Integrated Flood Management in Malaysia


Chukai Town, Kemaman Flood, 2013

Flood Risk Management Case Visit In Malaysia
8th July 2019
Bilik Dahlia, JPS Ampang

Presentation Outline

01 Introductions

02 Integrated Flood Management

03 Conclusions

1. Introduction

NATURAL DISASTER IN MALAYSIA

Kajang Town (2014)

Kuala Lumpur (2008)

Pendang (2014)

Ranau, Sabah (2015)

Disaster Types

- Flood
- Land-slide
- Tropical Storm
- Earth-quake
- Tsunami
- Forest Fire
- Haze
- Drought

Kuala Muda, Kedah (2004)

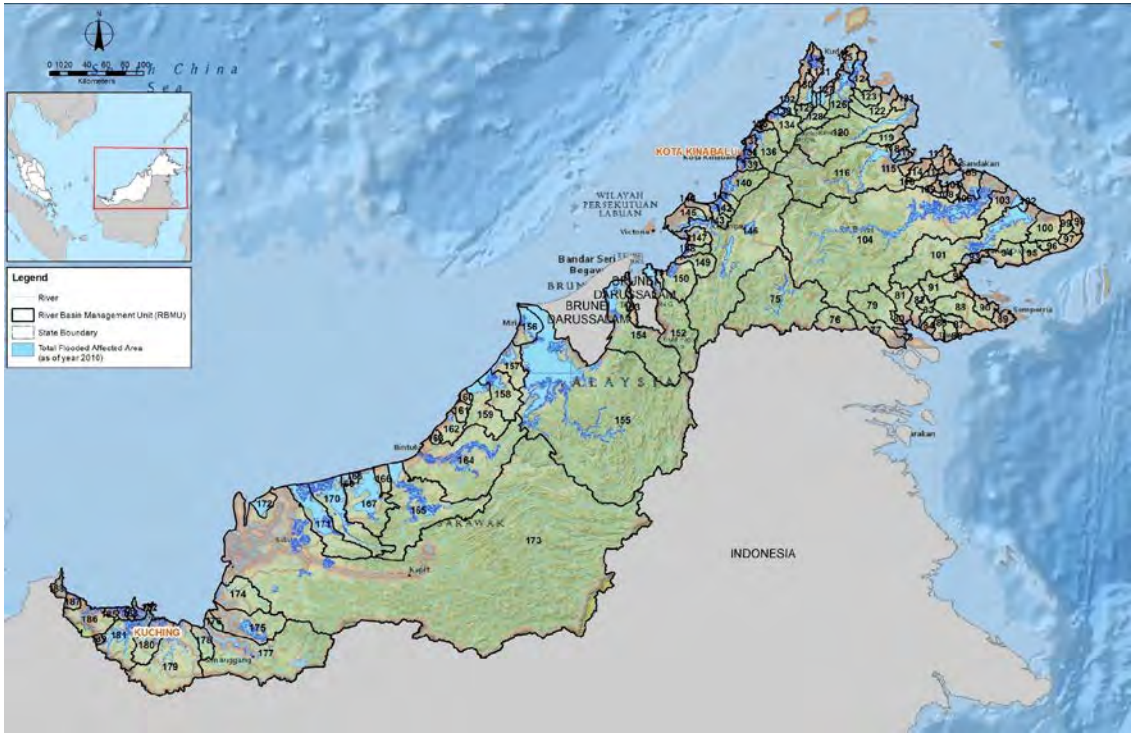
Selangor (2013)

Kuala Lumpur (2014)

Chuping, Perlis (2016)

Source: Malaysia: Disaster Management Reference Handbook, 2016

FLOOD PRONE AREA – Hotspots For Vulnerability



- Flood-prone areas ≈ 33,298 km^2 out of 330,436 km^2 (10.1%);
- Population directly affected by flood ≈ 5.7million Malaysian (> 21%).
- Estimated Flood Damage ≈ USD 278 Million (RM1.15 Billion)

Source: Updating of Condition of Flooding, 2012

FLOOD EVENTS - MALAYSIA SCENARIO

FLOOD EVENTS - MALAYSIA SCENARIO

East Coast Floods, Dec 2013 and Dec 2014

Chukai Town, Dec 2013

Kelantan, Dec 2014

Chukai Town, Dec 2013

Kelantan, Dec 2014

FLOOD EVENTS - MALAYSIA SCENARIO

Flooding in Kota Belud, Sabah, 2015

FLOOD EVENTS - MALAYSIA SCENARIO

Flooding in Pulau Pinang, 2017

LAST 20 YEARS WATER RELATED DISASTER IN MALAYSIA

Year	Flood Event	Death	Victims Evacuated
1993	Sabah	27	22,000
1995	Shah Alam / Klang Valley, Klang, Selangor,	8	23,870
1996	Keningau, Sabah (Tropical Cyclone Greg)	238	39,687
1998	Pos Dipang, Perak; Kuala Lumpur	49	> 100
1999	Penampang, & Sandakan, Sabah	9	4,481
2000	Kg. La, Terengganu	6	-
2001	Kelantan, Pahang, Terengganu; Gunung Pulai, Johor; Besut, Marang, Terengganu	14	> 11,000
2006/07	Johor & Kelantan	18	110,000
2008	Johor	28	34,000
2010	Kedah & Perlis	4	50,000
2013	Kemaman, Terengganu, Kuantan Pahang, Johor, Kelantan	3	>34,000
2014	Gua Musang, Kuala Krai, Kota Bharu Kelantan	25	500,000
2015	Kota Belud, Sabah	-	> 1,800
2017	Pulau Pinang	7	> 2,000


Keningau, Sabah, 1996

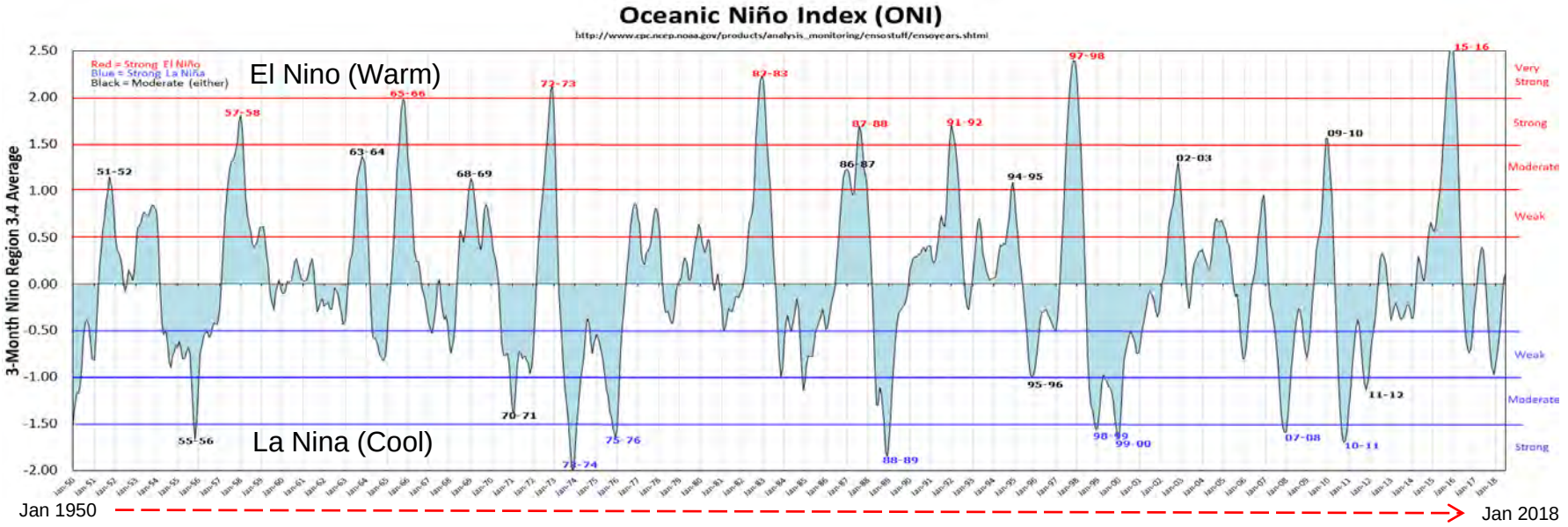

Kota Belud, Sabah, 2015


Pulau Pinang, 2017

Sources: Department of Irrigation and Drainage Malaysia, Malaysian National Security Council and Chan (2012)

Cause of Flood: Climate Change

EL NINO & LA NINA PATTERN

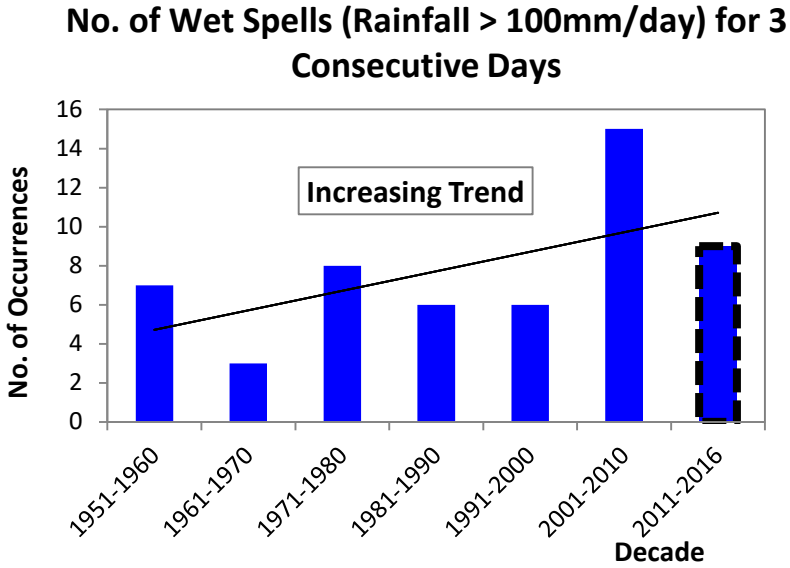


El Niño				La Niña		
Weak - 10	Moderate - 7	Strong - 5	Very Strong - 3	Weak - 10	Moderate - 4	Strong - 7
1952-53	1951-52	1957-58	1982-83	1954-55	1955-56	1973-74
1953-54	1963-64	1965-66	1997-98	1964-65	1970-71	1975-76
1958-59	1968-69	1972-73	2015-16	1971-72	1995-96	1988-89
1969-70	1986-87	1987-88		1974-75	2011-12	1998-99
1976-77	1994-95	1991-92		1983-84		1999-00
1977-78	2002-03			1984-85		2007-08
1979-80	2009-10			2000-01		2010-11
2004-05				2005-06		
2006-07				2008-09		
2014-15				2016-17		
				2017-18		

- El Nino and La Nina → global patterns of climatic variability;
- El Nino → intensity and duration of events are varied and hard to predict.

Source: GGWS, 2018

RAINFALL EVENT TREND – More Extreme Wet Spells

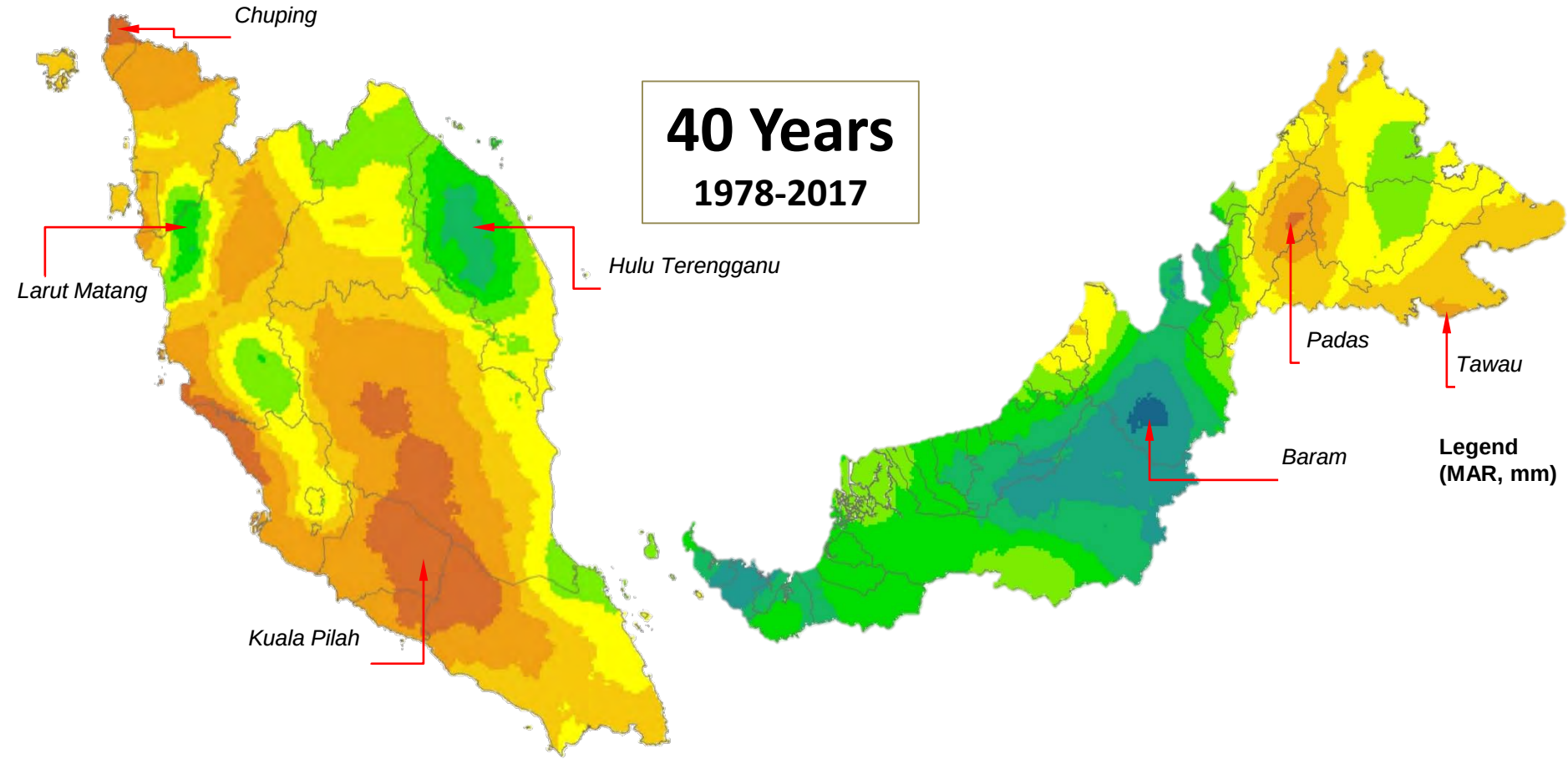


Kota Bharu, Kelantan, 2014

- Increasing number of wet spells;
- Leads to severe floods.

Source: Disaster and Climate Change Projection for Malaysia, 2016

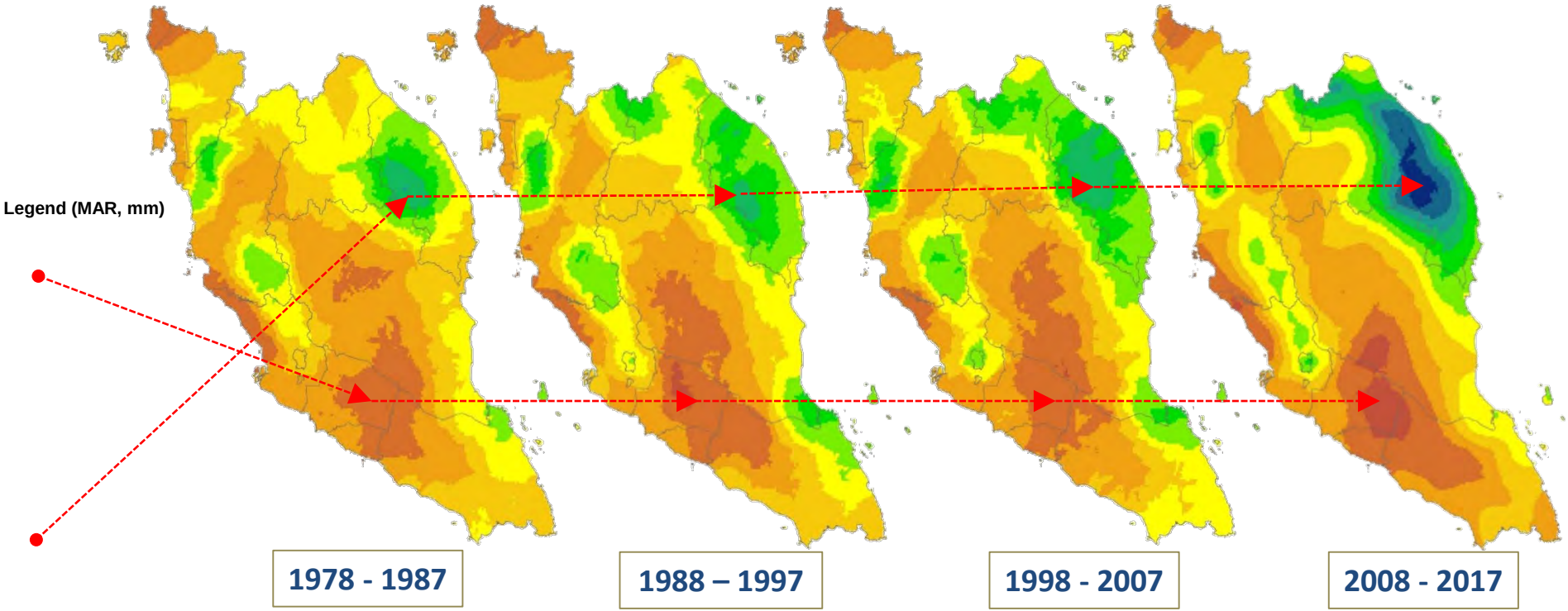
MEAN ANNUAL RAINFALL - Trend



Source: Kajian Penyediaan Perubahan dan Taburan Hujan Di Malaysia (JPS-NAHRIM, 2018)

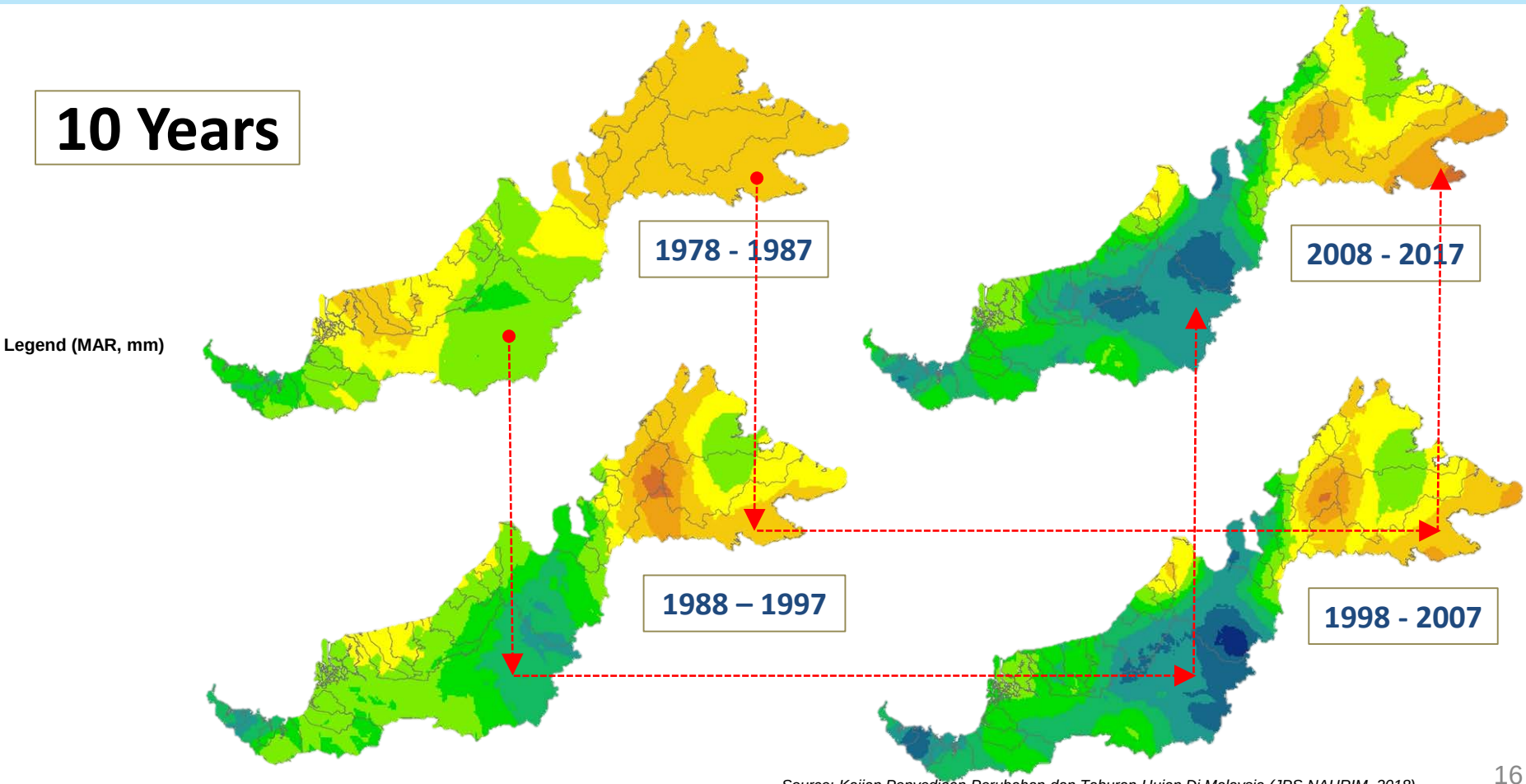
TEMPORAL AND SPATIAL DISTRIBUTION OF RAINFALL – Peninsular Malaysia

10 Years



Source: Kajian Penyediaan Perubahan dan Taburan Hujan Di Malaysia (JPS-NAHRIM, 2018)

TEMPORAL AND SPATIAL DISTRIBUTION OF RAINFALL – Sabah and Sarawak



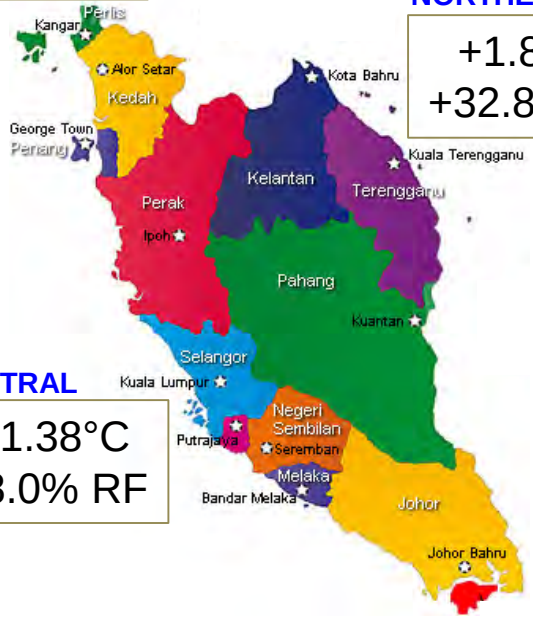
Source: Kajian Penyediaan Perubahan dan Taburan Hujan Di Malaysia (JPS-NAHRIM, 2018)

POSSIBLE FUTURE CLIMATE PROJECTION

Average Annual Rainfall & Mean Temperature (1984-93 vs 2025-34 & 2041-50)

NORTHWEST
+1.80°C
+6.2% RF

NORTHEAST
+1.88°C
+32.8% RF



CENTRAL
+1.38°C
+8.0% RF

SOUTHERN
+1.74°C
+2.9% RF

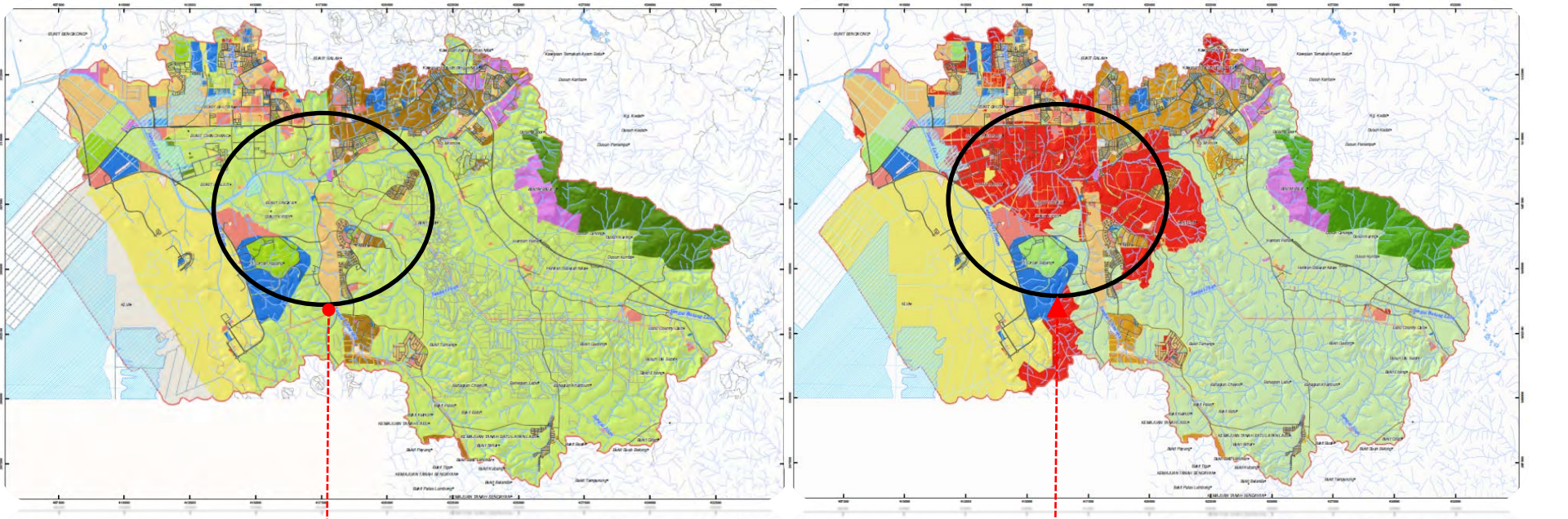
Regions / Sub-regions / States	Projected change* in maximum monthly value	
	Temperature (°C)	Rainfall (%)
North East Region • Terengganu, Kelantan, Northeast-coast	+1.88	+32.8
North West Region • Perlis (west coast), Perak, Kedah	+1.80	+6.2
Central Region • KL, Selangor, Pahang	+1.38	+8.0
Southern Region • Johor, Southern Peninsula	+1.74	+2.9

**Change In Maximum Monthly Value*

Source: NAHRIM, 2006

Cause of Flood: Human Intervention

EFFECT OF URBANIZATION

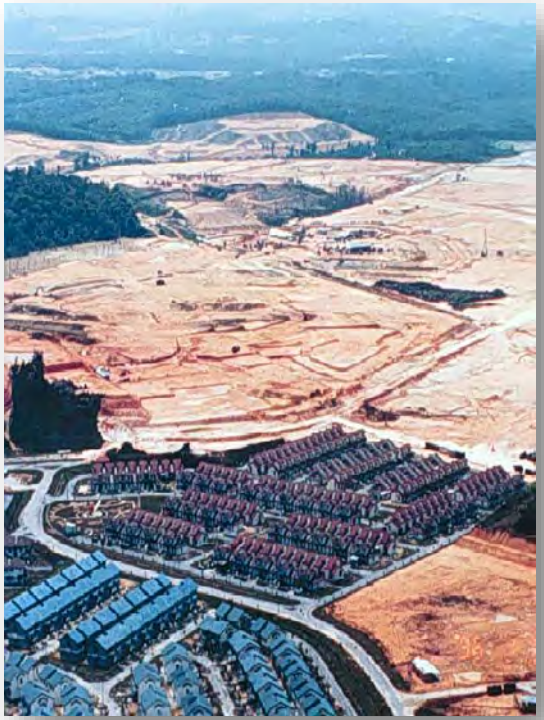


From Agriculture to Built up Area

EFFECT OF URBANIZATION

Sungai Miri River Basin in Sarawak

UNCONTROLLED DEVELOPMENT



- Human activity influences the frequency and severity of floods.
- Extensive land clearing for agriculture
- Loss of flood plain/ wetlands
- Encroachment into flood plains

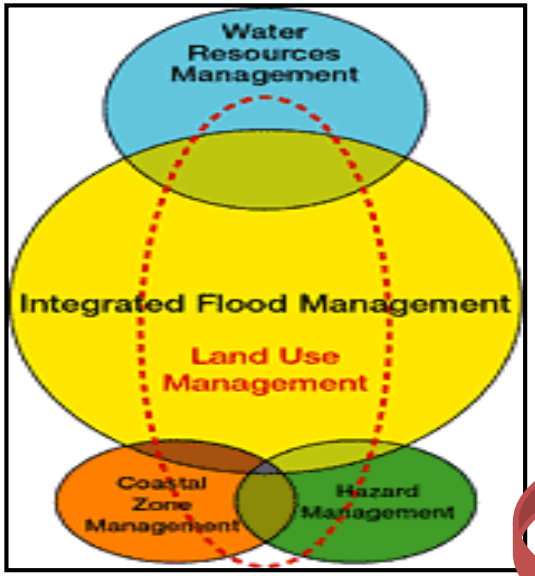
CONSTRICTION OF BRIDGE

CONSTRICTION OF UTILITY

GABBAGE DISPOSAL INTO THE RIVER

2. Integrated Flood Management

COMPONENT OF INTEGRATED FLOOD MANAGEMENT



1 Ensure a Participatory Approach

2 Integrated Land and Water Management

3 Manage Water Cycle as a Whole

4 Adopt a Best Mix of Strategies

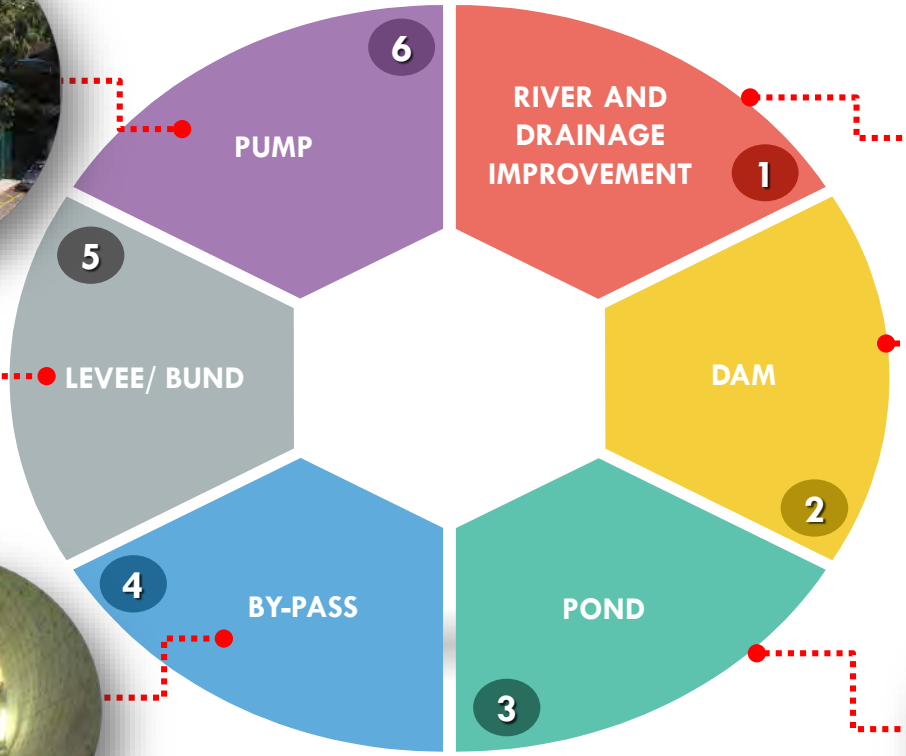
5 Adopt Integrated Hazard Management

6 Adopt Environmental Enhancement

7 Introducing National Flood Management

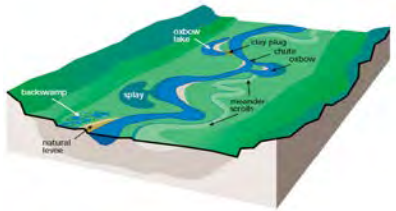
Source: DID Manual 2009

STRUCTURAL MEASURE

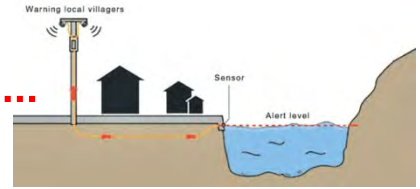


NON STRUCTURAL MEASURE

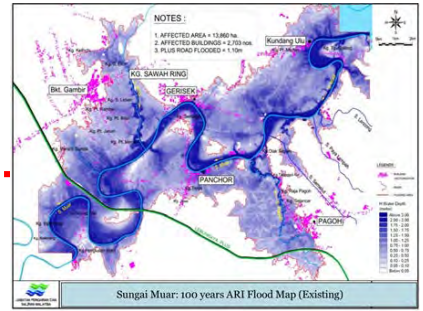
1. FLOOD PLAIN MANAGEMENT



2. FLOOD FORECASTING AND WARNING SYSTEM



3. FLOOD MAP



4. LAND USE PLANNING

5. EDUCATIONAL AND AWARENESS PROGRAMME

6. DEVELOPMENT PLANNING

FLOOD PROOFING

Guideline on Flood Proofing

STRATEGIES AND OPTIONS FOR INTEGRATED FLOOD MANAGEMENT

1 REDUCING FLOODING

- Dams And Reservoirs
- Dikes, Levees And Flood Embankments
- High Flow Diversions
- Catchment Management
- Channel Improvements

2 REDUCING SUSCEPTIBILITY TO DAMAGE

- Floodplain Regulation
- Development And Redevelopment Policies
- Design And Location Of Facilities
- Housing And Building Codes
- Flood Proofing
- Flood Forecasting And Warning

3 MITIGATING THE IMPACTS OF FLOODING

- Information And Education
- Disaster Preparedness
- Flood Insurance

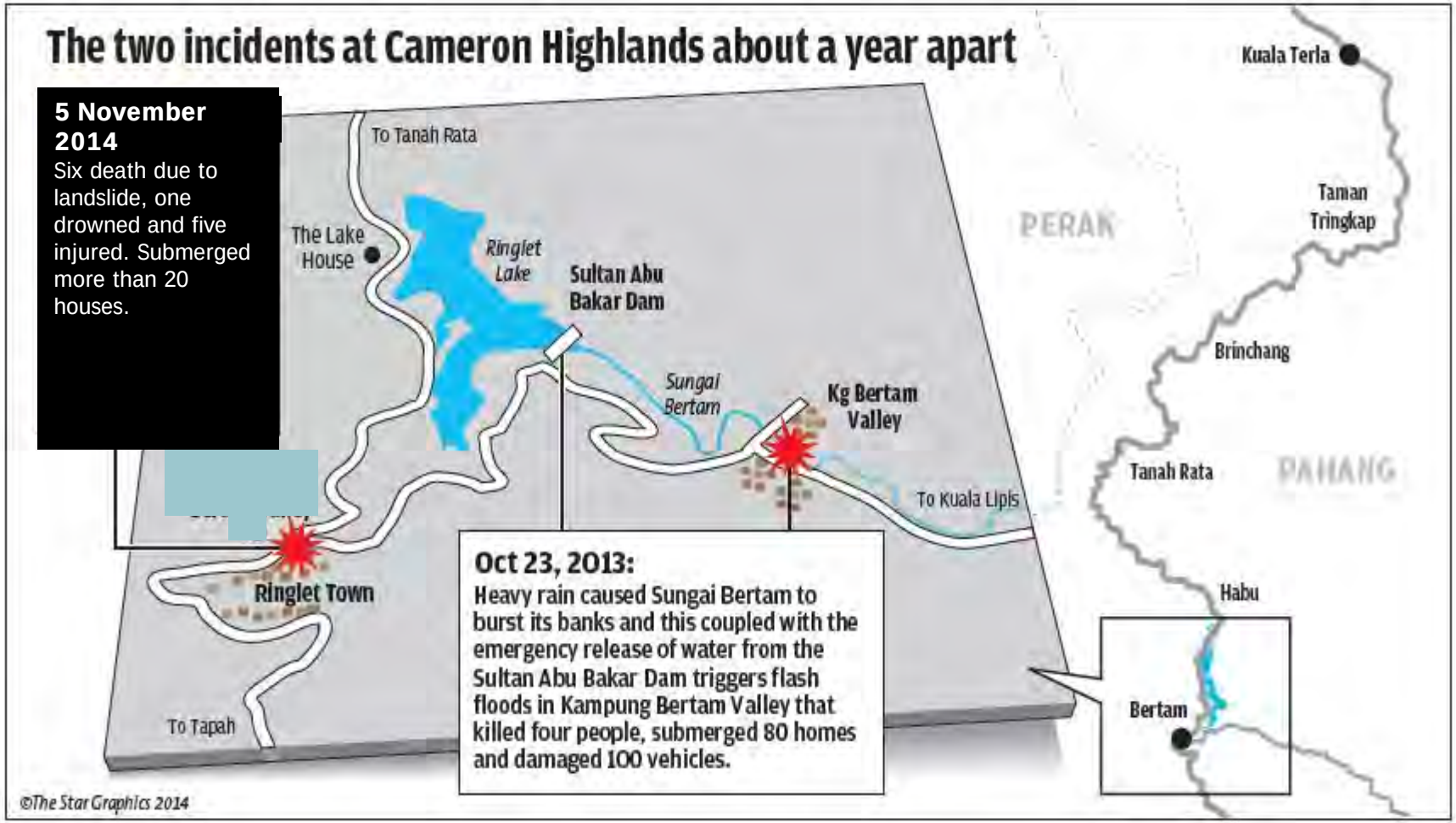
4 PRESERVING THE NATURAL RESOURCES OF FLOOD PLAINS

- Floodplain Zoning And Regulation

Integrated Flood Management – Malaysia Initiatives

IMPLEMENTING THE STRUCTURAL MEASURES

RTB LEMBAH BERTAM, CAMERON HIGHLANDS, PAHANG


The two incidents at Cameron Highlands about a year apart
5 November 2014
Six death due to landslide, one drowned and five injured. Submerged more than 20 houses.
To Tanah Rata
The Lake House
Ringlet Lake
Sultan Abu Bakar Dam
Sungai Bertam
Kg Bertam Valley
To Kuala Lipis
Ringlet Town
To Tapah
Oct 23, 2013:
Heavy rain caused Sungai Bertam to burst its banks and this coupled with the emergency release of water from the Sultan Abu Bakar Dam triggers flash floods in Kampung Bertam Valley that killed four people, submerged 80 homes and damaged 100 vehicles.
Kuala Terla
Taman Tringkap
PERAK
Brinchang
Tanah Rata
PAHANG
Habu
Bertam
©The Star Graphics 2014

FLOODING ON 5 NOVEMBER 2014

RIVER IMPROVEMENT WORK

CONSTRUCTION OF BRIDGE

Bridge MDCH 1

Bridge MDCH 2

CONSTRUCTION OF BRIDGE

Bridge MDCH 3

Bridge Kebun 1 dan 2

CONSTRUCTION OF DROP STRUCTURE

Drop Structure 1 - CH 100

Drop Structure 2 - CH 200

Drop Structure 3 - CH 300

Drop Structure 4 - CH 1450

CONSTRUCTION OF FLOOD WARNING SYSTEM

Stesen 1 - CH850

-Telemetry Rainfall
- Siren
- Water Level
- Web Camera

Stesen 2 - CH1700

- Water Level
- Web Camera

Stesen 3 – CH6000

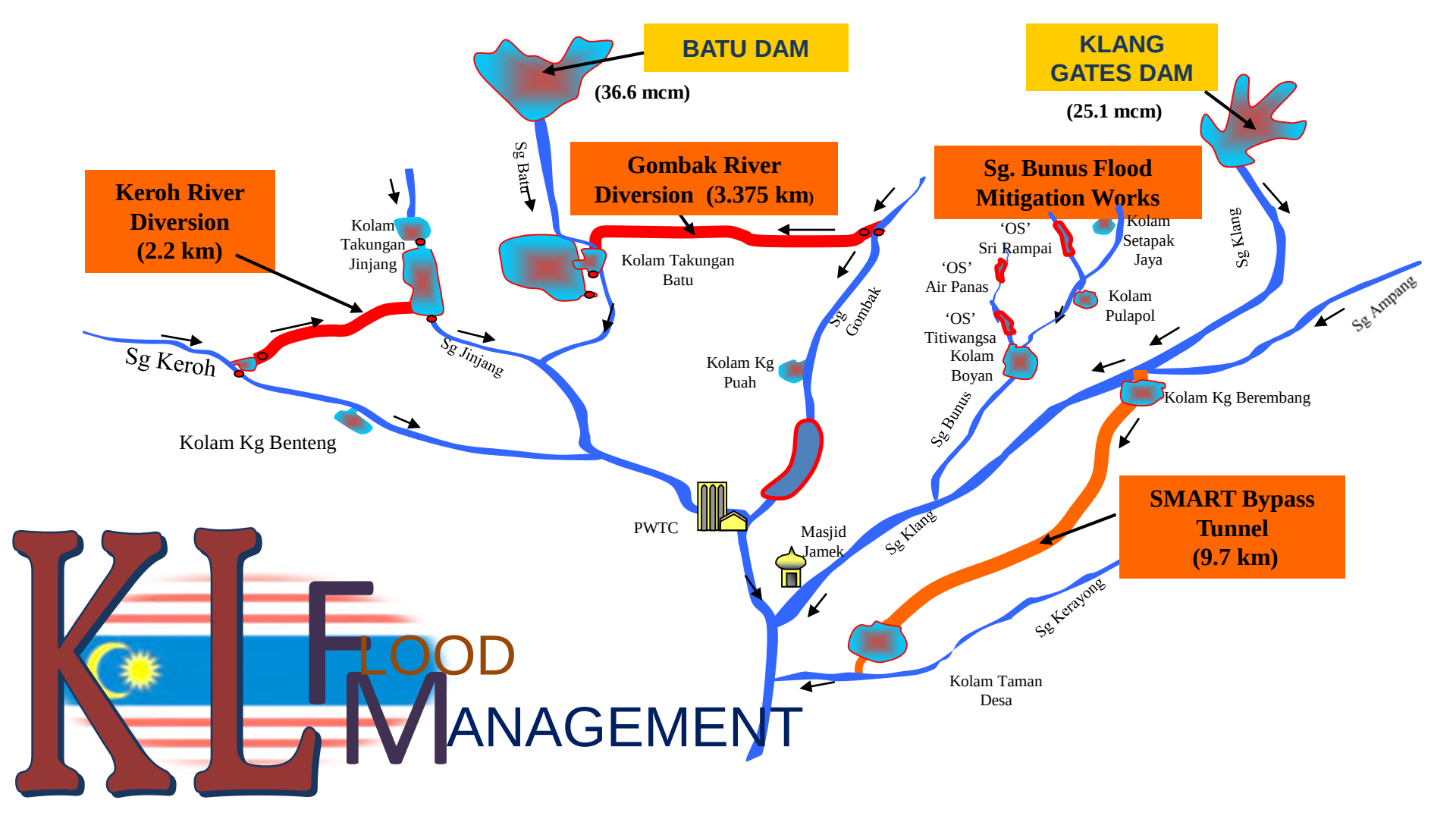
- Telemetry Rainfall
- Water Level

PROJECT COMPLETED NOVEMBER 2016

IMPLEMENTING THE STRUCTURAL MEASURES

KUALA LUMPUR FLOOD MANAGEMENT (KLFM)

1. STORMWATER MANAGEMENT AND ROAD TUNNEL (SMART)
2. FLOOD MITIGATION PROJEK SUNGAI BUNUS
3. FLOOD BYPASS GOMBAK AND KERUH

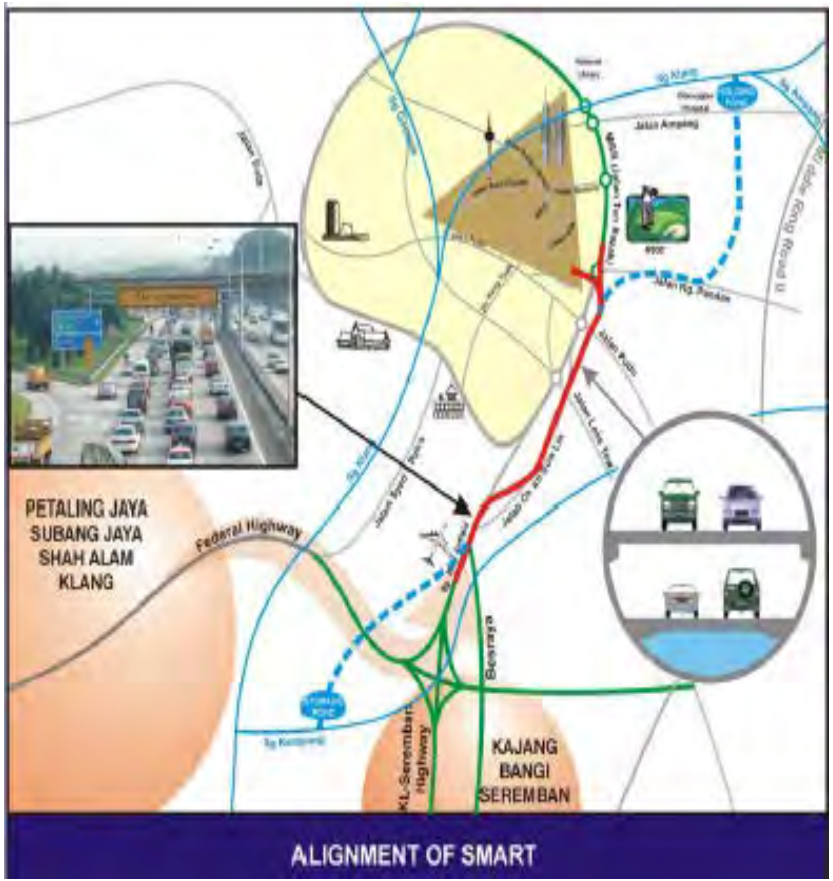


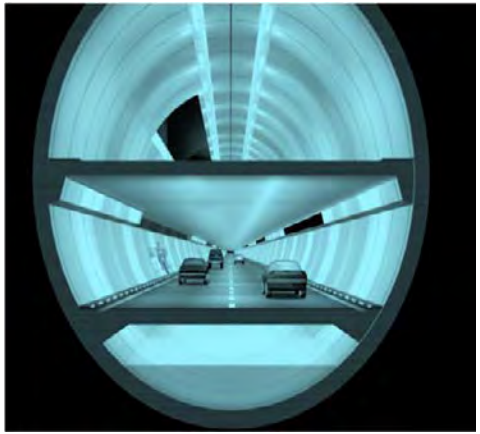
KL FLOOD MANAGEMENT

1. SMART – Flood Impact Area

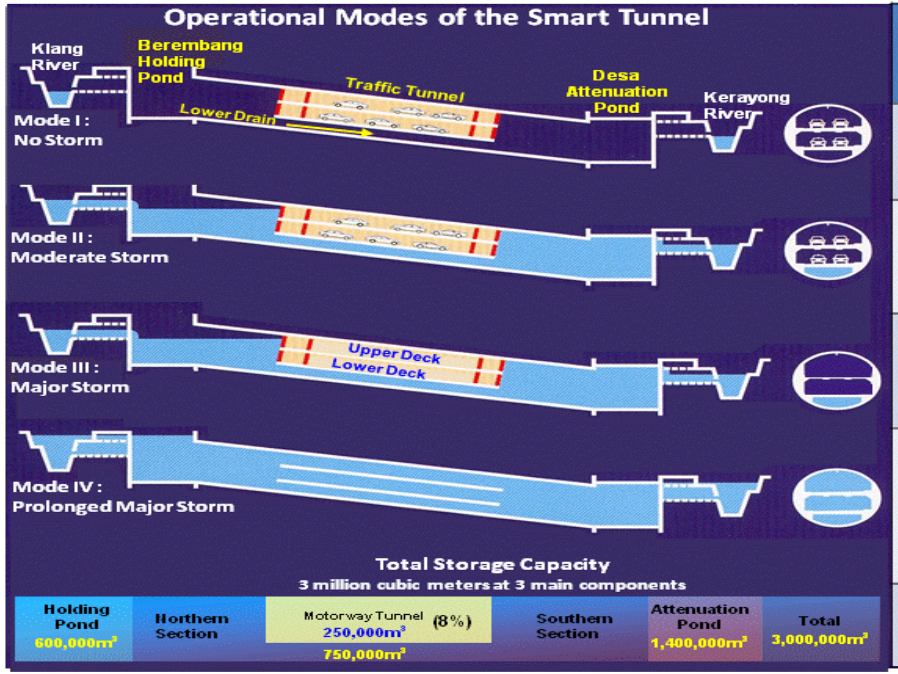
0.5 km^2 – 700,000 people
Damage cost USD 27.1 Million/Year (RM112 Million/Year)

1. SMART – Alignment





1. SMART – Event Mode 2, 3 and 4 (2007-2015)



Traffic Evacuation	Flow Thru' Lower Drain	Flow Thru' Traffic Tunnel	Mode	
✗	✗	✗	I	
✗	✓	✗	II	182 event
✓	✓	✗	III	81 event
✓	✓	✓	IV	5 event

EVENT MODE 4

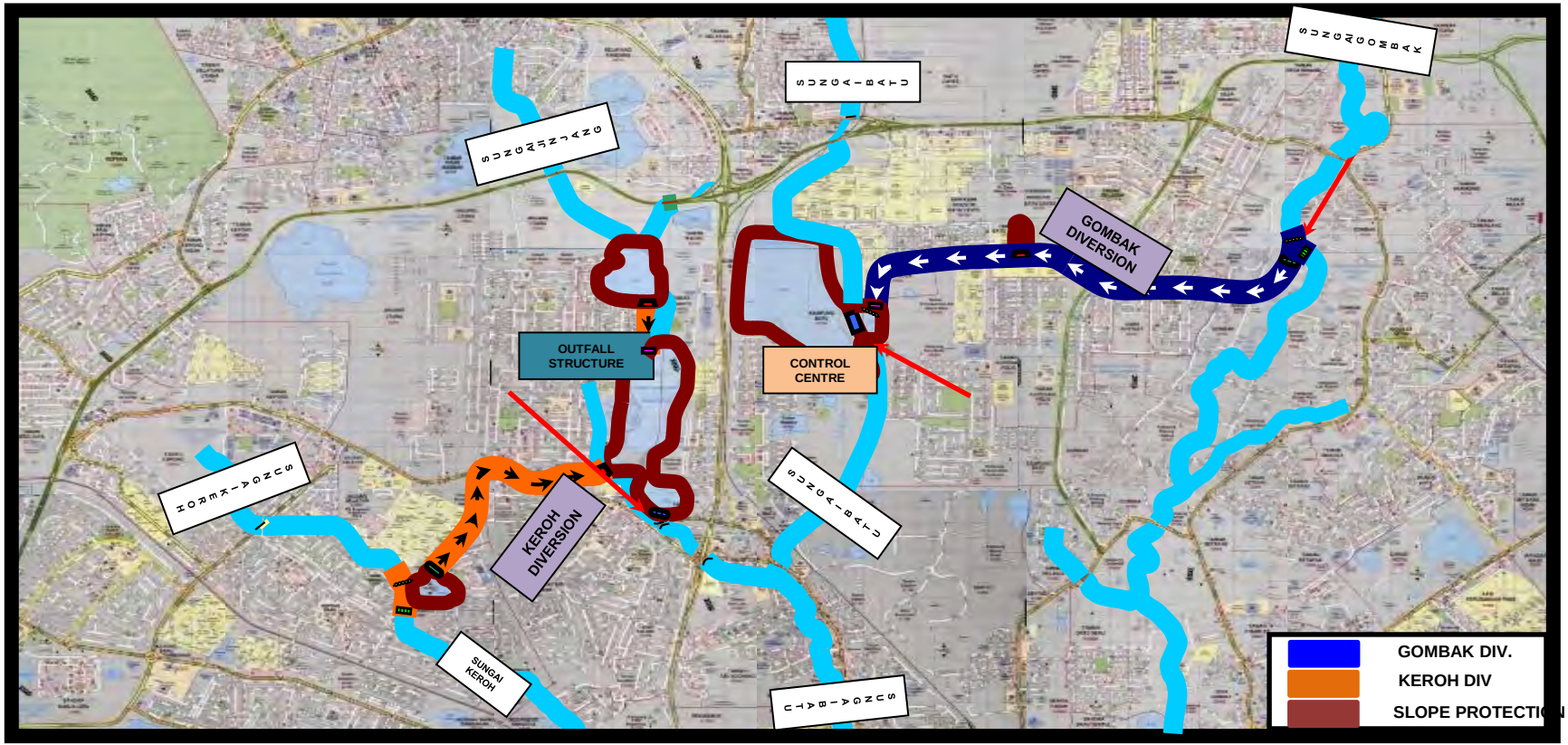
2008
1 event

2011
1 event

2012
3 event

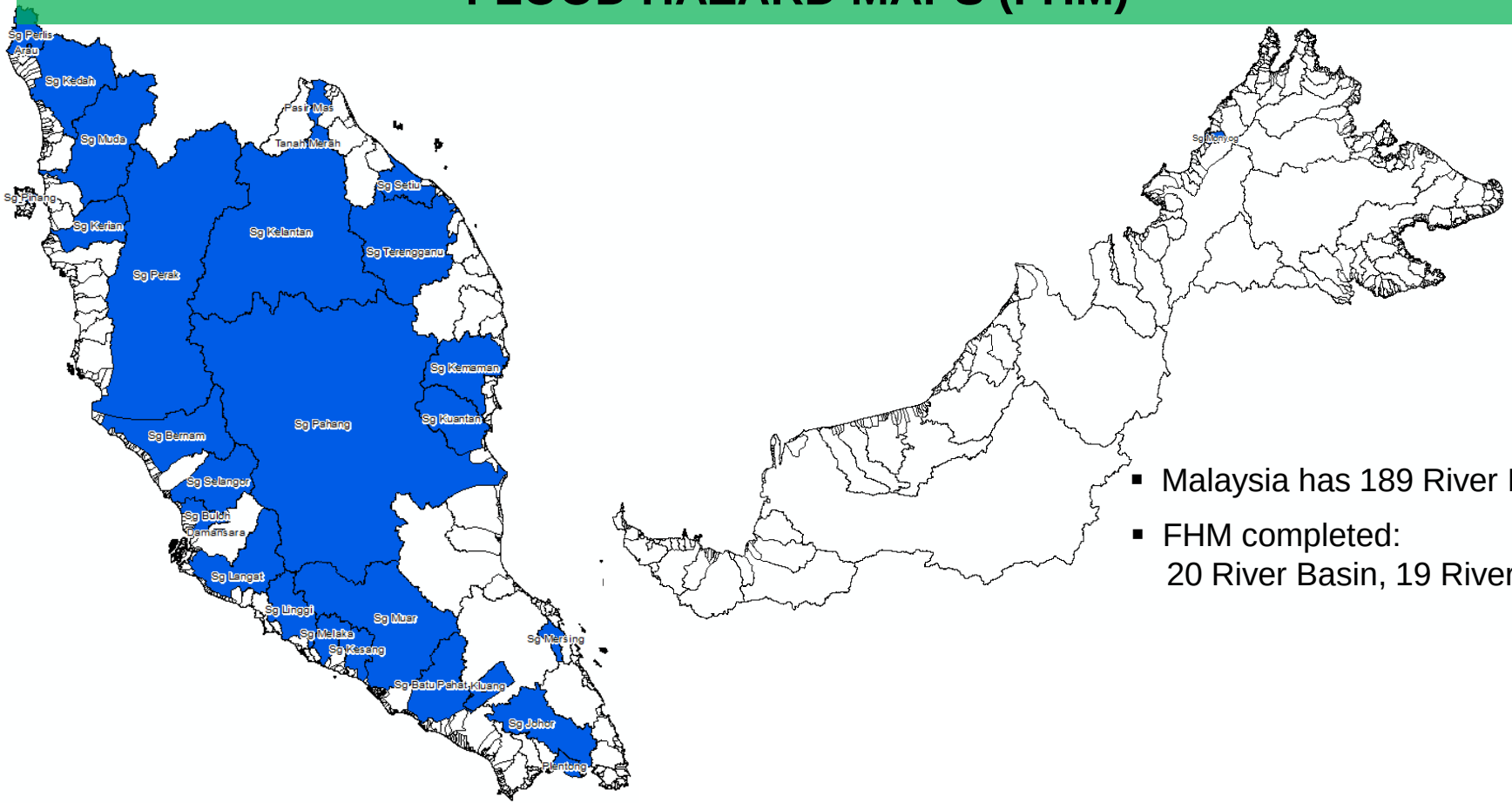
2. FLOOD MITIGATION PROJECT SUNGAI BUNUS

3. FLOOD BYPASS GOMBAK AND KERUH



IMPLEMENTING NON STRUCTURAL MEASURES

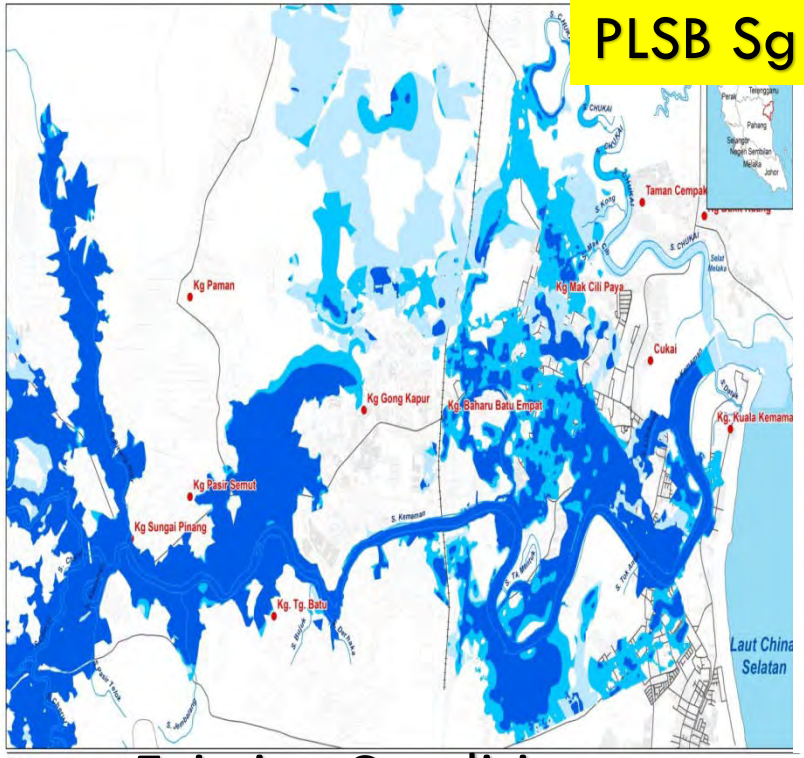
FLOOD HAZARD MAPS (FHM)



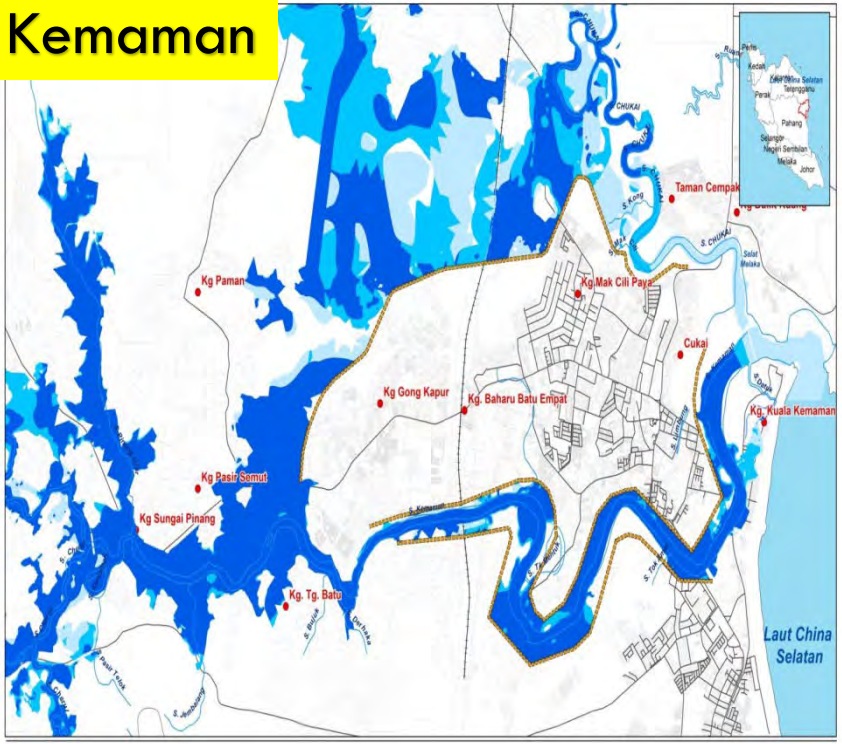
- Malaysia has 189 River Basin
- FHM completed:
  20 River Basin, 19 River

FLOOD HAZARD MAPS (50 YEARS ARI)

PLSB Sg Kemaman



Existing Condition



Flood Mitigation Condition

- Benefits to197,800 people
- Protected area 30km^2

Source: DID Malaysia, 2018

Challenges on Flood Management

THE CHALLENGES OF FLOOD MANAGEMENT

01

SECURING LIVELIHOODS

Increased population pressure and enhanced economic activities in floodplains, further increase the risk of flooding. Floodplains provide excellent, technically easy livelihood opportunities in many cases

02

RAPID URBANIZATION

Urbanization causes changes in the hydrological response of watersheds, and affects landforms, water quality and habitat. Population growth and migration towards unplanned urban settlements in the floodplains of developing countries increase the vulnerability of the poorest sectors of society to flooding.

03

THE ILLUSION OF ABSOLUTE SAFETY FROM FLOODING

Designing for high frequency floods entails a greater risk of disastrous consequences when more extreme events take place. Failures can occur when some structural measures are inadequately maintained due to long-term disuse or lack of finances, and may no longer function properly.

04

ECOSYSTEM APPROACH

IRBM + IWRM + IFM : encompass the main principles of the ecosystem approach by considering the entire basin ecosystem as a unit and by accounting for the effects of economic interventions in the basin as a whole.

05

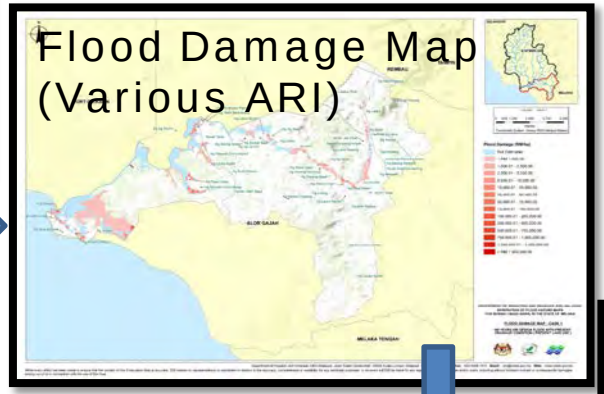
CLIMATE VARIABILITY AND CHANGE

Climate change poses a major conceptual challenge as it shakes the foundation of the normal assumption that the long-term historical hydrological conditions will continue into the future. Tackling climate change requires leadership, vision, capacity, and resources beyond our experiences to date.

Way Forward

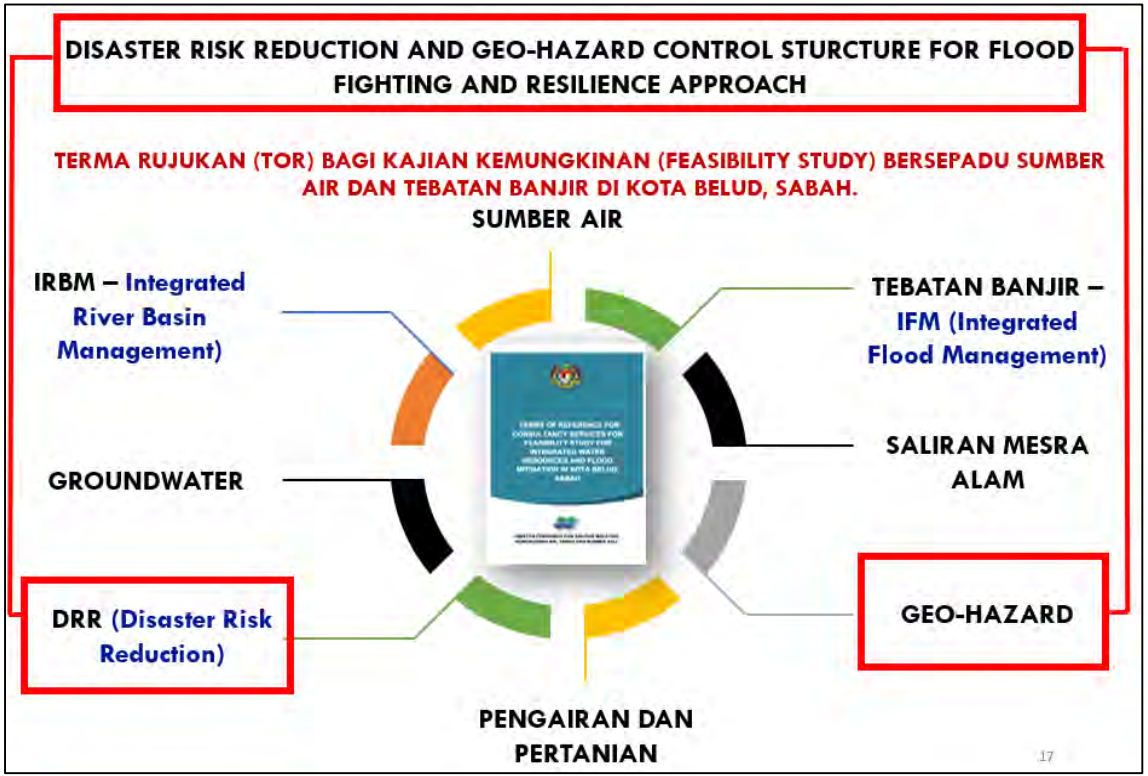
Flood Damage Assessment

Multiply Unit Damage Rates with Relevant Damage Factor for each pixel



Sum the results of the multiplication to produce the weighted average damage for each pixel.

Develop Masterplan/Feasibility Study



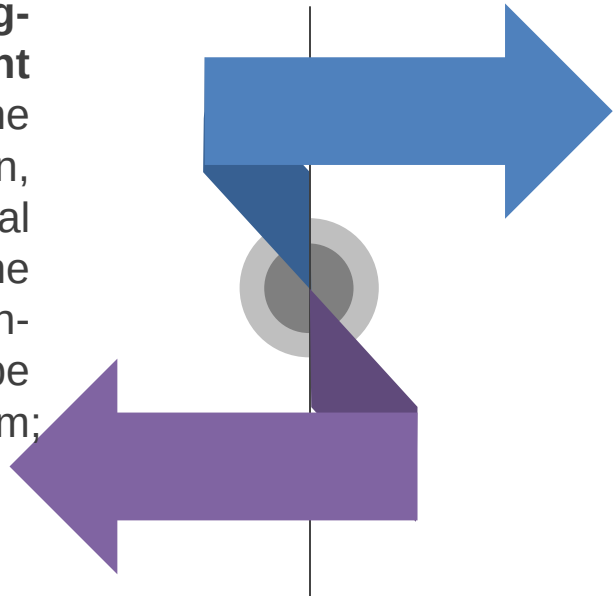
*Establish **Community-led CEPA (Communication, Education and Public Awareness)** Program through **Disaster Risk Reduction (DRR)** Program. DRR is the concept and practice of reducing disaster risks through systematic efforts to analyse and reduce the causal factors of disasters. It aims at reducing the damage caused by natural hazards like earthquakes, floods, and landslides, through an ethic of prevention.*

3. Conclusion

Conclusion

Integrated Flood Management

The most **successful long-term flood management strategies** will balance the implementation of short-run, quick gain, non- structural measures with a vision of the best suite of structural and non-structural measures to be implemented for the longer term;



Understanding the required resources, the best and worst case scenarios and the tipping points at which action becomes imperative, rather than justified, can lead to **better decisions**.

Thank You