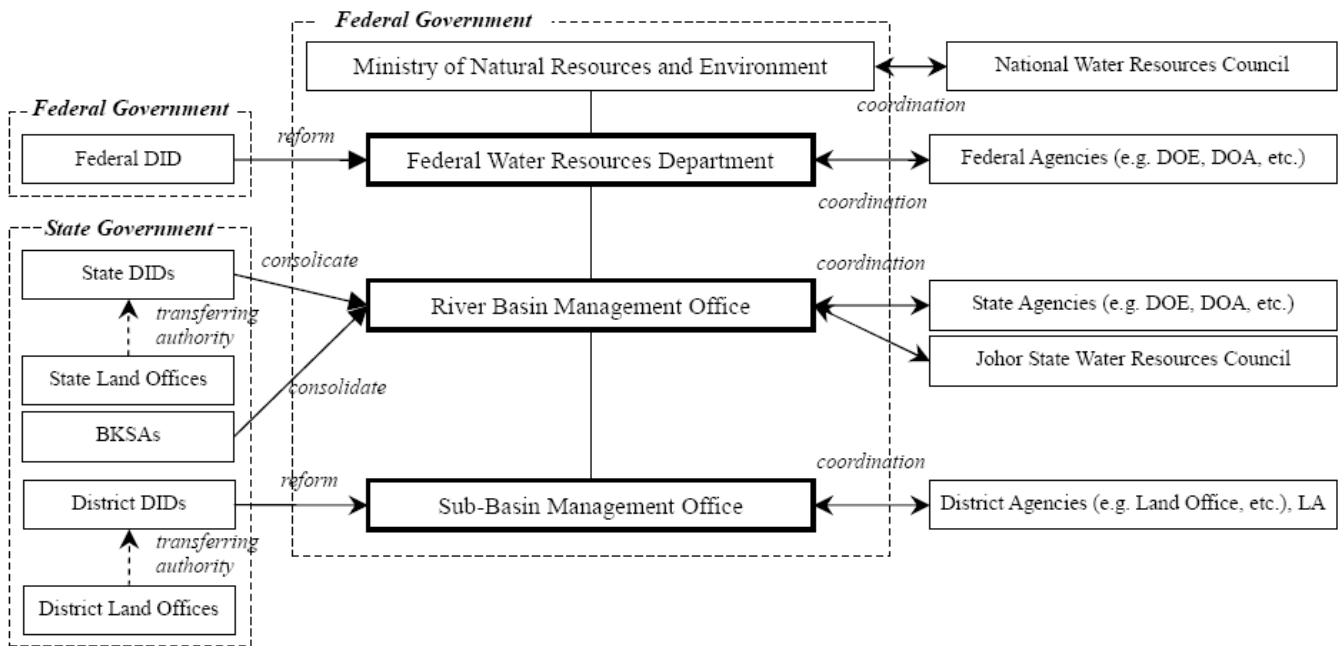
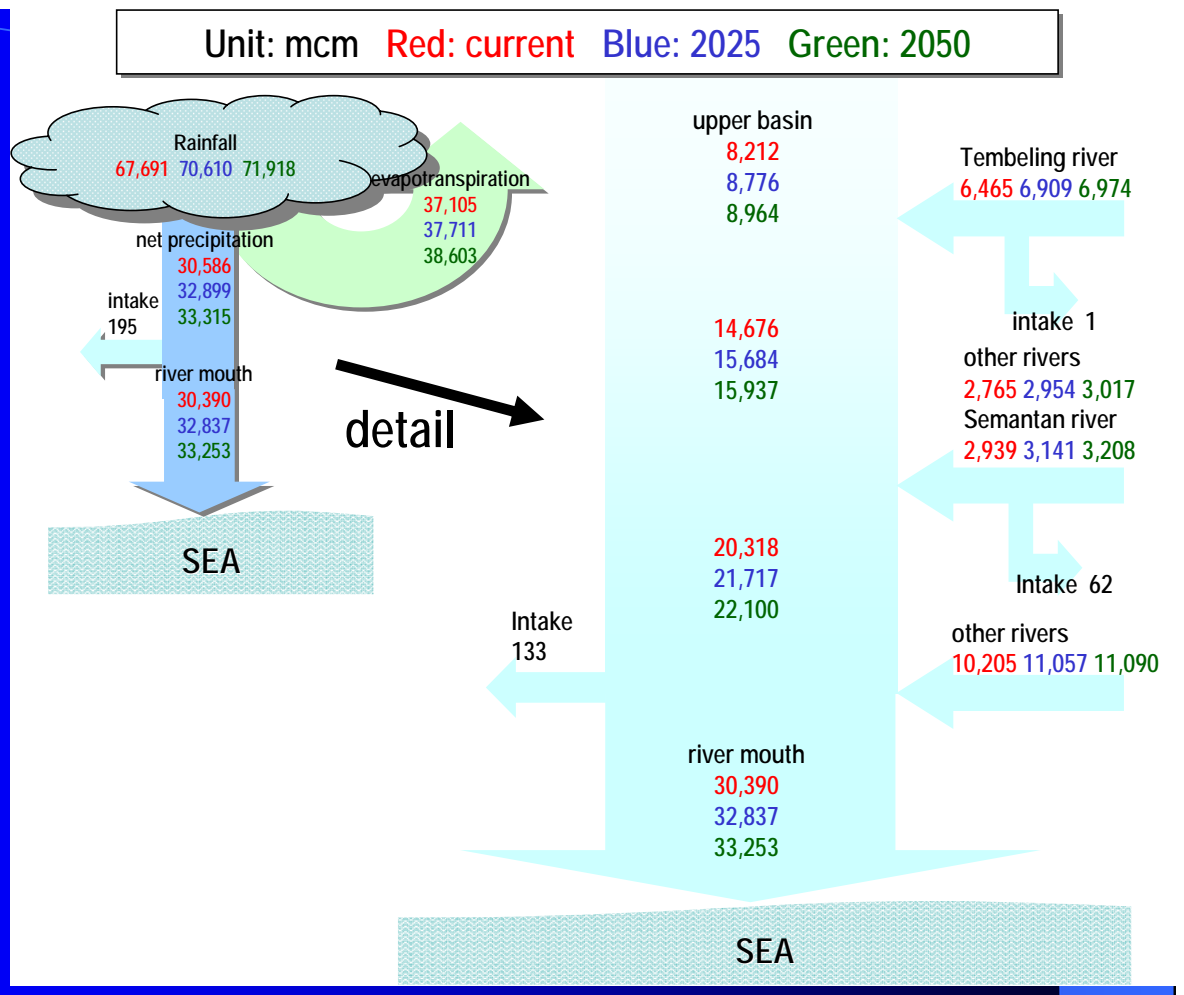


Figure 5.5.3 Proposed Framework of River Basin Management Office

Preparation of IRBM Plan for Pahang River Basin

Abundant River Water of Pahang River Basin (Annual Water Balance)



IRBM Issues for Pahang River Basin (Institution)

Issues	Related Issues
Insufficient coordination among relevant institutions	<ul style="list-style-type: none"> No coordination framework for river basin management No national policy for IRBM No integrated water law
Poor river administration	<ul style="list-style-type: none"> Jurisdiction for river administration is not properly allocated Administrative control is not suitably conducted
Insufficient river information management	<ul style="list-style-type: none"> No integrated river information system

IRBM Issues for Pahang River Basin (Water Utilization)

- Possibility of reduction of river water in dry season and intrusion of seawater by Climate Change
- Tightness of capacity of water supply against increasing demands
- Insufficient consideration of environmental flow
- No alternative water sources to river flow
- Restructuring of water service industry is delayed.
- High Non Revenue Water (Pahang:53%, N Sembilan:53%)
- Poor canal maintenance (Irrigation)

IRBM Issues for Pahang River Basin (Possible Agrochemical Pollution Sites)



IRBM Issues for Pahang River Basin (Wet Market)



Mentakab Market has no wastewater treatment plant.

45

IRBM Issues for Pahang River Basin (Degradation of Natural Environment and water quality at Tasik Chini)

Pahang wants to revive Tasik Chini

By SIMON KHOO

KUANTAN: The Pahang Government is seeking help from the Federal Government to revive Tasik Chini which is dying a slow death.

The state government also wants additional allocation to repair and maintain the lake, in addition to having permanent staff to monitor the development of the lake.

State Health, Local Government and Environment Committee chairman Datuk Hoh Khai Mui said that besides getting the funds, there must be closer co-operation and co-ordination with other agencies such as the Land and Mines Office, Forestry, Drainage and Irrigation and Orang Asli Affairs Departments and Felda to check activities detrimental to the area.

Tasik Chini, the country's second largest freshwater lake, used to attract scores of visitors during its lotus blooming season every year but it is dying due to a number of factors including illegal mining, logging and pollution which had adversely affected the entire eco-system.

Hoh said many key proposals outlined in a recent study conducted by a team of experts from Universiti Kebangsaan Malaysia (UKM) would be given careful consideration.

He said the state government was serious and would like to make the lake a major tourist attraction in Pahang again.

"The UKM report suggested that we seek an initial allocation of RM4mil from the Federal Government to carry out rehabilitation efforts.

"We had given our consent to the proposal during a recent state executive councillors meeting and hope to receive a favourable response," he said in an interview.

The state government, he said, would also seek additional allocations in the form of an annual grant of some RM1mil for repairs and other maintenance work in addition to the placement of permanent staff.

"I was informed that there was some illegal mining going on near the lake which may affect the eco-system.

"The relevant authorities must monitor the situation and take stern action against the culprits," he said, adding that strict enforcement had overcome the problem of illegal logging.



Slow death: Destructive weeds have overtaken the growth of lotus flowers in Tasik Chini.



The lake has now turned murky.

IRBM Issues for Pahang River Basin (Flood Records)

Item	Jan. 1971	Nov. 1988	Dec 2007
inundation Area (km2)	3,500	Not Available	484
Evacuees	150,000 (Affected People)	17,700	25,400
Casualties	?	-	8
Damages	38 mil. USD	RM 7 million	263 mil RM
Scale	Over 100 year	9 years	27 year
8 Days Rainfall (mm)	490	270	320
Duration	1 to 3 weeks	8 days	1 to 3 weeks

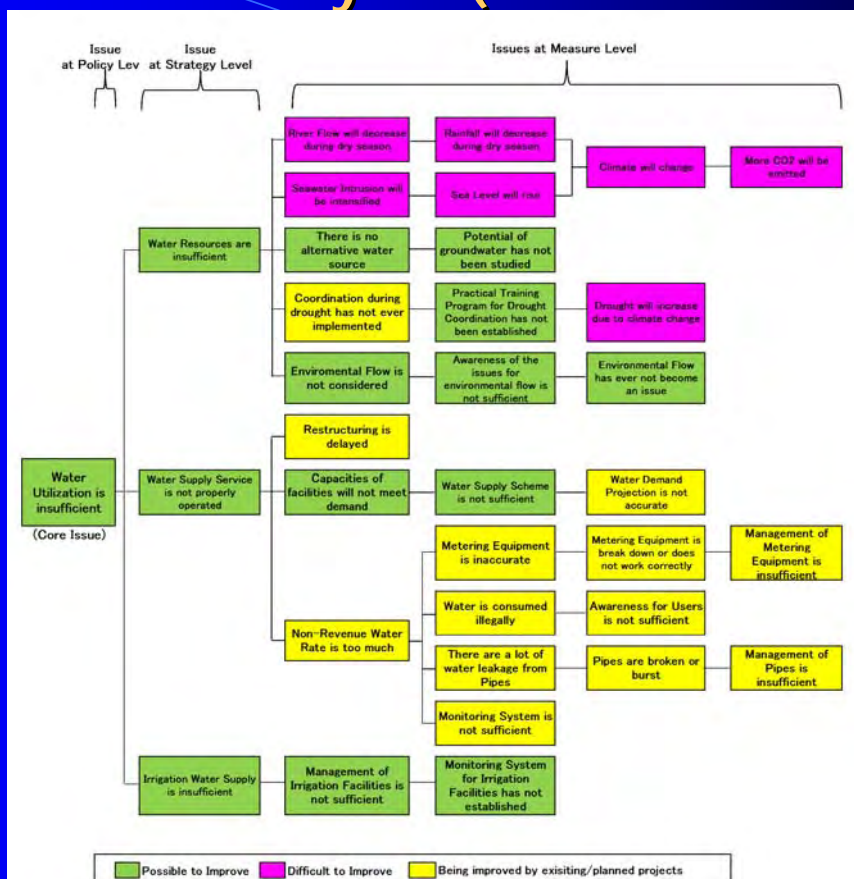
Identified Four Core Issues

1. Institutional Framework for IRBM is weak.
2. Water utilization will be insufficient.
3. Water quality is deteriorated.
4. Flood causes damage.

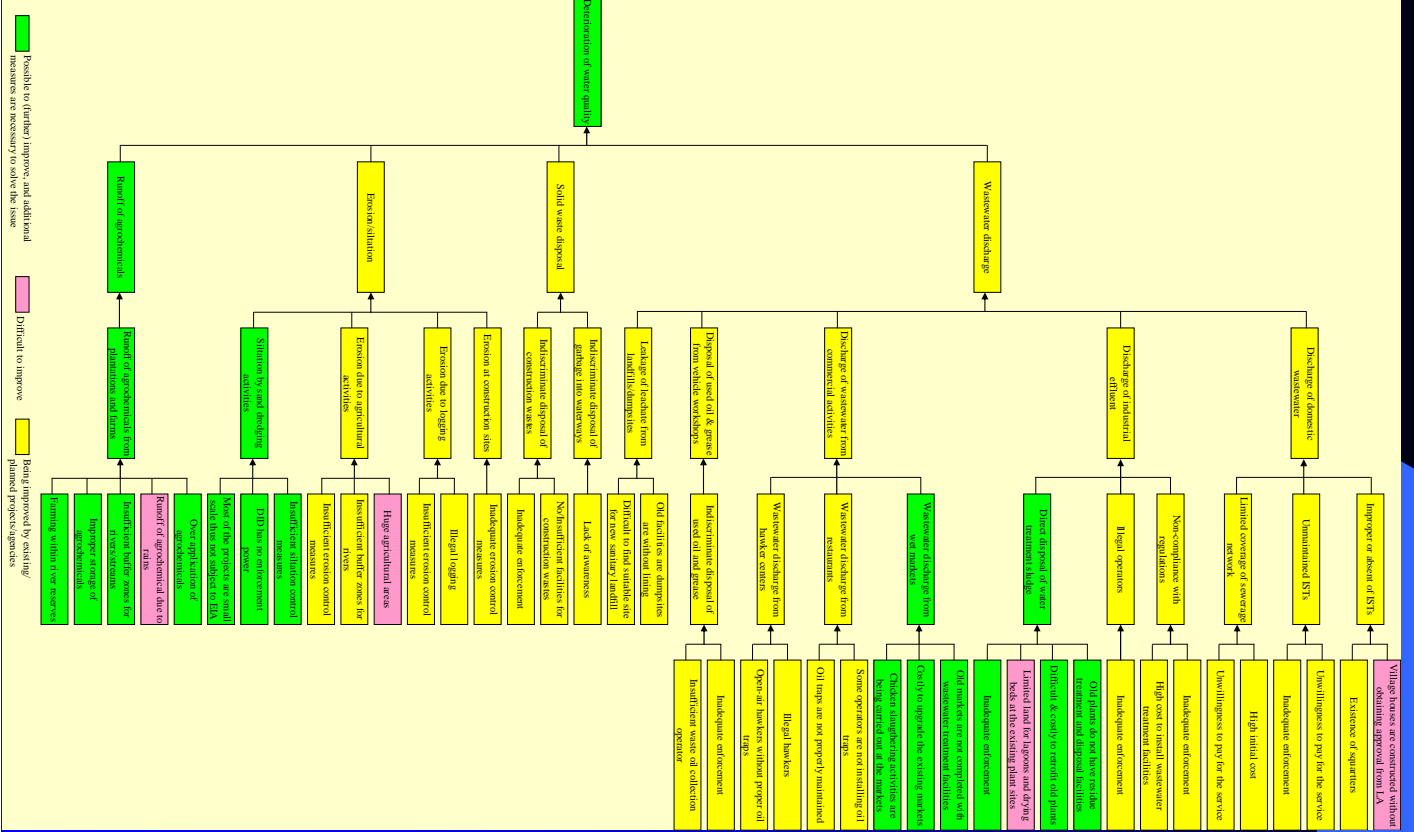
Problem Analysis (Institutional Setup)



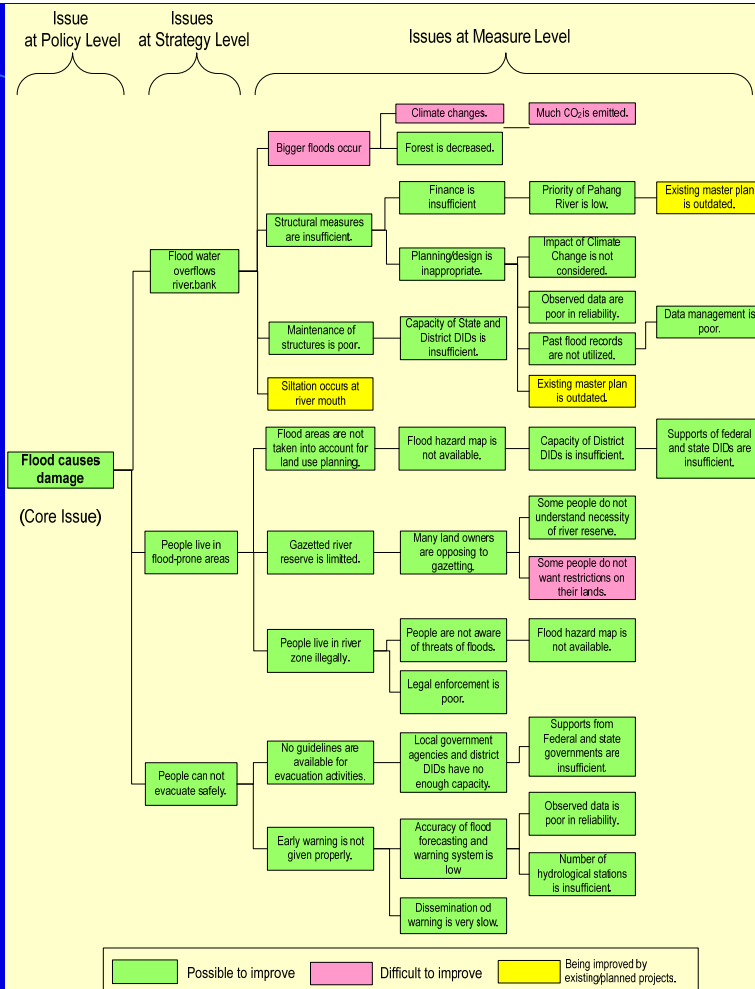
Problem Analysis (Water Utilization)



Problem Analysis (Environment)



Problem Analysis (Flood Issue)



State Policies

Pahang State Structural Plan 2020

Sector	Policies
Development Location Policy	Agricultural development is pursuant to state agricultural development plan.
	Industrial development will be concentrated in Kuantan and Temerloh-Mentakab.
Environment	Environmental quality will be further improved.
	All regions of permanent forest reserve areas and water catchment areas are managed in a sustainable manner.
Infrastructure and utilities	Increase distribution of water supply, electricity, gas and telecommunication in urban and rural areas.
	Centralized sewerage system will be available in high density domestic area, commercial areas, industrial areas and tourism
	Provision of structural measures, flood control system and application of MASMA in any development to reduce risks of floods.

N. State Structural Plan 2020

Sector	Policies
Land use	Regulate and protect main agricultural areas.
	Development of urban settlements are concentrated in strategic growth nodes.
Environment	State government will practice sustainable development with attention to the environmental protection and natural resources conservation.
Agriculture	Increase production of high quality foods in environmentally friendly manner.
Forestry	Preserve permanent reserve forest areas for production revenue; protect diversified forests, water and land; improve research and education; and make forests as economic resources and human well-being.
Infrastructure and utilities	Provide adequate quality of economic and integrated infrastructure and utilities facilities in all districts to accommodate the needs of communities and developments.

Proposed IRBM Policies, Strategies and Measures (Pahang 1/2)

Policies	Strategies	Measures
Strengthen Institutional Setup	I-1 Establish Coordination Framework	I-1.1: Enhance RBC (River Basin Committee)
		I-1.2: Formulate National Water Policy & Nation Water Resources Law
	I-2 Implement Proper River Management	I-2.1: Authorize River Management Agency
		I-2.2: Determinate River Management Area
I-3 Integrate River Basin Information	I-3.1: Establish Integrated Information System for River Basin Management	
Ensure sustainable water utilization	W-1: Ensure sufficient water resources	W-1.1: Monitor impact of Climate Change
		W-1.2: Review water resources development plan
		W-1.3: Incorporate environmental flow with water resources development plan
		W-1.4: Establish response and coordination mechanism to droughts
		W-1.5: Explore alternative water resources
	W-2: Ensure sustainable water services industry	W-2.1: Complete restructuring of water services industry
		W-2.2 Reduce Non Revenue Water (NRW)
W-3: Ensure sufficient irrigation water	W-3.1 Manage irrigation facilities properly	

Proposed IRBM Policies, Strategies and Measures (Pahang 2/2)

Policies	Strategies	Measures
Create a sustainable and pleasant river environment	E-1: Reduce pollution load to ensure achievement of at least NWQS Class II water quality.	E-1.1 Reduce wastewater discharge
		E-1.2: Implement integrated waste management by reducing waste as source, increasing recycling rate and ensuring efficient and clean disposal.
		E-1.4: Minimize runoff of agrochemicals into rivers.
		E-2.1: Control large scale agricultural development
	E-1.2: Implement integrated waste management by reducing waste as source, increasing recycling rate and ensuring efficient and clean disposal.	E-2.2: Control logging activities
		E-2.3: Proper planning and management of Environmental Sensitive Areas.
		E-3.1: Proper management of all catchment areas for water intake.
	E-1.3: Minimize siltation of river by reducing erosion at source and controlling runoff of eroded soil particles into rivers.	E-4.1 Integrate rivers into the townscape and recreational facilities.
E-1.4: Minimize runoff of agrochemicals into rivers.	E-1.4: Minimize runoff of agrochemicals into rivers.	
Build a resilient society to floods	F-1: Manage flood water	F-1.1: Implement appropriate structural measures
		F-1.2: Upgrade data management procedures
		F-1.3: Monitor and review impacts of climate change
		F-1.4: Conserve forests
	F-2: Create flood-flexible land use	F-2.1: Prepare flood hazard maps
		F-2.2: Promote gazettement of river reserve
	F-3: Ensure safe evacuation	F-3.1: Upgrade flood forecasting and warning system
		F-3.2: Prepare community-based flood management plan

Proposed Roadmap for IRBM (Pahang)

Sector	Project/Action	Agencies	Cost (RM million)	Schedule		
				10 th MP	11 th MP	12 th MP
				2015	2020	2025
Institution Setup	I-1.1: Enhancement of River Basin Committee (RBC)	RBC		●		
	I-2.1.1: Establishment of Federal and State Water Resources Department (WRD)	NRE			●	
	I-2.1.2: Establishment of River Basin Management Office (RBMO)	NRE				●
	I-3.2: Establishment of integrated information system	DID, MaCGDI	●●●			
	I-2.2: Determination of river management area (River Reserve)	DID, Land Office	●●●●●●●●	●●●●●●●●	●●●●●●●●	
	Review and Updating of IRBM plan	RBC		●	●	●
Water Utilization	W-1.1.1: Monitoring of impact of climate change	BKSA		●	●	●
	W-1.3.1: Study on environmental flow	BKSA	1-2	●●		
	W-1.4.1: Study on groundwater potential	BKSA, JMG	3-4	●●		
	W-2.2.1: Reduction of Non-revenue Water (NRW)	JBA, SAINS, SPAN, PAAB		●●●●●●●●	●●●●●●●●	●●●●●●●●
Environment Management	E-1.1.1: Capacity development for establishment of a mechanism for developing and maintaining pollution load inventory	DOE	2-4	●●		
	E-1.1.2: Study on drinking water treatment sludge	Water Services Dept.	2-4	●●		
	E-1.1.3: Feasibility study and pilot project for wastewater treatment system for wet-markets	Dept. of local government	1-2	●●		
	E-1.3.1: Monitoring of sand dredging activities	DID		●●●●●●●●	●●●●●●●●	●●●●●●●●
	E-1.4.1: Monitoring of agrochemicals	DOE		●●●●●●●●	●●●●●●●●	●●●●●●●●
	E-2.3.1: Study on integrated ESA management plan	UPEN	2-4	●●		
Flood Management	Implementation of structural measures of IFM plan	DID	701	●●●●●●●●	●●●●●●●●	●●●●●●●●
	Implementation of non-structural measures of IFM plan	DID and others	39	●●●●●●●●	●●●●●●●●	●●●●●●●●



The Preparatory Survey for Integrated River Basin Management incorporating Integrated Flood Management with Adaptation of Climate Change

Final Report (Part 2)

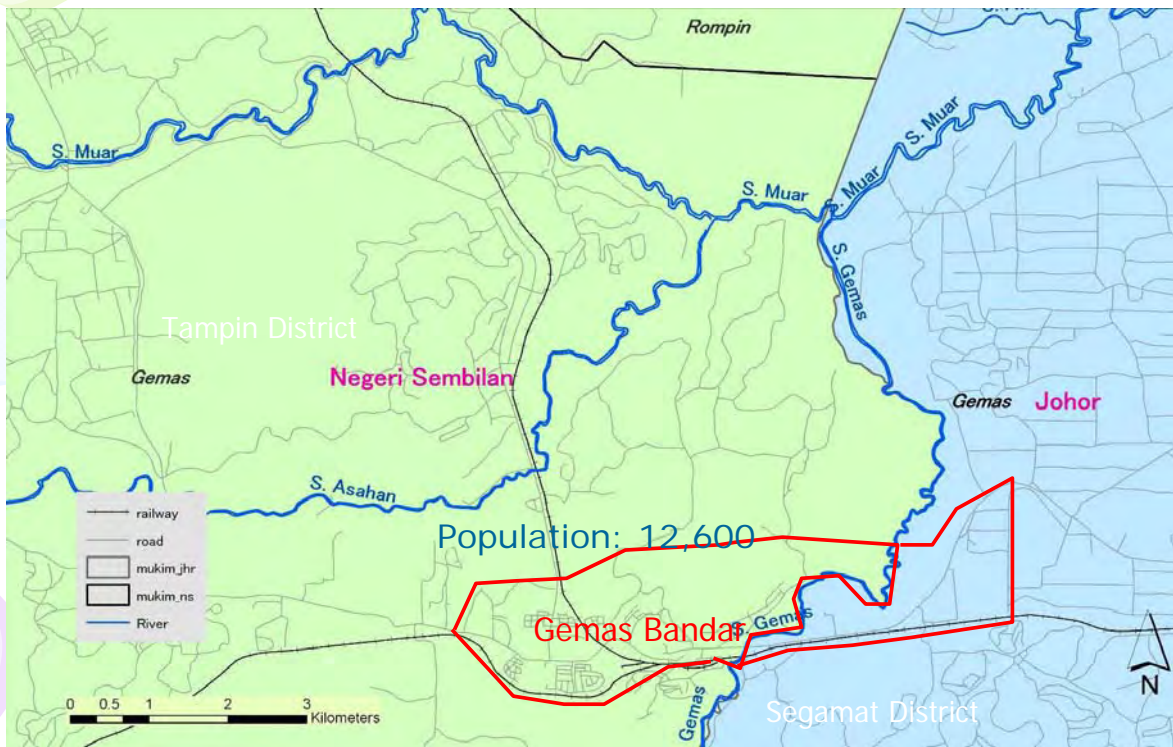


Study Area for F/S

- Muar River Basin : Gemas Town

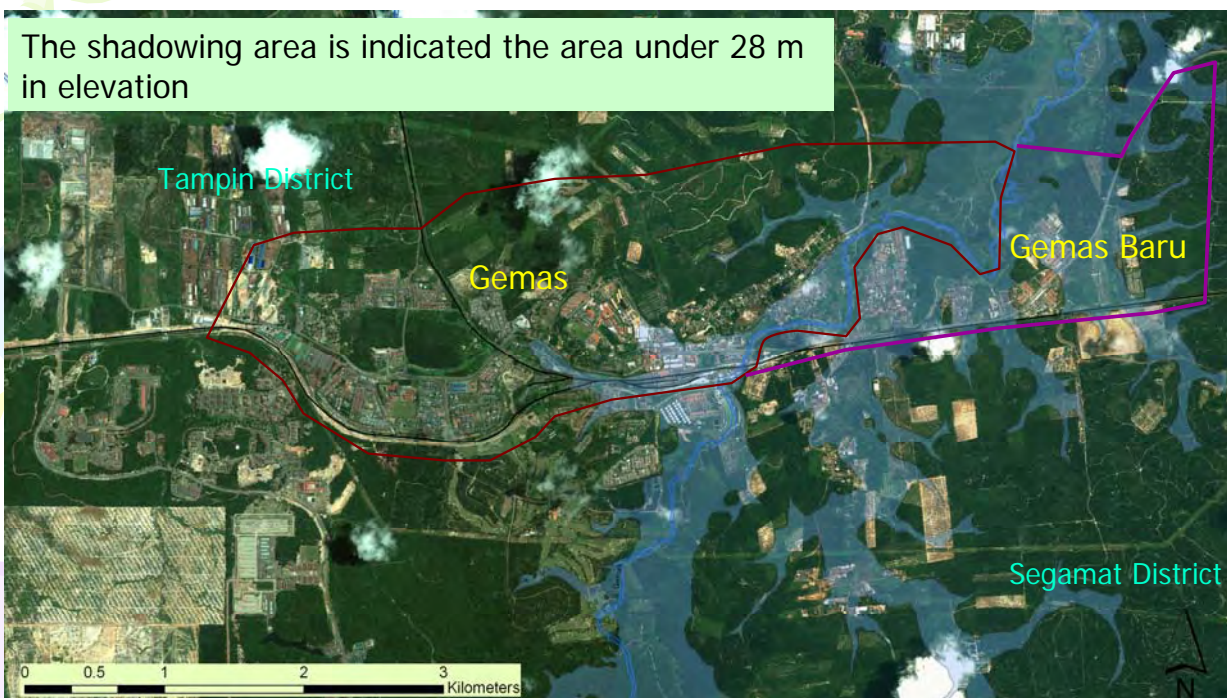


Target Area (Gemmas, Muar)



Target Area (Gemmas)

The shadowing area is indicated the area under 28 m in elevation



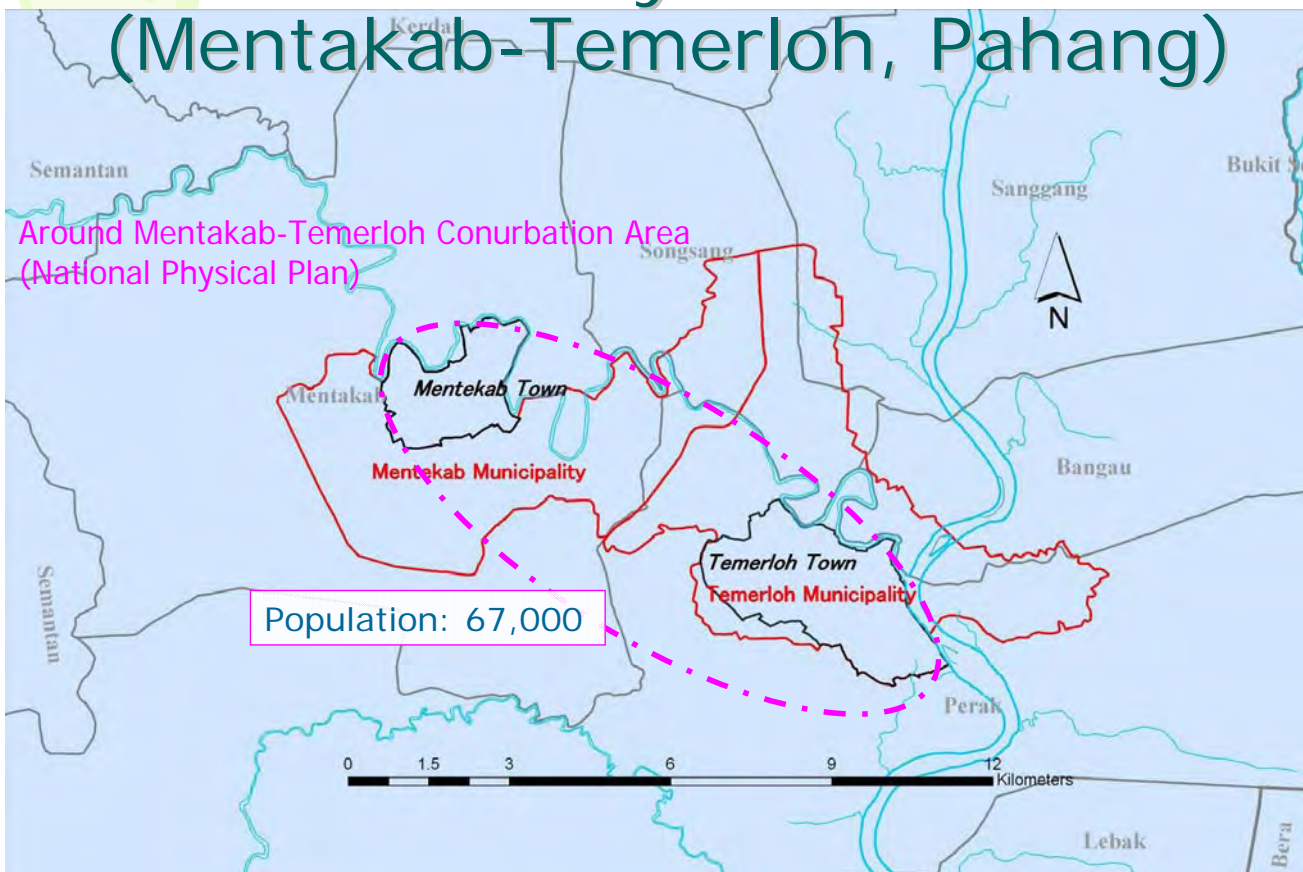
Study Area (Pahang)

- Pahang River Basin: Temerloh and Mentakab Town including its surrounding area



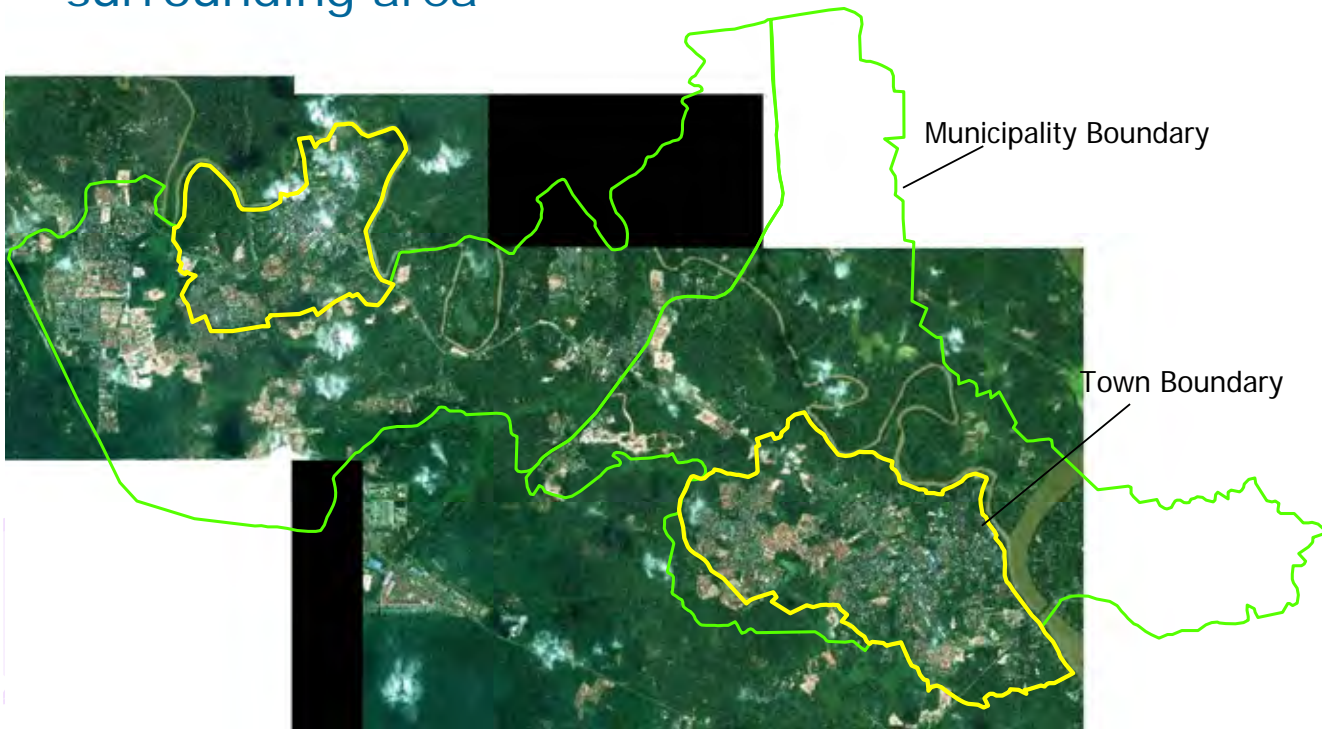
Study Area (Mentakab-Temerloh, Pahang)

Around Mentakab-Temerloh Conurbation Area
(National Physical Plan)



Study Area

- Temerloh & Mentakab Town including its surrounding area



Proposed Component of Projects

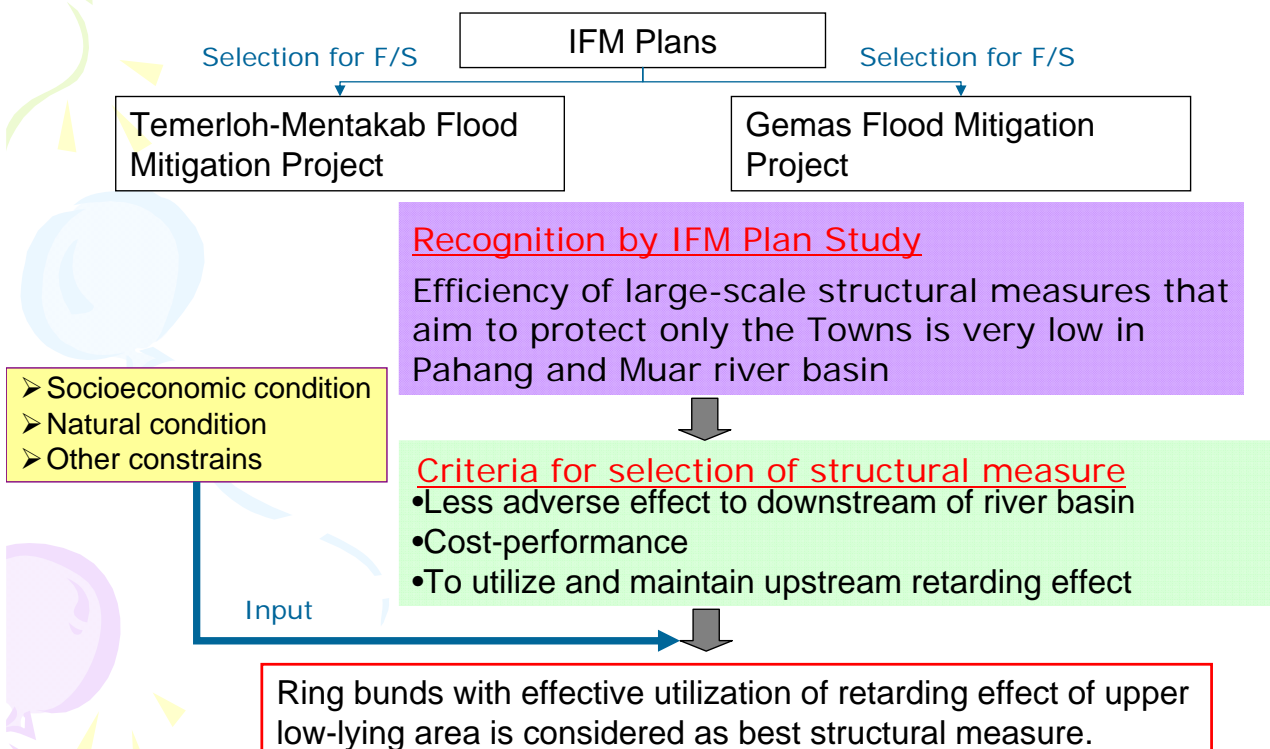
Item	Project Component Components
Structural Measure	The structural measures below was designed and combined to protect the towns with the surrounding area from river overflows and inland floods - Bunds, Shortcut of river, By-pass, Flood wall - Pumping Station, Sluice Gate, Regulation Pond, Retarding Basin and so on
Non-Structural Measure	The measures below will be designed to protect the target area from larger floods than the design scale of structural measures. - Capacity development, - Land use management & control, - Community-based flood management, - Strengthening of flood monitoring system, etc.



Structural Measure



Selection of Measures -in consideration of IFM Plan-



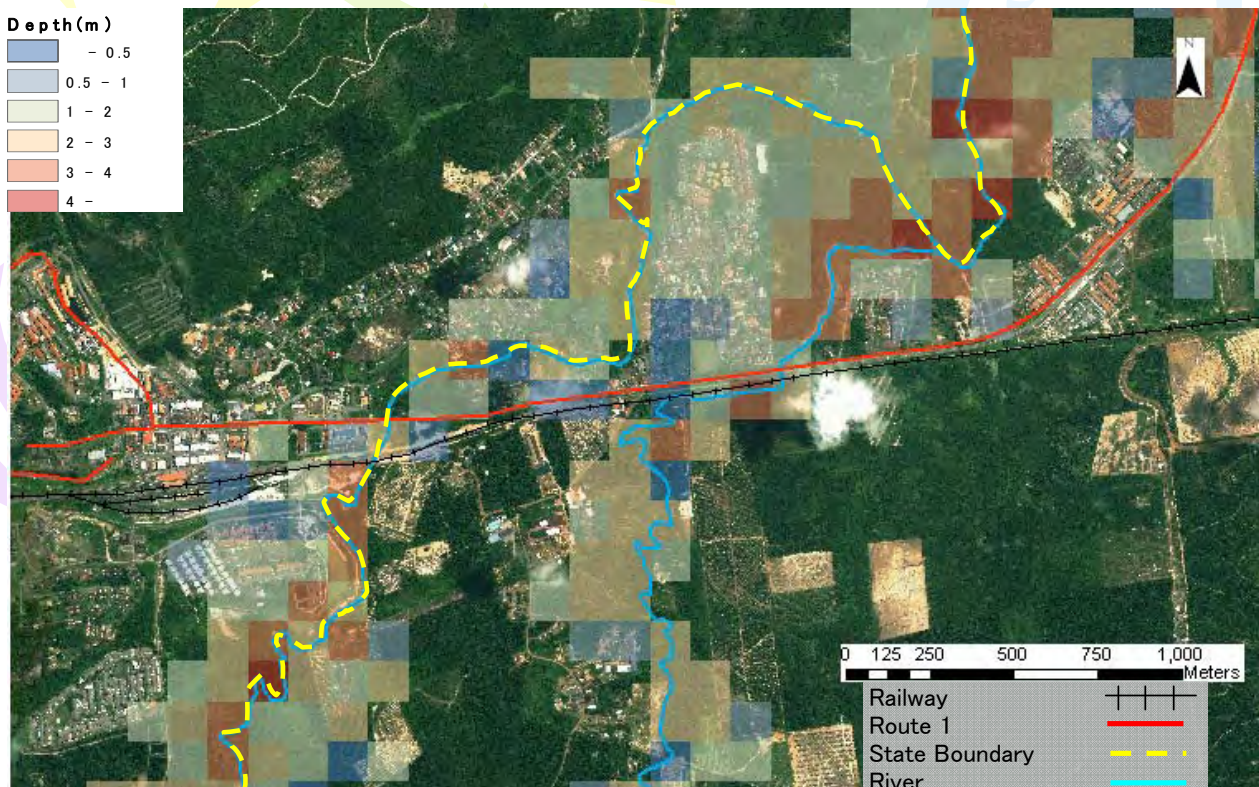
Structural Measure Design Criteria

As a result of discussions with stakeholders and officials concerned and by reference to DID Manuals....

- Design Scale for Bunds: 50 year flood
- Design scale for urban drainage: 10 year flood

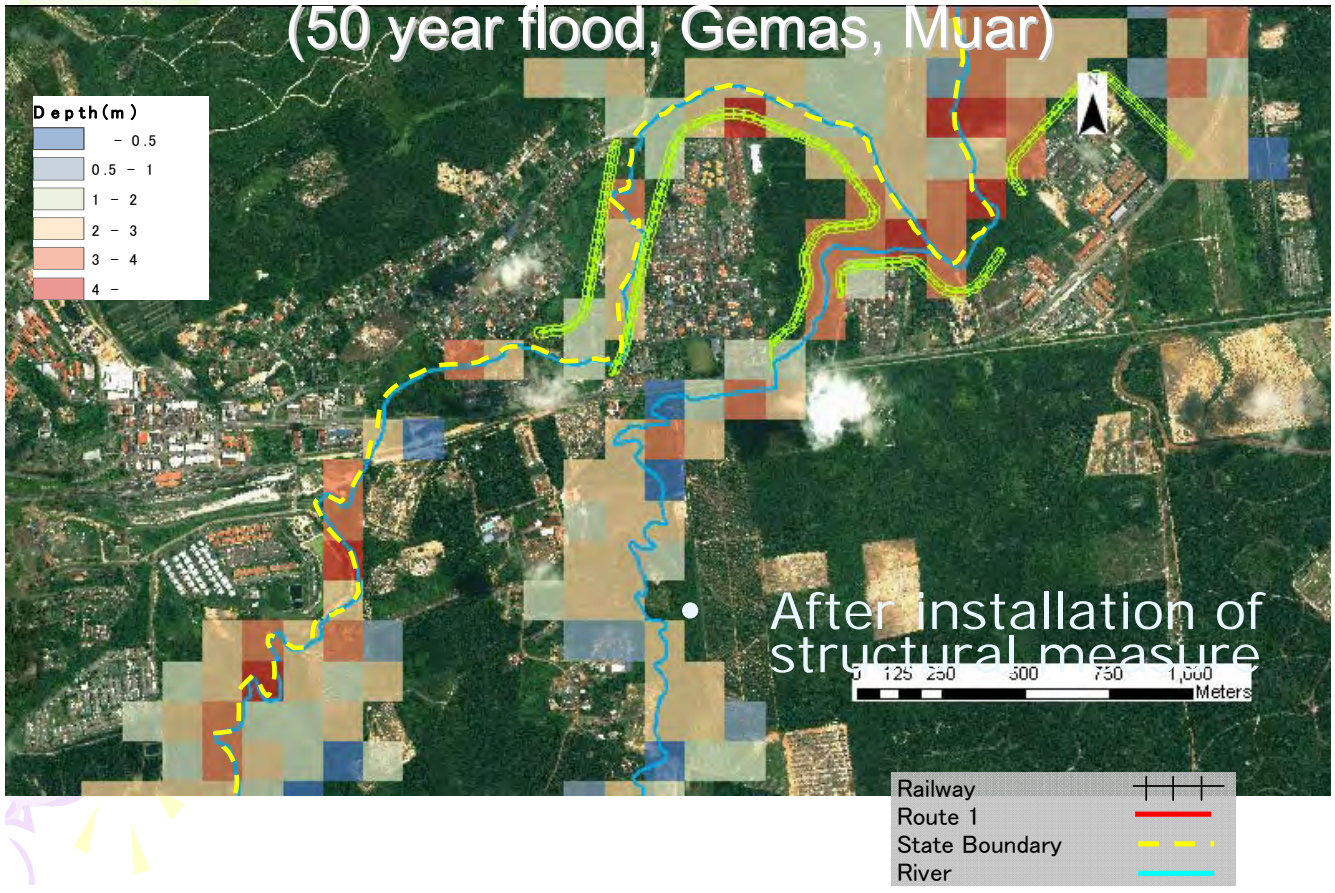
Issues	Conceivable Countermeasure
River Overflow Flood	Construction of Bunds, Bypass and Road Heightening
Inland Flood	A) Installment of Pumping Station and Sluice Gate B) Designation of Allowable Flooding Area and/ or Construction of Detention Pond for Pump Operation

Structural Measure (50 year flood, Gemas, Muar)



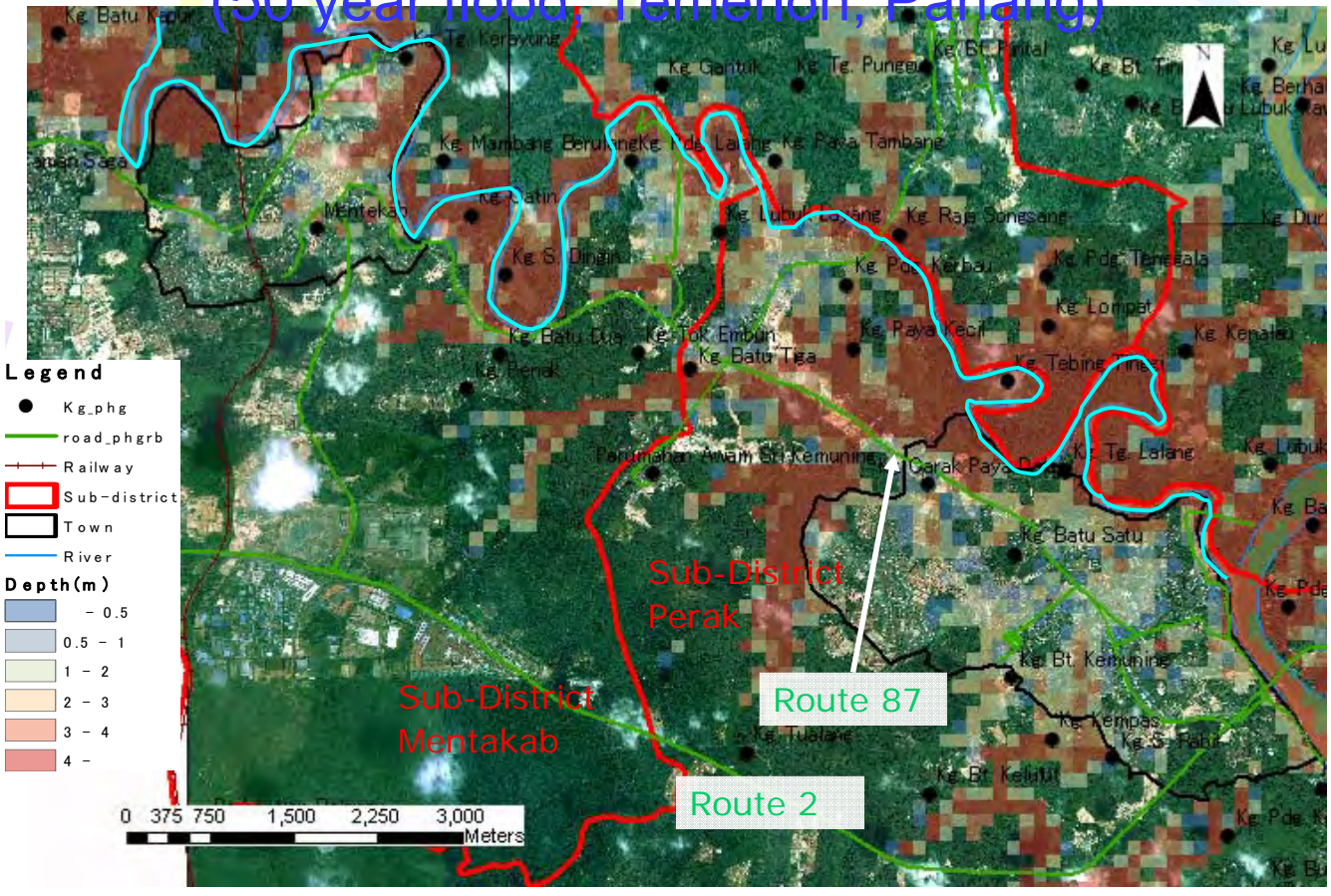
Structural Measure

(50 year flood, Gemas, Muar)



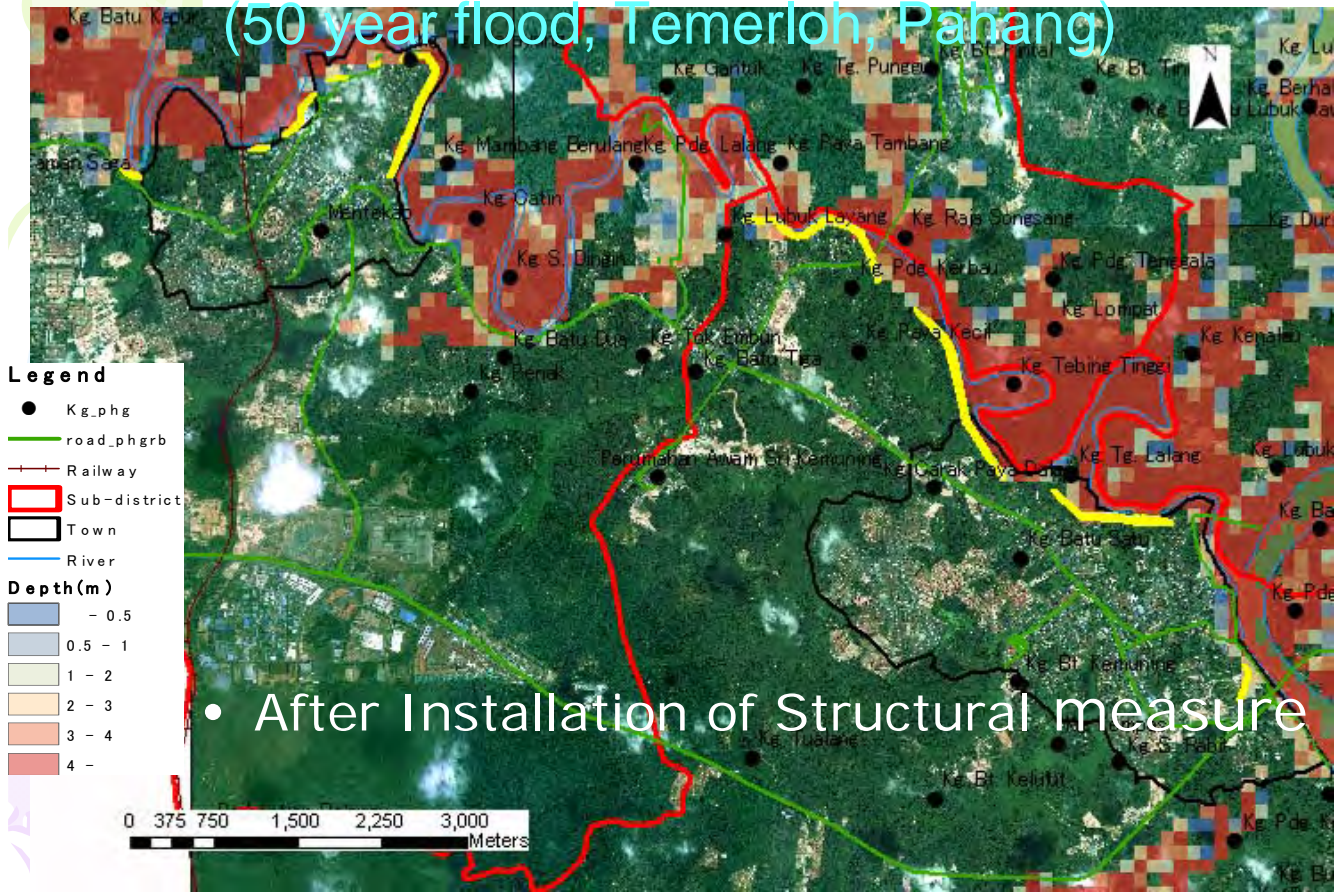
Structural Measure

(50 year flood, Temerloh, Pahang)



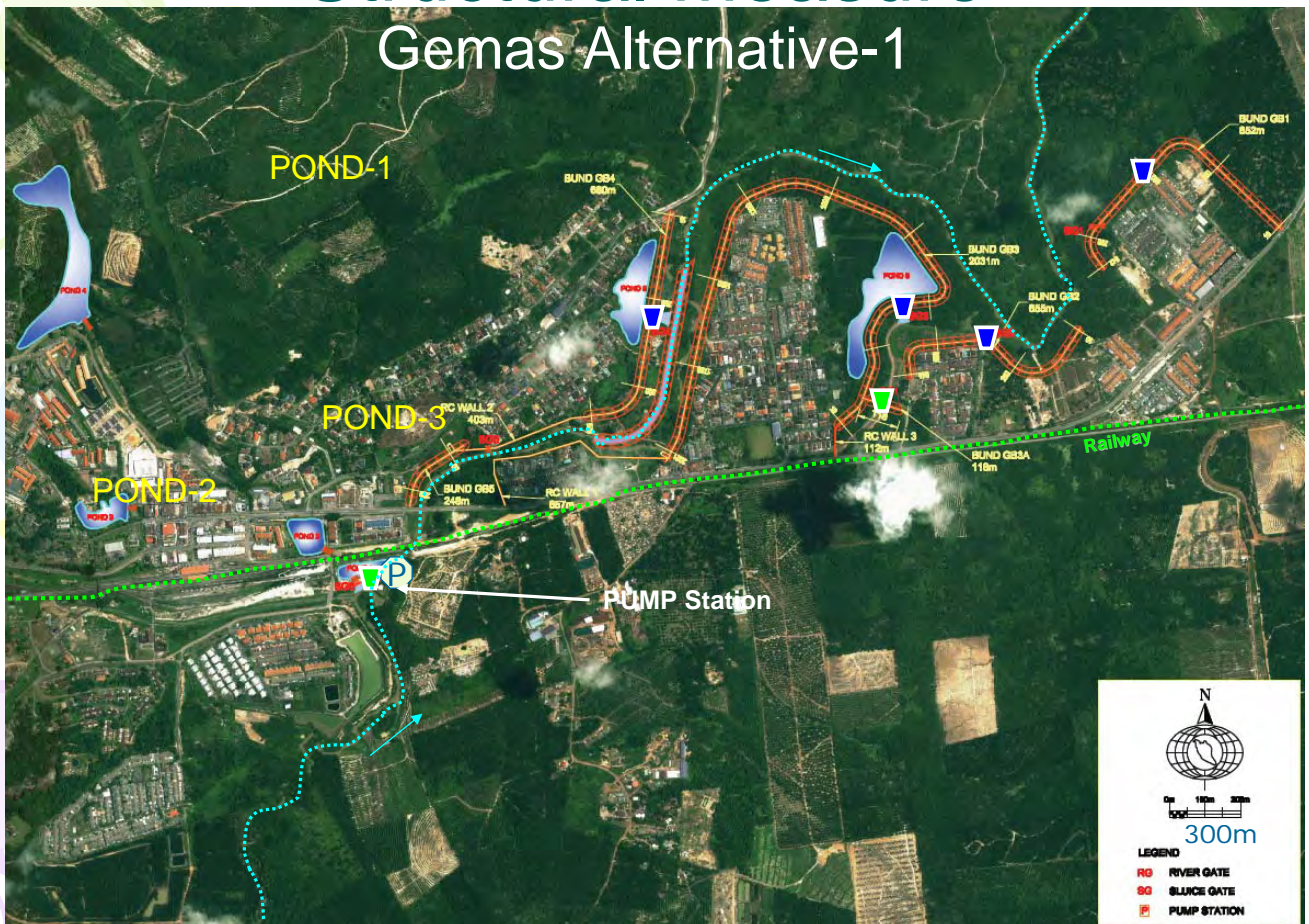
Structural Measure

(50 year flood, Temerloh, Pahang)



Structural Measure

Gemas Alternative-1



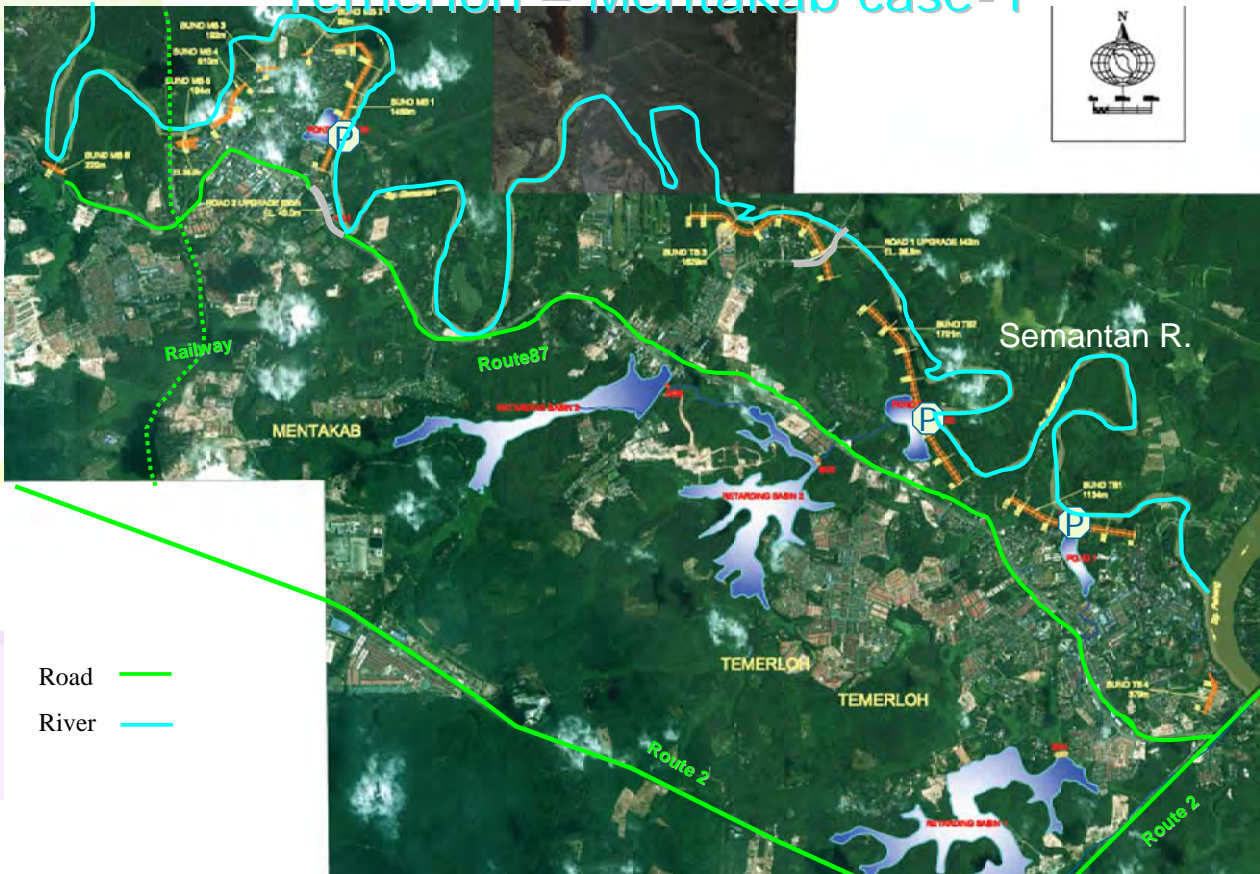
Structural Measure

Gemas Alternative-2



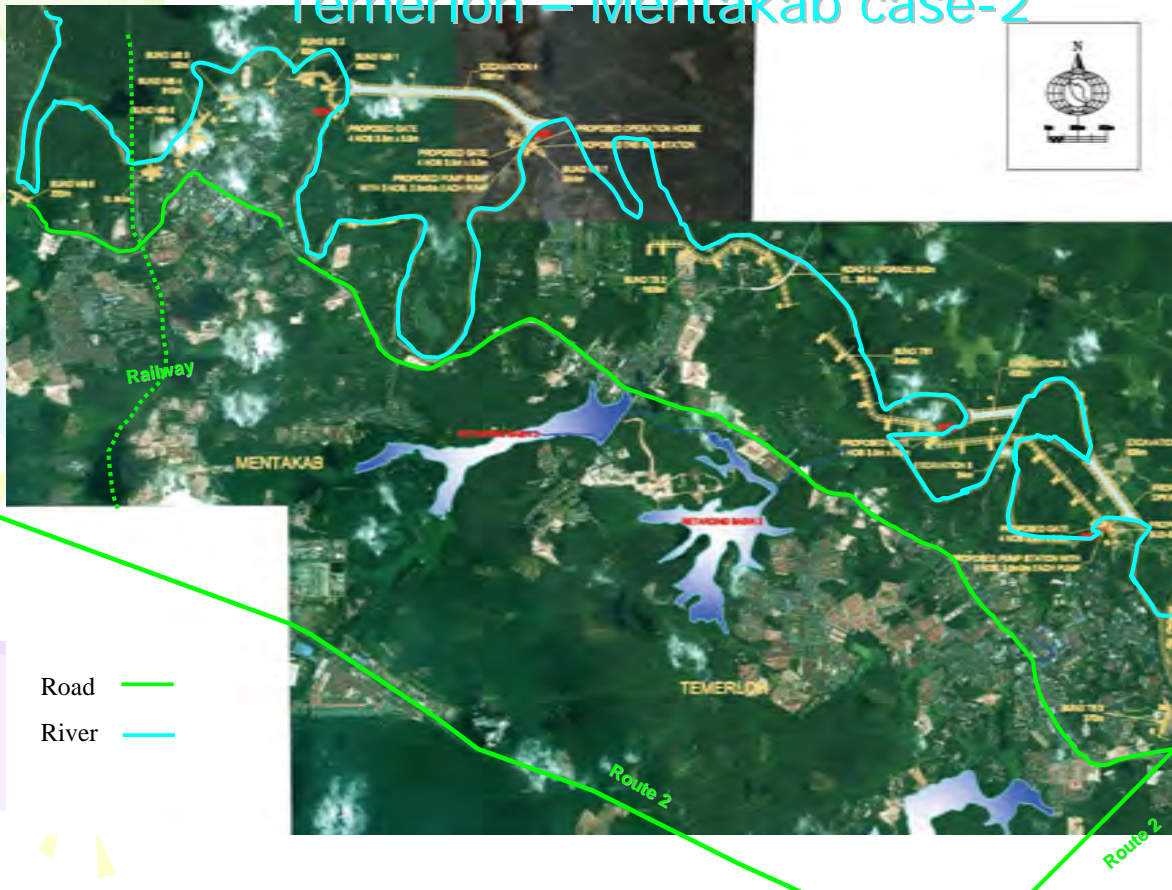
Structural Measure

Temerloh – Mentakab case-1



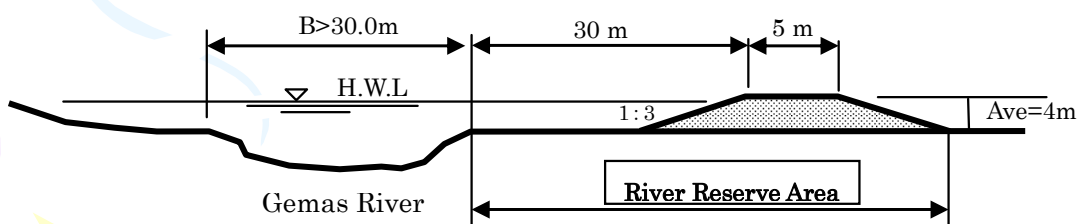
- Road ———
- River ———

Structural Measure Temerloh – Mentakab case-2



Structural Measure (Dimension for Gemas, Muar)

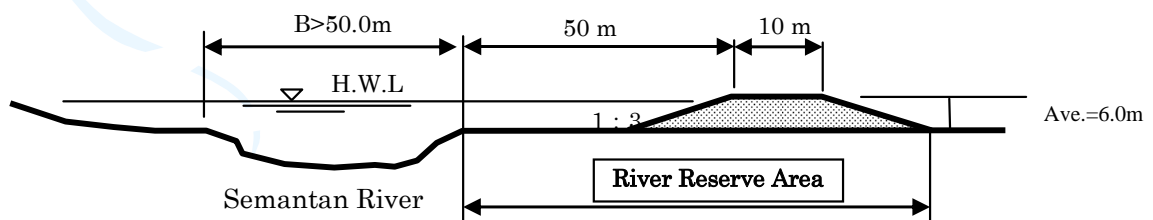
Structure	Case-1		Case-2	
	Num. of Location	Dimension	Num. of Location	Dimension
Bunds	5	H=4m, L=4,584m	7	H=4m, L=3,742m
Concrete Wall	-	1) H=4m, L=1,060m, 2) H=2.0m, L=112m	1	1) H=4m, L=112m
River Excavation	1	L=649 m	-	-
Short Cut Channel	-	-	1	2,756m
Regulation Ponds	6	10.72ha	-	(Retarding Basin 30ha)
Back Water Gate	2	1) H=5m, B=(5m × 3), 2) H=5m, B=(5m × 1); w/Pump	3	H=5m, B=(5m × 3)
Pump Station	1	1.0m ³ /s	1	5.1m ³ /s
Sluice Gate	4	H=1m, B=(1m × 1)	2	H=1m, B=(1m × 1)



Typical Cross Section

Structural Measure (Dimension for Temerloh, Pahang)

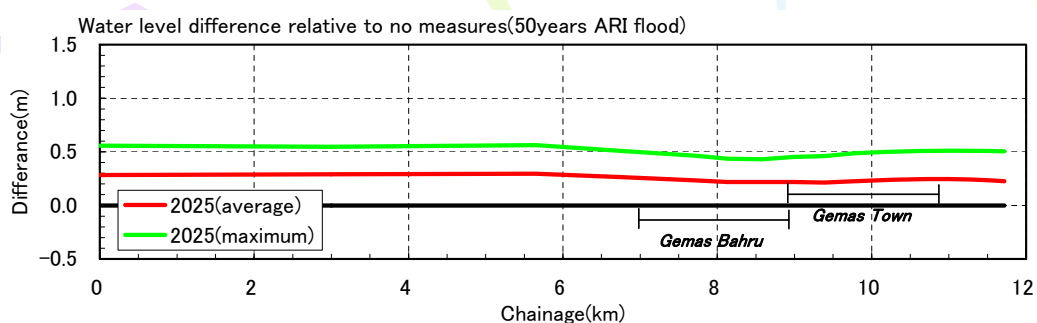
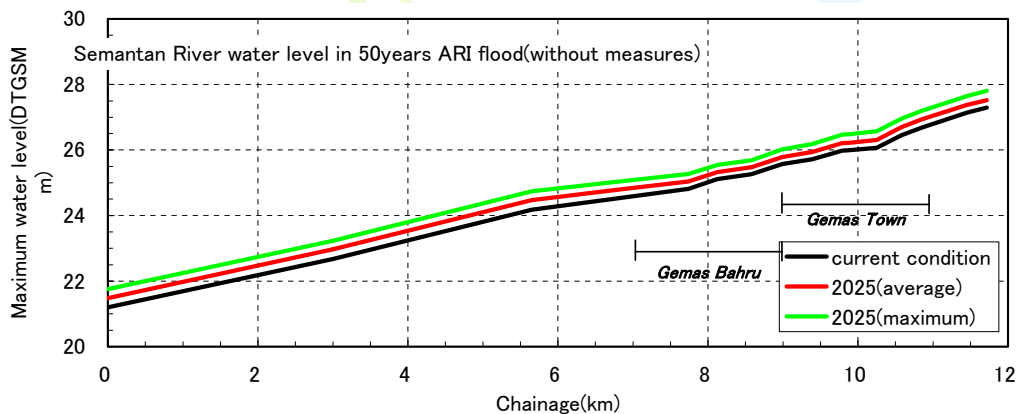
Facility	Case 1	Case 2
Bunds	11 (H=6m-7m, 7,860m)	7 (H=6m-7m, 7,736m)
Short Cut Channel	-	4 (2,800m)
Regulation ponds	3 (A=21ha)	0
Retarding Basin	167ha	167ha
Pump Station	3 (19m ³ /s)	2 (25.1m ³ /s)
Road Heightening	2 (793m)	2 (793m)



Typical Cross Section

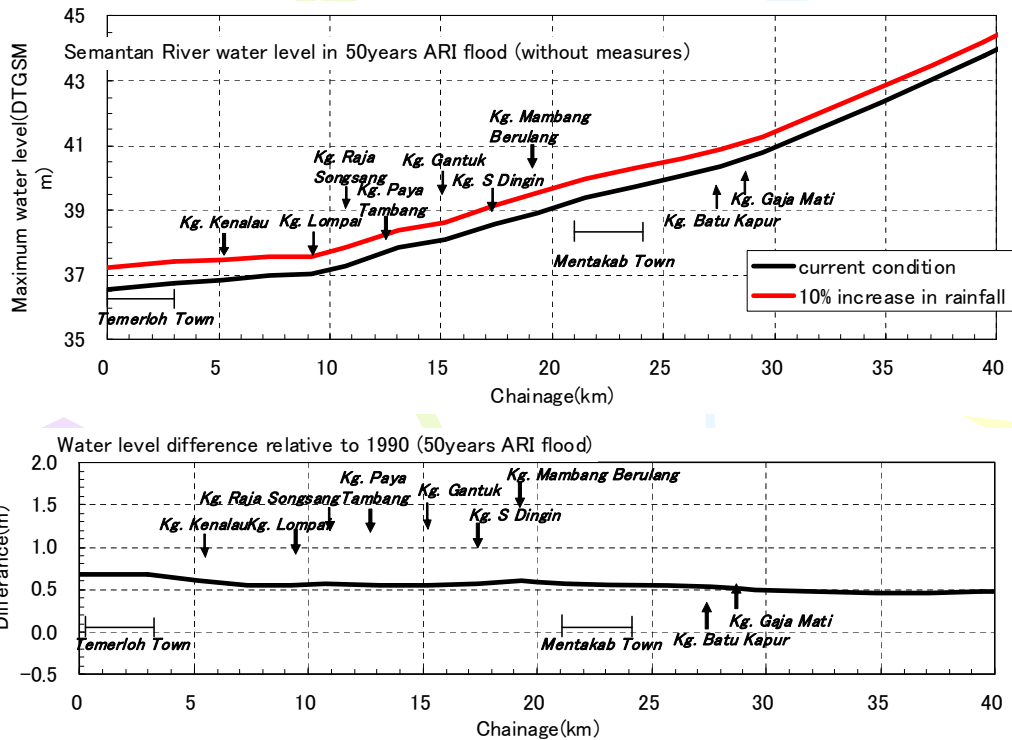
Structural Measure

(Water Level of 50 year flood w/ &w/o Climate Change Impact, Gemas, Muar)



Structural Measure

(Water Level of 50 year flood w/ &w/o Climate Change Impact, Temerloh, Pahang)



Structural Measure (Adaptation to Climate Change)

1. Countermeasure for Extension of Flood Duration

Extension of Flood Duration -> Seepage Failure

- Slope protection works of riverside slope by impervious material
- Installment of drainage structure at back slope toe
- Enlargement of dike width
- Gentle Slope of Dike (proposed dike slope=1:3)
- Installment of Sheet pile screen at riverside slope toe
- Blanket works (Covering the high water bed)
- Securement of river reserve area

2. Countermeasure for Rising up Water Level

Water level rising-> Overflow -> Collapse of dike

- Installment of Parapet at crown of dike
- Heightening of Dike
- Securement of river reserve area

Structural Measure

(Optimum Plan for Gemas)

Criteria		Alternative-1	Alternative-2	
Economic Evaluation	Cost (including land acquisition)	51.9 (Mil. RM)	59.3 (Mil. RM)	
	EIRR (%)	10.7	8.7	
	B/C	1.09	0.86	
	NPV (RM '000)	3,755	-7,700	
Environmental Evaluation	Social Condition	Affected House	2	1
		Land Acquisition (ha)	33 ha	32 ha
		Live hood	No significant impact	Affect aquaculture
	Natural Condition	No significant impact	No significant impact	
Flexibility for Impact of Climate Change		Same Condition		

Alternative-1 is superior to Alternative-1 from the economic point of view though Alternative-1 and 2 obtain the same evaluation level from the other criteria.

Structural Measure

(Optimum Plan for Temerloh & Mentakab)

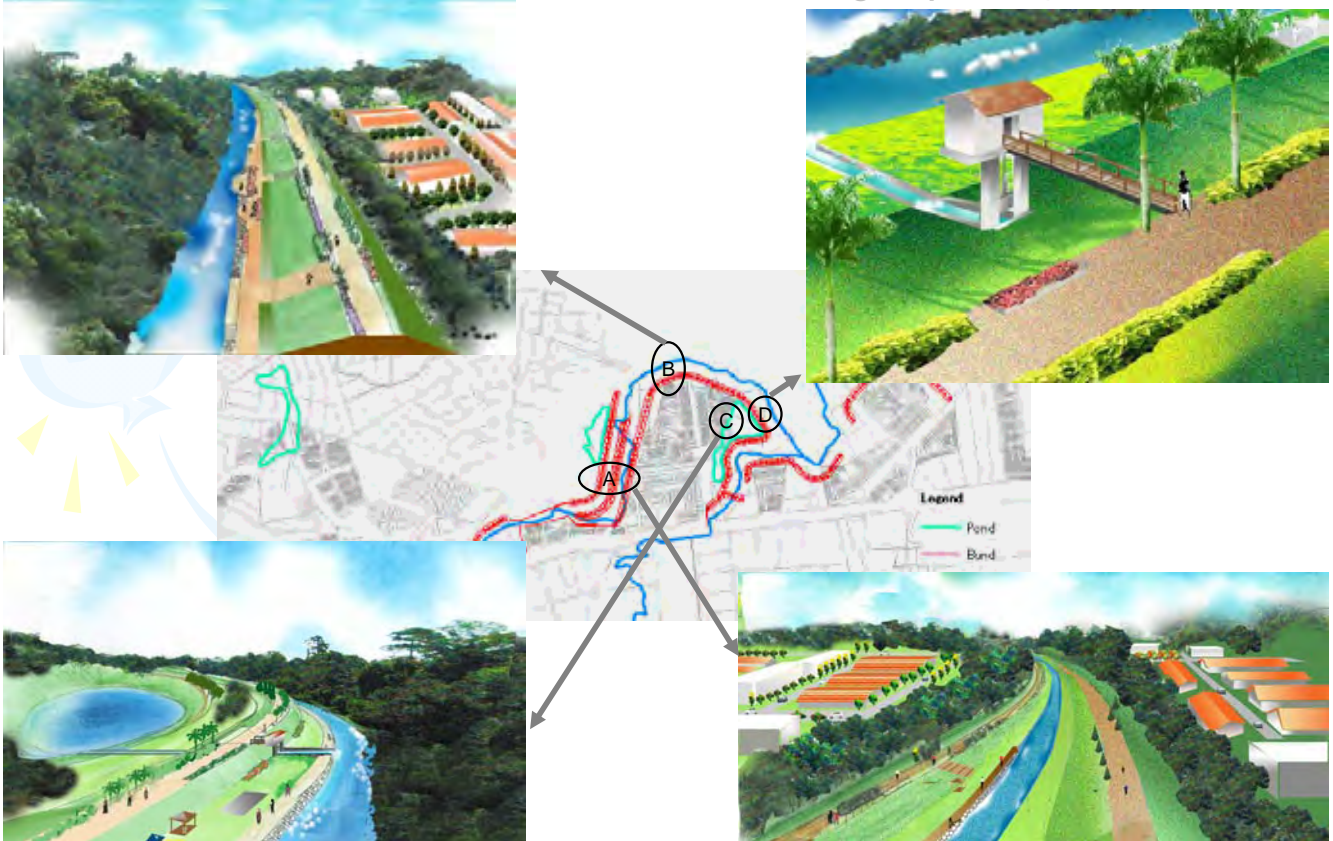
Criteria		Alternative-1	Alternative-2	
Economic Evaluation	Cost (including land acquisition)	108.8	130.7	
	EIRR (%)	14.7	12.6	
	B/C	1.6	1.3	
	NPV (RM '000)	50,328	31,628	
Environmental Evaluation	Social Condition	Affected House	17	9
		Land Acquisition (ha)	62 ha	71 ha
		Live hood	No significant impact	Affect aquaculture
	Natural Condition	No significant impact	Some impact on forest and nature	
Flexibility for Impact of Climate Change		Same Condition		

Alternative-1 is superior to Alternative-1 from the economic point of view though Alternative-1 and 2 obtain the same evaluation level from the other criteria.



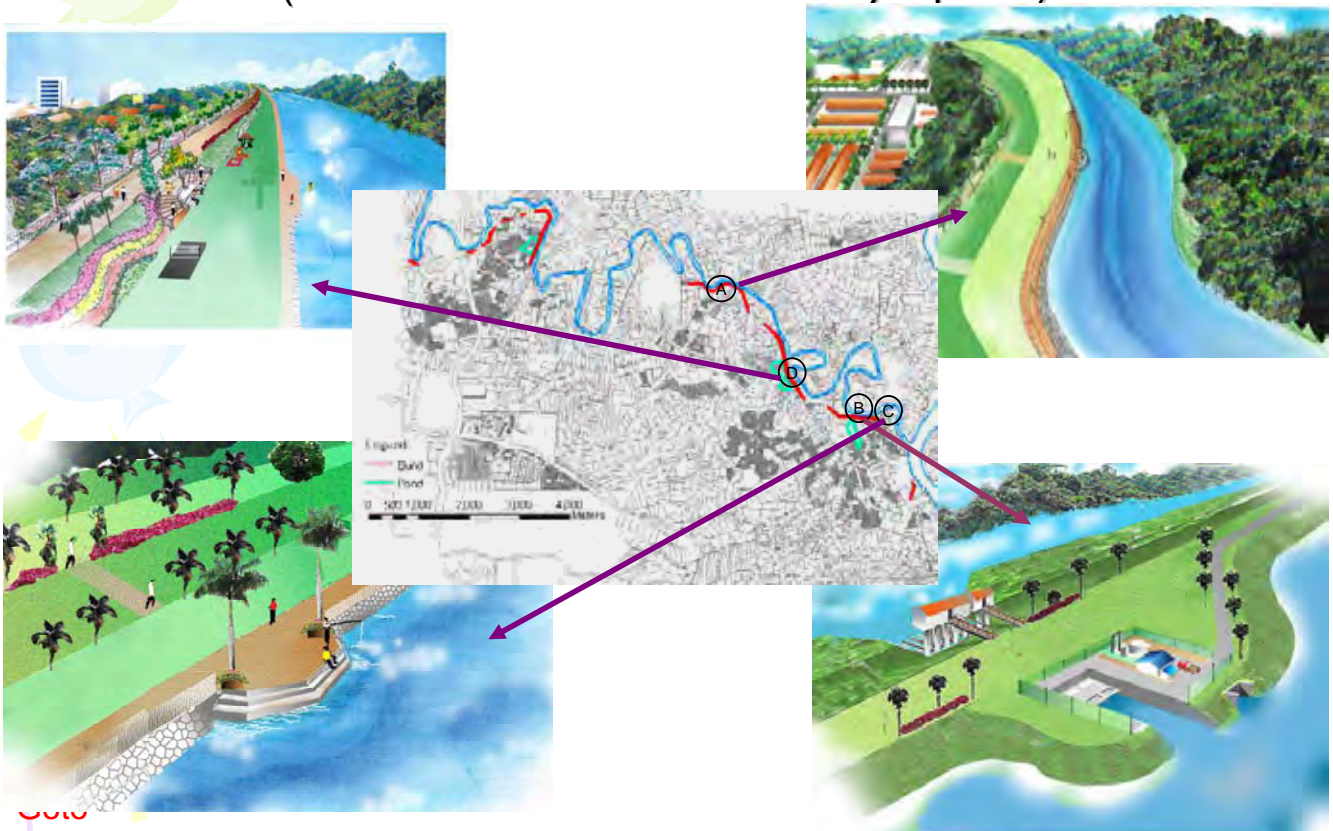
Structural Measure

(Creation of Water Amenity Space)



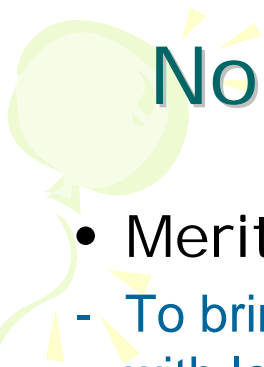
Structural Measure

(Creation of Water Amenity Space)





Non-Structural Measure



Non-Structural Measures

- Merit of Non-Structural measure
 - To bring about the early effect of flood mitigation with less cost of implementation as compared with the structural measures
 - To contribute to a certain range of flood mitigation effect for every scales of flood
 - To adapt a uncertain variation of future climate change impact



Non-Structural Measures

-Existing Measures-

The existing non-structural measures have been already developed to some extent. Institutional frameworks for implementing them have been also generally established.

No.	Existing Non-Structural Measures	Relevant Organizations/Agencies
1	Flood forecasting and warning system	DID
2	Flood management and operation	National Security Council (MKN)
3	Flood maps	DID (JPS)
4	Flood proofing	-
5	Land use control	Local Authority, DTCP (JPBD), etc.
6	Others (Donation)	Department of Social Welfare (JKM)

Non-Structural Measures

Present Condition

(1-1) Flood Warning System (JPS)

- Two warning siren systems are installed along the Gemas River around Gemas town
- No installation in Temerloh and Mentakab inside Target Area
- A siren detects a predetermined water level and sounds automatically.



(Sg. Gemas, Kg. Tiong)



(Sg. Gemas, Taman Sg. Gemas)

Non-Structural Measures

Present Condition

(1-2) Flood Forecasting System (JPS)

- Before flood coming, JPS forecasting system starts forecasting of water level at Temerloh station
- Based on this, information for water level will be sent relevant agencies



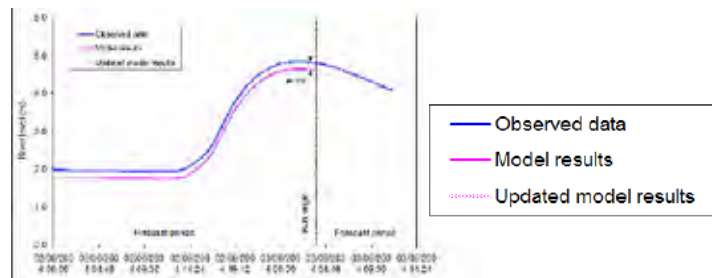
RTUs (Rainfall)



Water Level



DID Temerloh



Forecasting Discharge and Water level

Non-Structural Measures

Present Condition

(1-3) Monitoring System & Communication System

- The Inforbanjir system with communication and alarms by SMS is introduced as a information method of hydrological information (rainfall, water level).
- A regular monitoring water level is transmitted by SMS to DID headquarters by the technician.



Dynamic Cross Sections

No.	Name of Station	Location	Type of Data
1	PANGSOON	152.19 m	Water Level
2
3
4
5
6
7
8
9
10
11
12
13
14
15

Real-time Data



Graphs for Rainfall & Water level



Infobanjir



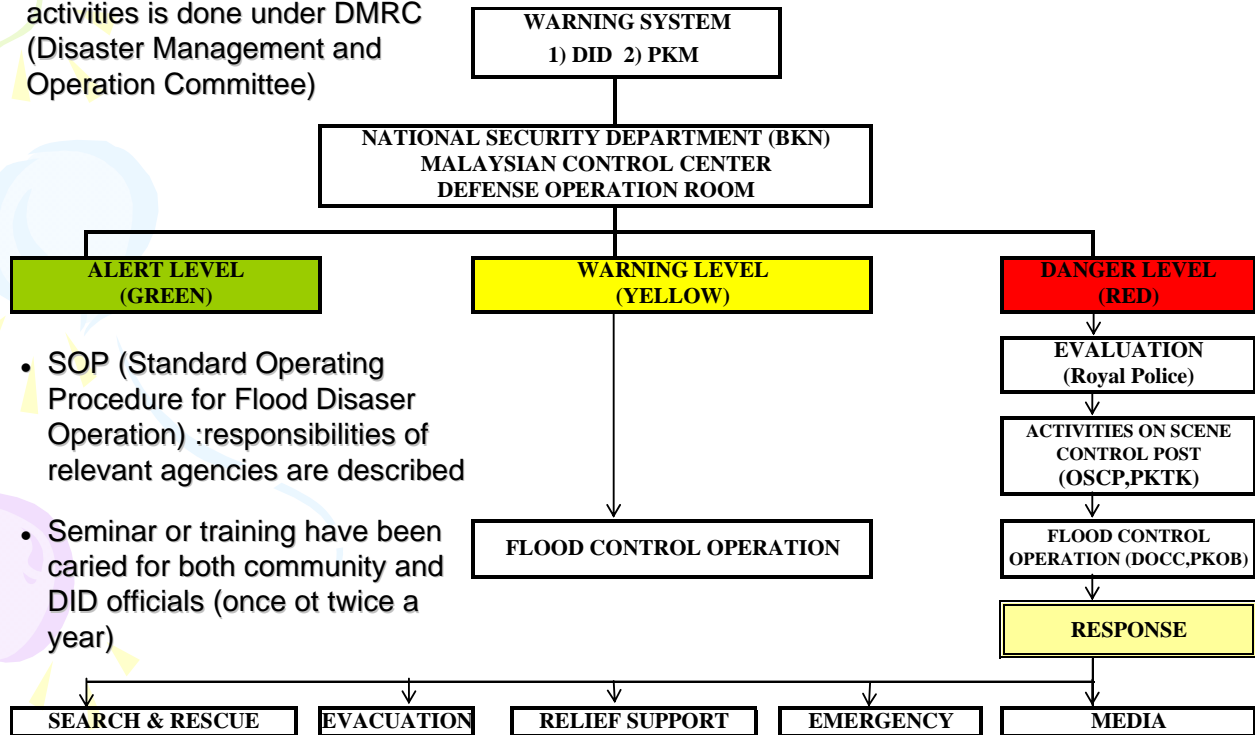
Communication and Alarms by SMS

Non-Structural Measures

Present Condition

(2-1) Flood management & operation

- Flood management and relief activities is done under DMRC (Disaster Management and Operation Committee)



- SOP (Standard Operating Procedure for Flood Disaster Operation) :responsibilities of relevant agencies are described
- Seminar or training have been carried for both community and DID officials (once or twice a year)

Non-Structural Measures

Present Condition

(2-2) Flood Management & Operation

- In accordance with Standard Operating Procedure (SOP) for flood disaster operation, guideline for flood management is prepared in Daerah, Mukim and Kampong level.
- Guideline shows list of disaster operation control center (PKOB), forward bases, communication charts, evacuation centers, foods supply and helicopter bases.



Evacuation Center
(Sek. Men. Tunku Abd. Rahman)



Evacuation Center (Kg. Gemas Baharu)
(S.J.K. (C) Tah Kang)



Non-Structural Measures

Present Condition

(3) Flood Map

- Detailed flood maps of the scale 10,000 to 25,000 have been not developed in the project area.



Non-Structural Measures

Present Condition

(4) Flood Proofing

Raising (stilt) houses is constructed at Kampong in Temerloh & Mentakab



Image of Stilt House



Non-Structural Measures

Present Condition (Land Use management)

(5) Land use Control

- Municipality Council manages land use along “Local Plan”.
- To maintain water retention function of the basin, land use for farmland, forestland and swamp areas shall be preserved by the management.



Image of Retention Area



Image of Retention Area

39

-39-

Non-Structural Measures

- The existing non-structural measures have been already developed to some extent.
- Institutional frameworks for implementing them have been also generally established.



- Therefore, those efforts should be continued to enforce or operate the existing non-structural measures.

Proposed Component of Non-Structural Measures

Capacity Development for flood management

Land Use Monitoring & Control

- 1) Preservation of low land areas
- 2) Flood proofing

Upgrading flood forecasting and Warning system

- 1) Upgrading flood forecasting and warning system
- 2) Dissemination of flood monitoring system
- 3) Installation of additional warning system

Preparation and Utilization of Hazard Maps and Guidelines

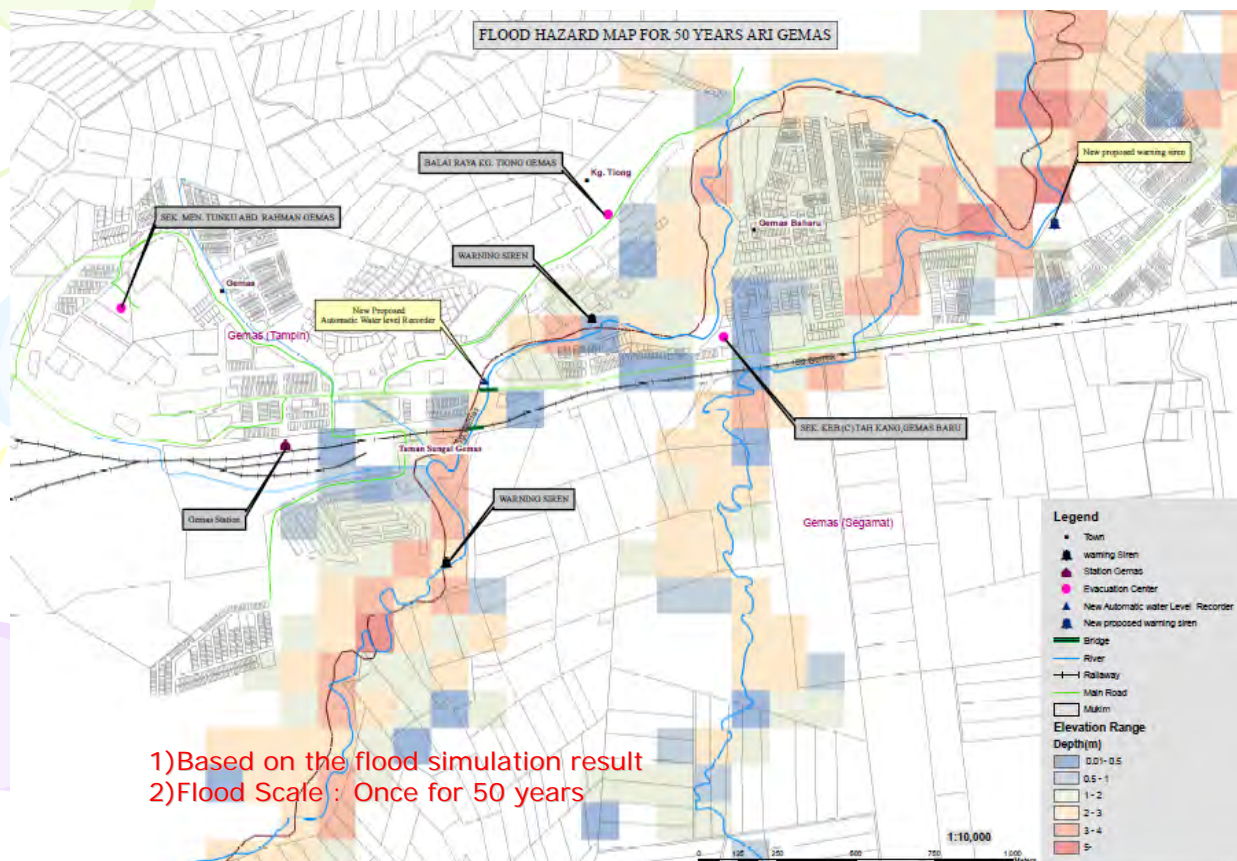
- 1) Preparation and Utilization of hazard maps
- 2) Preparation of guidelines/manuals for flood fighting

Climate Change!!

Upgrade and Renovate

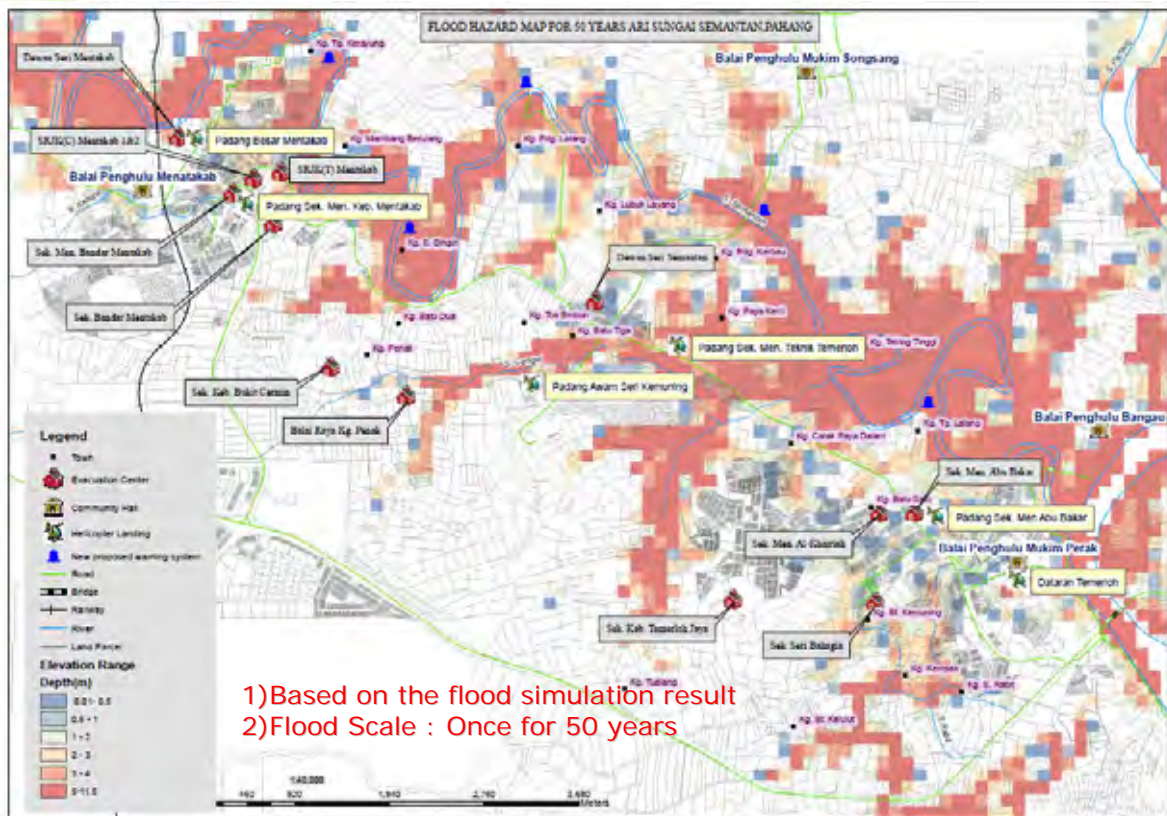
Non-Structural Measures

Hazard Map, Warning post, WL Station, Evacuation Center



Non-Structural Measures

Hazard Map, Warning post



Project Components of Non-Structural Measure

Upgrading Warning System, Enhancement of Flood Risk management

Gemas

- In Gemas, the total seating number of **evacuation centers** should be **increase to 500** persons or more.
- For smooth flood management activities, **Forward Base** should be opened in at Gemas Sub-district Office
- The **evacuation center**, Sek. Keb.(C) Tah Kang, Gemas Baru located in the area of elevation 26m, will be **transferred to the higher place** which currently located.
- Water level monitoring station shall be installed at the Gemas River Bridge located in Road No.1.
- Further instillation of monitoring post in Gemas Baru

Temerloh & Mentakab

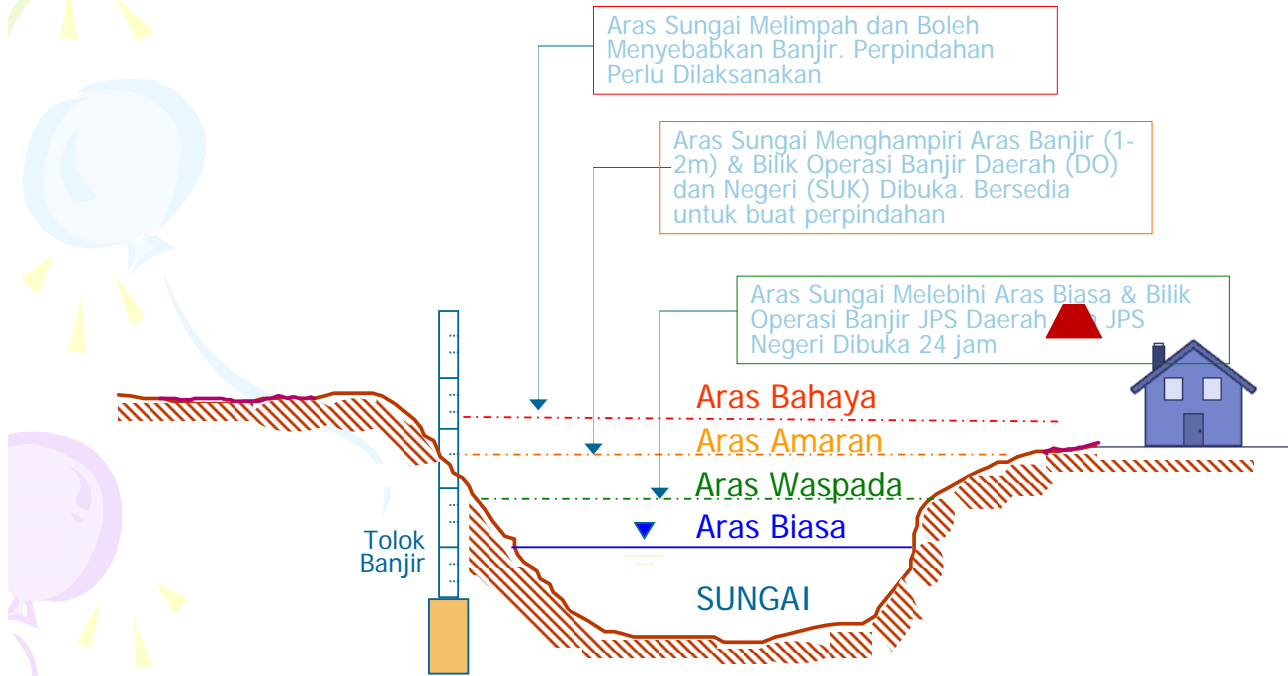
- **Installation of Warning Posts** at opposite site/outside of Ring bunds.
- **Flood Proofing** at the area under 34m in Temerloh town and 37m in Mentakab town

Non-Structural Measures

- For Upgrading Monitoring System-

Setting of Warning Water Level

- Installment of Water level stations locates near Gemas
- At present Water level at Ulu Gemenches is monitored for flood management like evacuation activities.



Non-Structural Measures

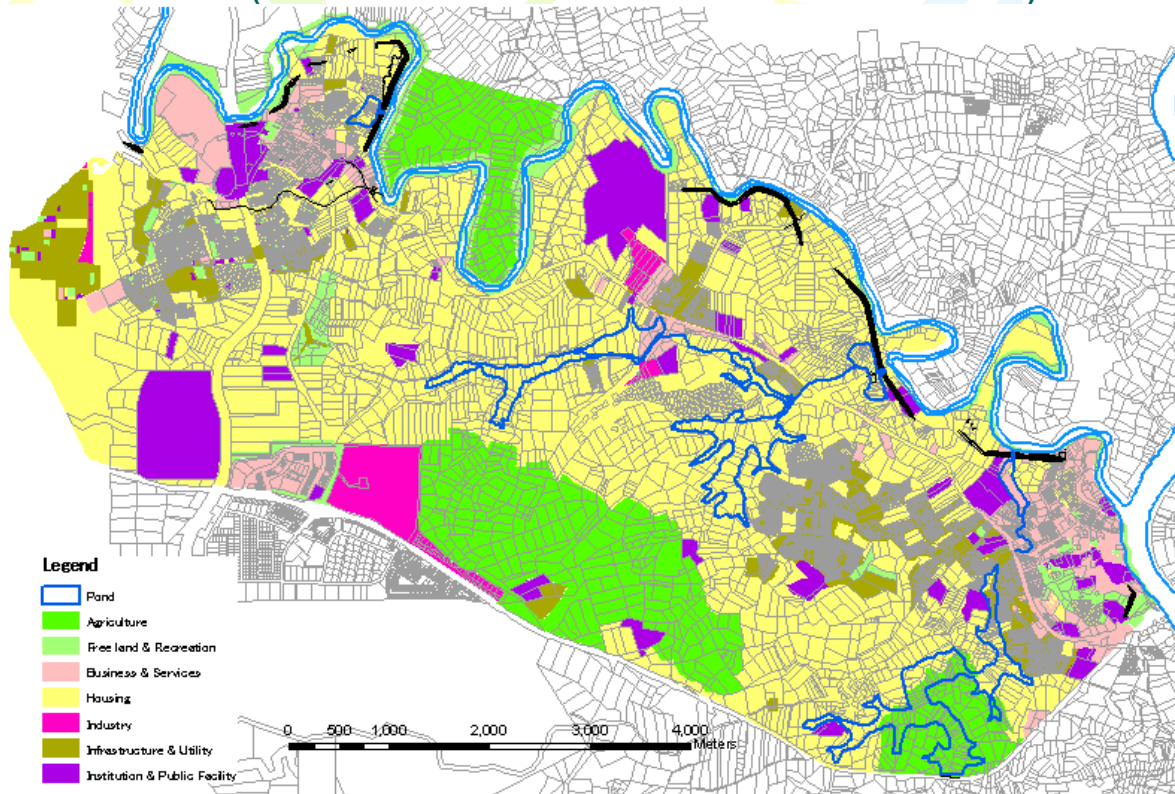
Land Use management

- Municipality Council manages land use along "Local Plan".
- MASMA mention that regulation pond should be constructed in case of land development



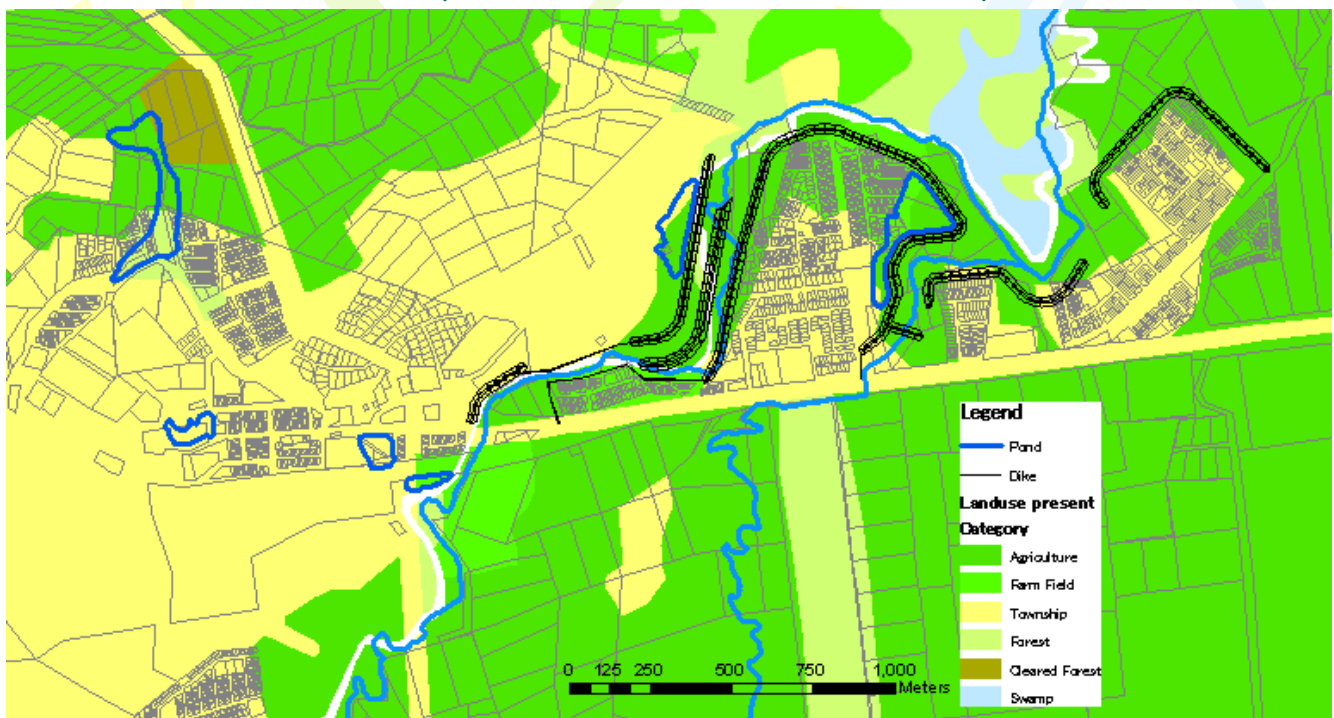
Non-Structural Measure

(Draft Local Plan Temerloh & Mentakab)



Non-Structural measure

(Draft Local Plan for Gemas)



Non-Structural Measures

- Preparation of Guideline/Manual -

Guidelines for flood fighting activities shall be prepared with the following contents:

- 1) Guideline for monitoring and inspection of bunds
- 2) Guideline for flood fighting
- 3) Flood Fighting Techniques for bunds protection



Making Sand Bags in Flood Fighting Drills



Sand bag Piling (Flood Fighting) ⁴⁹

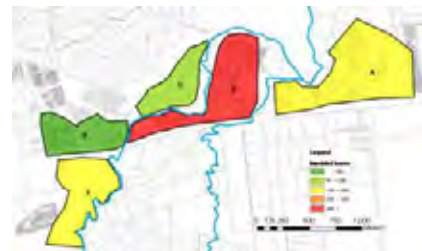
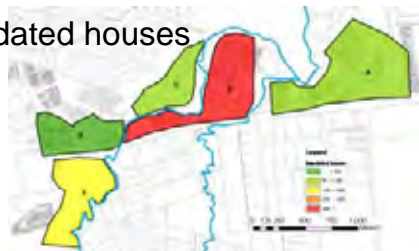
Non-Structural Measures

Adaptation to Climate Change

Based on Flood Risk Assessment by JICA Study Team (8.3.3), flood risk in the target area is increased in 2025 by the climate change impact if without countermeasures.

Number of inundated houses

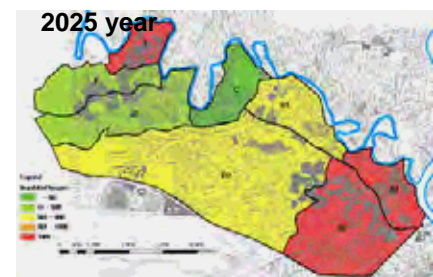
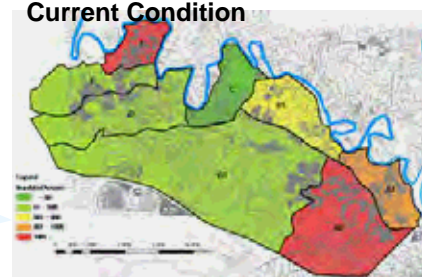
Gemas



Current Condition

2025 year

Temerloh & Mentakab

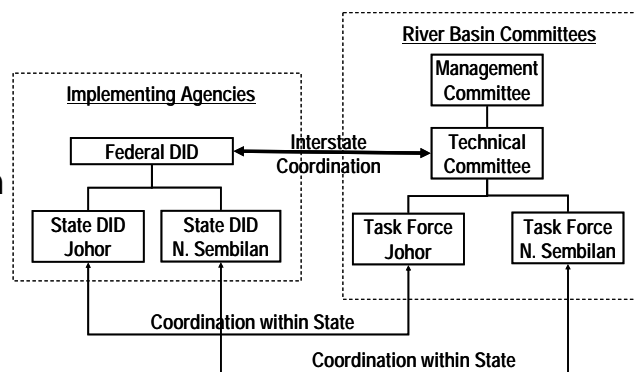


- Continue to enhance and operate the existing non-structural measures
- To revise flood hazard map
- Upgrade evacuation system in accordance with the revised map

Institutional Setup

Project Implementation: Muar River Basin

- JPS is primary implementing agency
- Other agencies will be involved
- RBC: facilitate the collaboration with relevant agencies

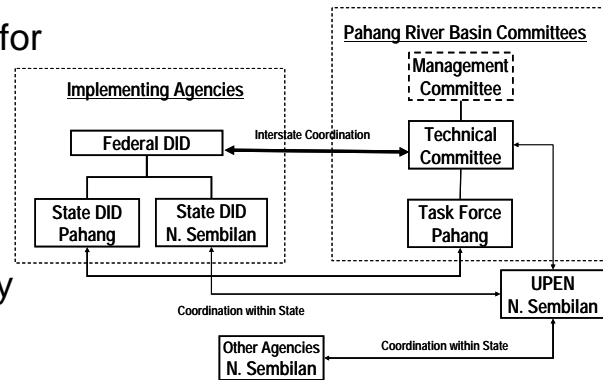


	Funding	Project Management		O&M
		Planning & Design	Construction Supervision	
MoF	○			
Fed. JSP	○	○	○*	
JPS Negara			○	○

*Federal funded project will be supervised by federal JPS.

Project Implementation: Pahang River Basin

- JPS is primary implementing agency for Flood Mitigation Project
- Other agencies will be involved
- RBC: facilitate the collaboration with relevant agencies
- UPEN needs to carry out inter-agency coordination instead of Task Force



	Funding	Project Management		O&M
		Planning & Design	Construction Supervision	
MoF	○			
Fed. JSP	○	○	○*	
JPS Negara			○	○

*Federal funded project will be supervised by federal JPS.

Project Implementation: (Non-Structural Measure)

Project Components	No.	Non-Structural Measures	Organizations/Agencies
I. Capacity Development for flood management	1	Flood management with hazard maps	National Security Council (MKN)
	2	Flood fighting activities along the Semantan River	National Security Council (MKN)
II. Upgrading flood forecasting and warning system	3	Upgrading flood forecast and warning system by AMRRF system	DID (JPS)
	4	Dissemination of monitoring system	DID (JPS)
	5	Installation of warning system such as warnings siren outside areas of the project area	DID (JPS)
III. Preparation of hazard maps and guidelines	6	Preparation of hazard maps and share the information among the local authorities and communities	DID (JPS)
	7	Preparation of guidelines/manuals for flood fighting activities	DID (JPS)
IV. Control and management of land use	8	Preservation of low land areas for the retention of water	DTCP, Local Authority
	9	Flood proofing by construction of stilt house	-