

“Time for Solutions”

26 & 27 NOVEMBER 2012

Perbadanan Putrajaya, Putrajaya



FLOOD MAPPING AS A PLANNING AND MANAGEMENT TOOL



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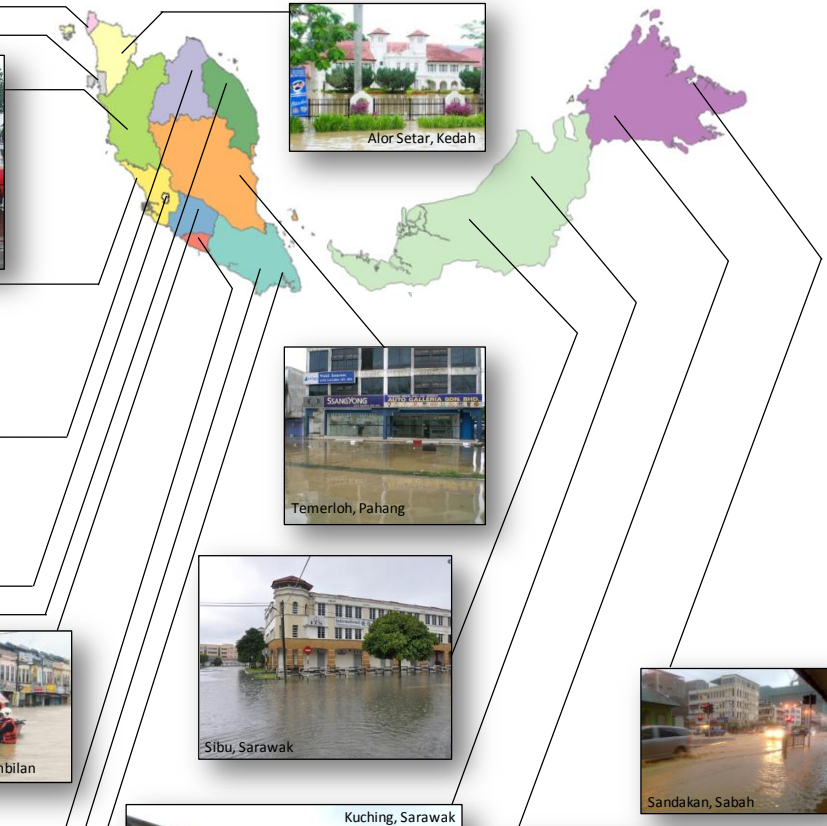
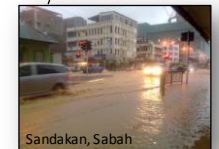
(Dr. Nik & Associates Sdn. Bhd.)



Introduction

- Flood management covers the holistic and continuous assessment, evaluation and reduction of flood hazard and flood risks. As such flood management has three distinct goals:
 - 1) to prevent the further build-up of risks through appropriate and risk-conscious development
 - 2) to reduce existing risks through preventive and preparedness measures
 - 3) to adapt to changing risk factors (e.g. climate change adaptation)
- The authorities should ensure that the information concerning flood prevention and protection plans is transparent and easily accessible to the public. This can be achieved by:
 - ✓ Flood maps point out areas at risk and are necessary for planning. Flood maps should be used for the reduction of damage potential by integrating its outputs into spatial planning and emergency planning.
 - ✓ Information based on Geographic Information Systems (GIS) should be widely diffused and explained. Media plans should be prepared, following an agreed procedure.

FLOOD PHOTOS IN MALAYSIA



Flood Maps

- Flood maps are indispensable tools to show information about hazards, vulnerabilities and risks in a particular area. Only the clear understanding of flood risks permits the authorities to decide on type and scale of appropriate action to avoid, mitigate, transfer, share, or accept the risks.
- There are generally three distinct types of flood maps :
 - ✓ Flood inundation maps indicate the geographical areas which could be covered by a flood according to one or several probabilities
 - ✓ Flood hazard maps shows areas which could be flooded according to three probabilities (low, medium high) complemented with: type of flood, the flood extent; water depths or water level as appropriate; where appropriate, flow velocity or the relevant water flow direction.
 - ✓ Flood risk maps indicate the potential adverse consequences associated with floods under several probabilities, expressed in terms of: the indicative number of inhabitants potentially affected; type of economic activity of the area potentially affected; installation which might cause accidental pollution in case of flooding.

PETA "HAZARD" BANJIR

HAZARD MAP

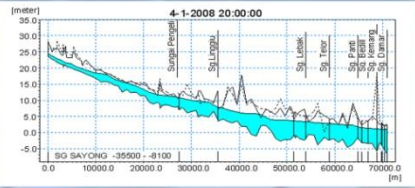
DEFINISI / Definition

Peta Hazard Banjir ialah peta yang menunjukkan kawasan yang boleh dibanjiri berdasarkan tiga kebarangkalian (rendah, sederhana, tinggi) dilengkapi dengan maklumat seperti keluasan banjir dan kedalaman air. Jika sesuai maklumat jenis banjir, paras air, halaju aliran atau arah aliran arus banjir juga boleh dipamerkan.

Flood hazard map shows areas which could be flooded based on three probabilities (low, medium high) complemented with information such as the flood extent and water depths. Where appropriate, type of flood, water level, flow velocity or water flow direction is also shown on the map.

PROSES / Process

Peta Hazard Banjir dihasilkan daripada analisis hidrologi dan hidraulik yang dijana oleh pemodelan lembangan sungai. *Hazard Map is produced from the hydrology and hydraulic analyses generated by the river catchment modelling.*

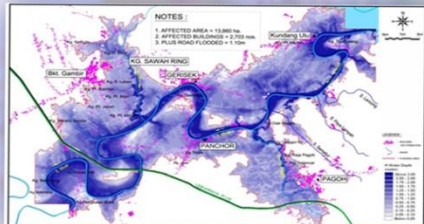


DATA YANG DIPERLUKAN / Data Needed

- Ciri Kawasan Tadahan / Catchment Characteristics
- Jajaran Sungai / River Alignment
- Keratan Rentas Sungai / River Cross Section
- Model 3D Permukaan Bumi / 3D Elevation Model
- Imej Satelit / Satellite Image
- Foto Udara / Aerial Photo
- Guna Tanah / Land Use
- Jenis Tanah / Soil Type
- Infrastruktur / Infrastructure

OUTPUT

Keluasan banjir berdasarkan kebarangkalian banjir atau peristiwa banjir lalu / *Flood Extent According to Probability or Past Event*
 Kedalaman banjir / *Flood Depth*
 Halaju aliran air banjir / *Flow Velocity*
 Serakan gelombang / *Propagation of Wave*

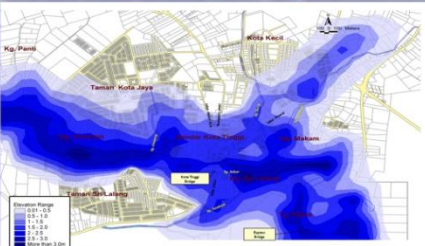


CONTOH - CONTOH / Examples

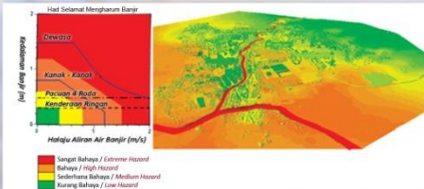
Peta Hazard Banjir bagi Sungai Buloh / *Hazard Map for Sungai Buloh*



Peta Hazard Banjir bagi Kota Tinggi / *Hazard Map for Kota Tinggi*



Hubungkait Antara Kedalaman dan Halaju Air / Relationship between Depth and Velocity of Water



PETA RISIKO BANJIR

FLOOD RISK MAP

DEFINISI / Definition

Peta Risiko Banjir ialah peta yang menunjukkan potensi kerugian akibat banjir berdasarkan beberapa tahap seperti risiko rendah, risiko sederhana dan risiko tinggi.

Flood risk map shows the potential adverse consequences associated with floods under several levels such as low risk, medium risk and high risk.

PROSES / Process

Peta Risiko Banjir dihasilkan daripada gabungan kebarangkalian peristiwa banjir dengan nilai potensi kerugian akibat banjir kepada alam sekitar dan aktiviti ekonomi yang berkaitan.

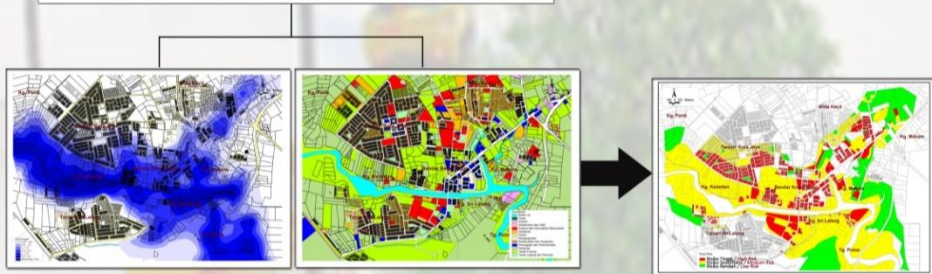
Flood risk is produced from the combination of the probability of a flood event and of the potential adverse consequences to the environment and economic activity associated with a flood event.

Peta Risiko Banjir dihasilkan daripada operasi spatial yang dijana menggunakan perisian teknologi informasi dan geografi seperti Geographic Information System (GIS).

Flood Risk Map is produced from the spatial operation using Information and Geographical Technology Software such as Geographic Information System (GIS).

$$\text{Risiko Banjir} = \text{Kebarangkalian Peristiwa Banjir} \times \text{Potensi Kerugian Akibat Banjir}$$

$$\text{Flood Risk} = \text{Probability of Hazardous Process} \times \text{Potential Adverse Consequence}$$



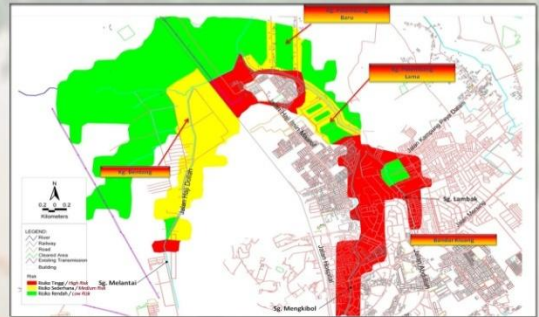
- Peta Hazard Banjir / Flood Hazard Map**
- Keluasan Banjir / Flood Extent
 - Kedalaman Banjir / Flood Depth
 - Halaju Aliran Air / Flow Velocity

- Peta Indeks Kemudahterancaman / Vulnerability Index Map**
- Populasi / Population
 - Aset & Aktiviti ekonomi / Economic Asset & Activities
 - Isu Alam Sekitar / Environmental Issues

Peta Risiko Banjir / *Flood Risk Map*

OUTPUT

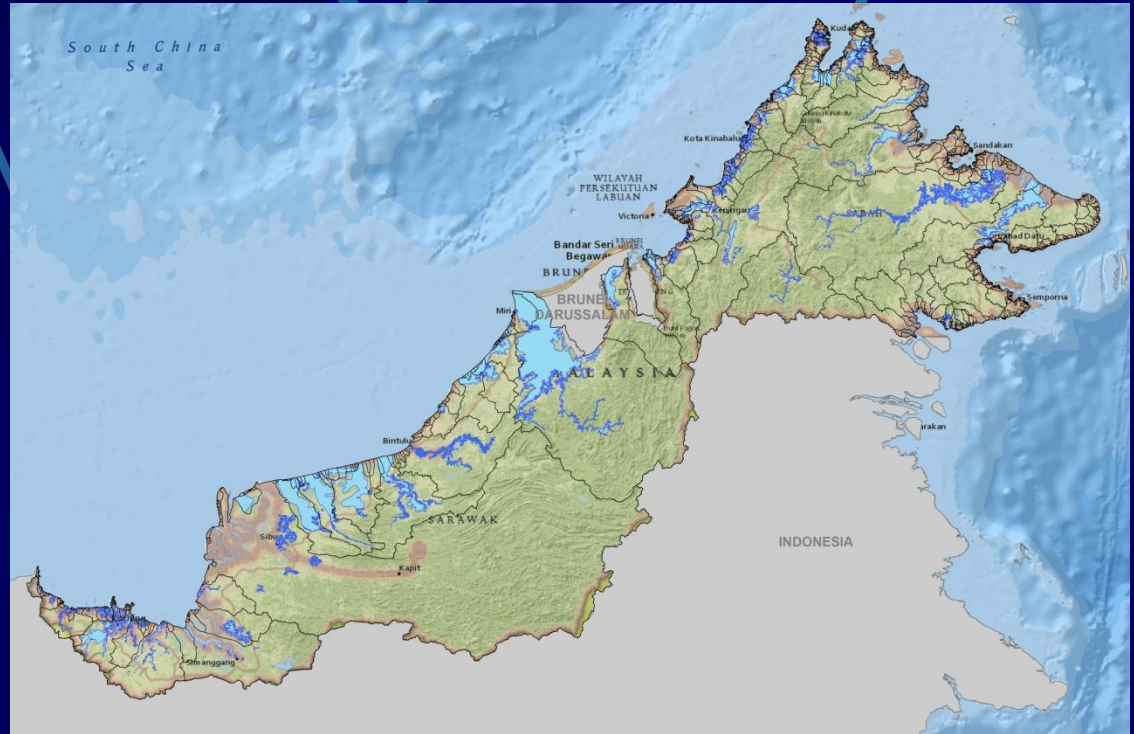
- Keluasan banjir / *Flood Extent*
- Zon Risiko banjir / *Flood-Risk Zone*
- Risiko aset-aset / *Asset Risk*
- Kemudahterancaman Banjir / *Flood Vulnerability*
- Kemungkinan Kerosakan / *Probable Damages*
- Kemungkinan Kerugian / *Probable Loss*



Purpose of Flood Maps

- The purpose of flood hazard / flood risk mapping is the geographical identification and illustration of areas at different level of risk from flood hazard.
- In this respect flood maps need to be designed to meet the end-user needs.
- This is important in order to convey the complex messages about flooding and flood risk.
- In general, flood mapping addresses the effects of flooding and those effects are represented in hazard and risk mapping.
- However, for management purposes the cause of flooding are of very high importance. Early warning systems, warn and alarm schemes, clearance of channels etc. are fully based on the cause and development of flood events. This has to be kept in mind when performing flood mapping.

FLOODED AREAS IN MALAYSIA



Reported as of year 2010:

- Total of flood-affected area = 32,460 km²
- 9.8 % of Total area of the country (330,803 km²)
- Total of people affected = 5.677 mil
- 21 % of Total Population = 27,566mil

Production of Flood Maps

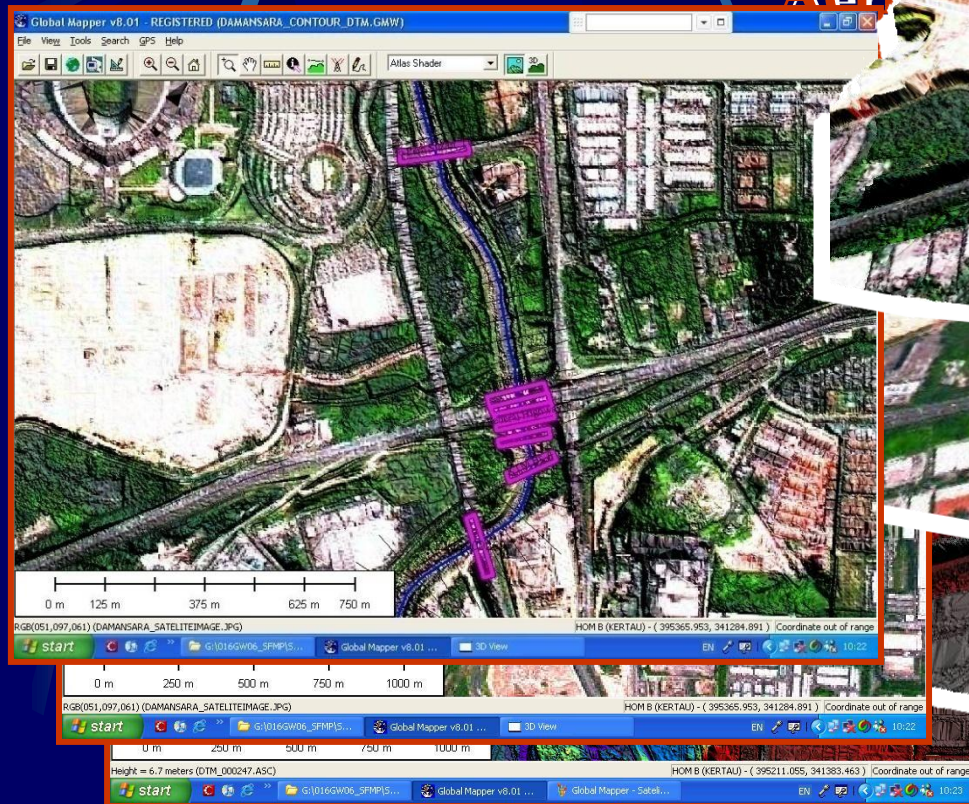
- Database Requirements :-
 - ✓ Topography, river survey, digital elevation models (DEM) - To enable accuracy of inundation modelling as well as to secure the identification of the endangered properties detailed
 - ✓ Historical data - very important for public awareness raising as well as for the calibration of flood modelling such as event flood maps, flood level records, velocity records (gauge), flood marks, newspapers relating flood events, flood reports, aerial and satellite photos.
 - ✓ Land use and related data - Population data; land cover and projected land use maps; depth-damage relationships for different land use and property classes from research and evidence of flooding over many years, looking at the economic losses incurred - both tangible and intangible; basic services: transportation, energy supply, communication, water supply, sewerage, healthcare, social, and education facilities; environmental consideration; cultural heritage areas; etc.

GIS Processing

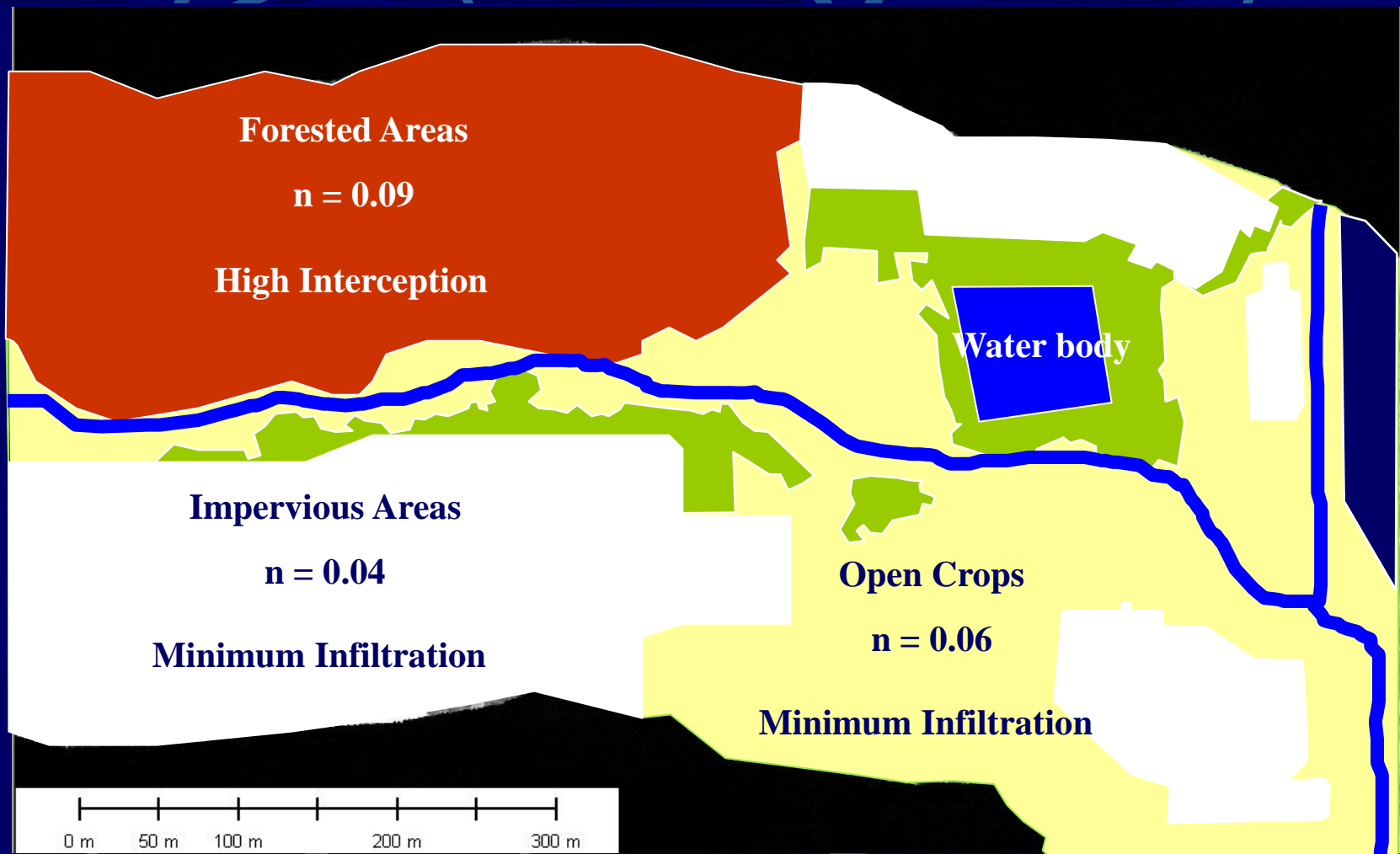
3-D Terrain Model

Superimposing of

Aerial

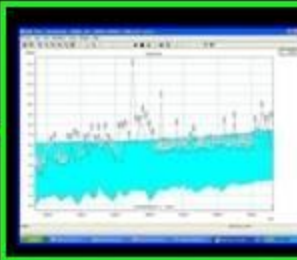
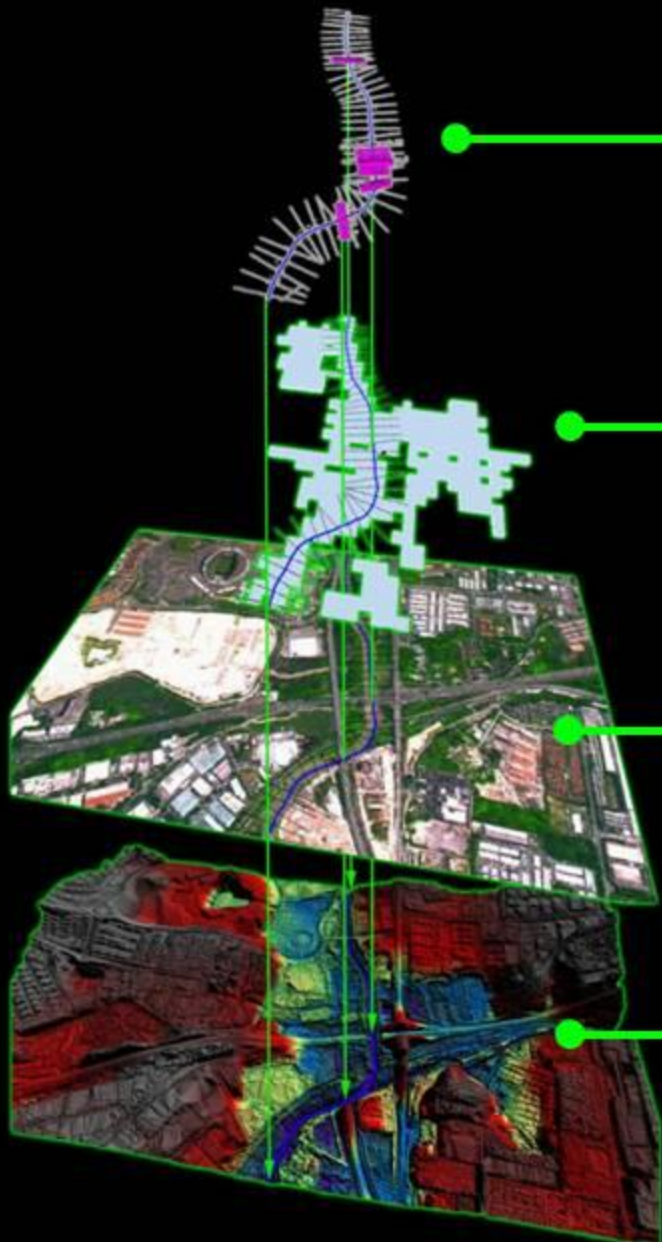


Intensity & Resistance Map

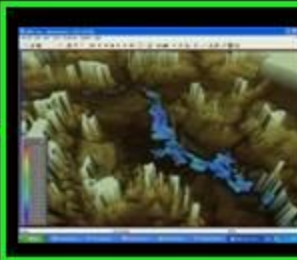


Production of Flood Maps

- Flood Modelling :-
 - ✓ Hydrological modelling - Various rainfall-runoff models or statistical models are used to determine flood hydrographs which are input data of hydrodynamic models.
 - ✓ Hydrodynamic modelling - River flood routing (flood propagation in rivers) can be described by one dimensional (1D) mathematical model. This solution is suitable for the modelling of inundation of open floodplains as well but in case of sophisticated morphological conditions application of quasi 2D or 2D models might be necessary. There is a wide range of tools for this modelling.
 - ✓ Large flood plain areas - projection method is used for large areas with little slope and requires an approximate DEM and design water levels; propagation method is for sloping terrain and requires an approximate DEM and basic 1D modelling
 - ✓ Coastal flooding - both flood projection and 2D modelling can be used for coastal inundation modelling



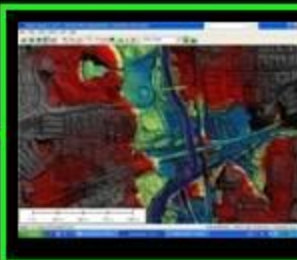
**1-D MIKE 11
HYDRODYNAMIC
RIVER MODEL**



**2-D MIKE 21
HYDRODYNAMIC
FLOODPLAIN MODEL**



**SPOT 5
SATELITE IMAGERY**



**1M x 1M GRID
LIDAR SURVEY DEM
(0.3M ACCURACY)**

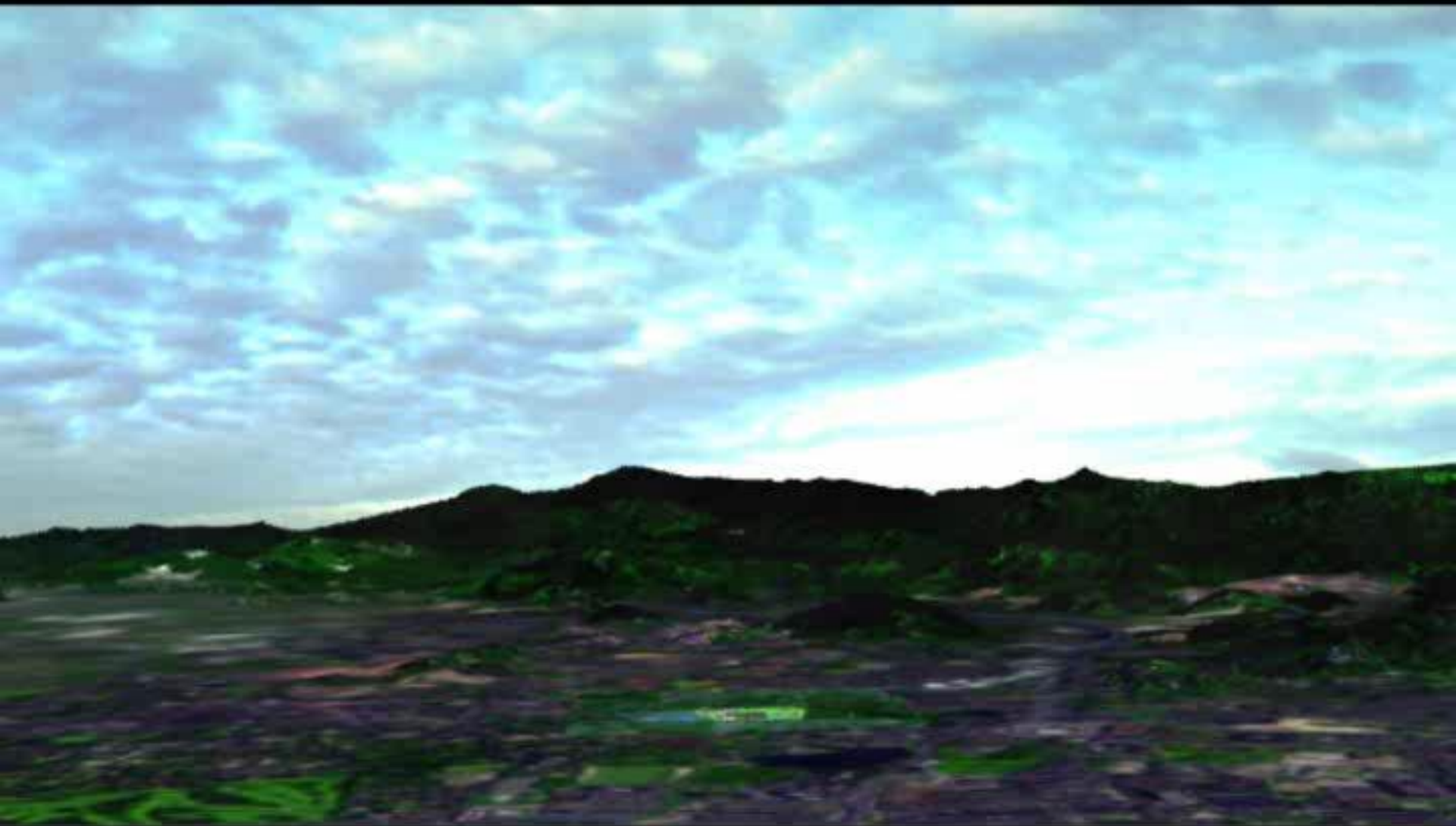
Production of Flood Maps

- Layout issues and GIS approaches are to help ensure that the content of the maps is correctly understood and that the maps might convey the relevant information to their users, thus achieving the objectives for which they have been developed :-
 - ✓ Basic and explanatory information – Title including its purpose, intended use and ARI, responsible authority, date of preparation / publication, legend, method of development, limitations, disclaimer, North and scale
 - ✓ Meta-data - should be provided where maps are issued / downloadable in GIS format, information necessary for use of the GIS data, including the map projection, datum levels used, coordinate system and height reference system so that the data can “communicate” with other information like warning levels etc.
 - ✓ Background mapping or imagery - showing topography, towns / buildings, roads, rivers and waterbodies, land use or ortho-rectified aerial photographs are normally used to provide geographical reference for the flood information
 - ✓ Location and navigation - identify the geographical location
 - ✓ North and scale: preferably using scale bar as this allows for changes in page size
 - ✓ Colour palettes and symbols - different colours (or shades of a single colour) may be used to present multiple parameters (such as flood extents for multiple flood frequencies, flood depths within a given flood extent, or classes of flood hazard or risk) in a clear and comprehensible format on a single map.
 - ✓ Numerical flood data - visualisation can be supplemented with numerical data, such as values of water level or flow, either directly as text on the map or in a table on the legend. Such data can also be provided as attributes or tables associated with the flood maps where the maps are issued or downloadable in digital GIS format.

Flood Map Usage

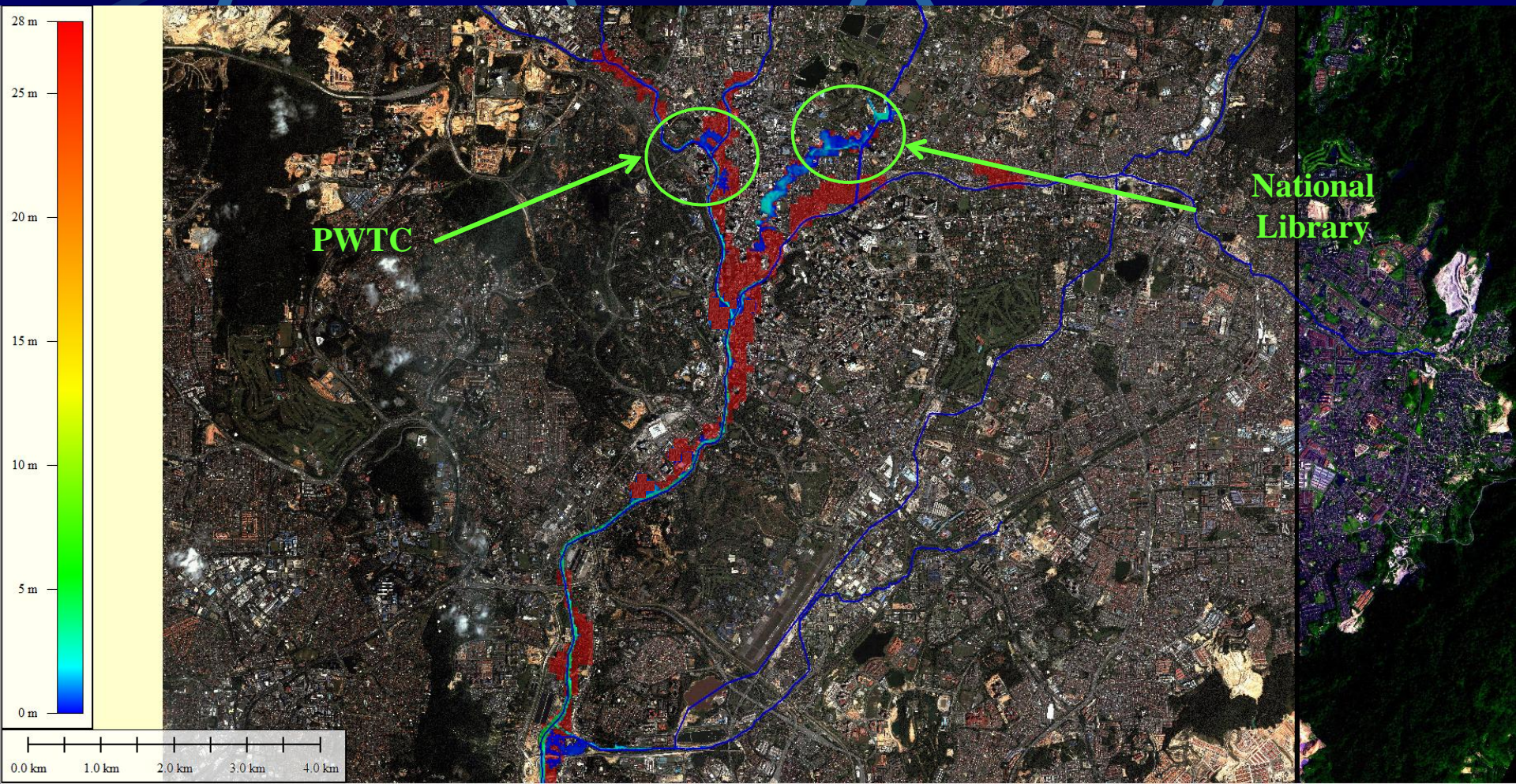
- Flood maps are used by many different stakeholders. The maps serve at least one of the three purposes of flood risk management:
 - 1) prevent the build-up of new risks (planning and construction),
 - 2) reduce existing risks, and
 - 3) adapt to changing risks factors.
- Depending on the purpose, the stakeholders have very specific demands on content, scale, accuracy or readability of the map. Flood maps are primarily used for:
 - ✓ Flood Risk Management Strategy (prevention, mitigation)
 - ✓ Land-use planning, land management
 - ✓ Emergency planning
 - ✓ Public Awareness raising
 - ✓ Private sector, in particular insurance sector

Flood Diversion into SMART



Comparison of Flood Maps

- No SMART, No BatuJinjang Scheme
- With SMART, With BatuJinjang Scheme



Flood Extent / Inundation Map

- The flood extent map is the most widely distributed and it is normally used for :
 - Serves as a basic product to establish hazard maps and risk maps
 - Land use planning (legally binding)
 - City, village and rural planning
 - Risk management
 - Awareness building (particularly when combined with past events)

**Sg Batu @
Sentul**
– WL 33.81m



Jalan Kolam Air

**Sg Gombak @
Jalan Tun Razak**
– WL 31.20m



**Segambut (Berita
Harta)**



**Segambut (Utusan
M'sia)**



Jalan Segambut (The Star)

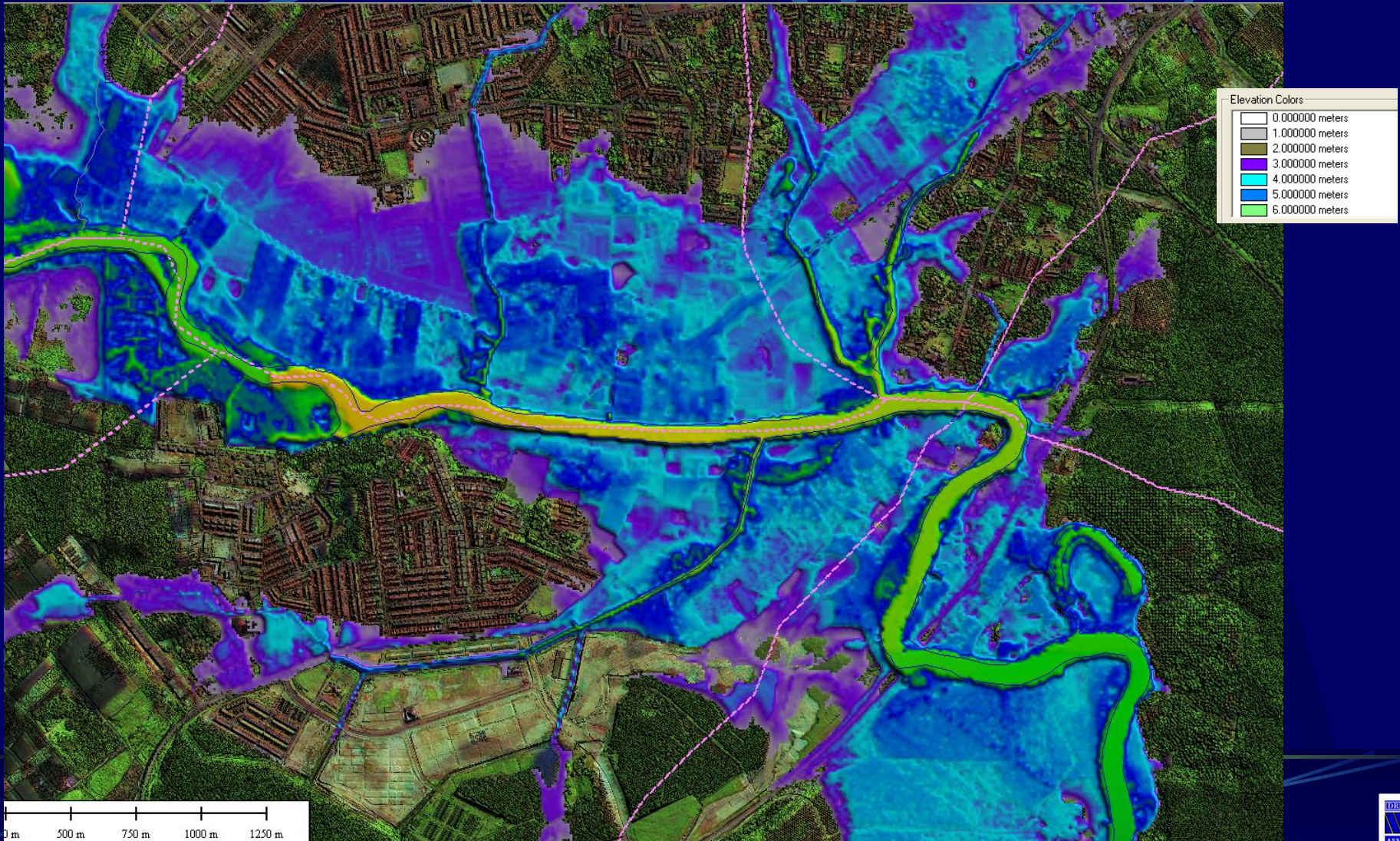


Jalan Tun Razak (NST)

Flood Depth Map

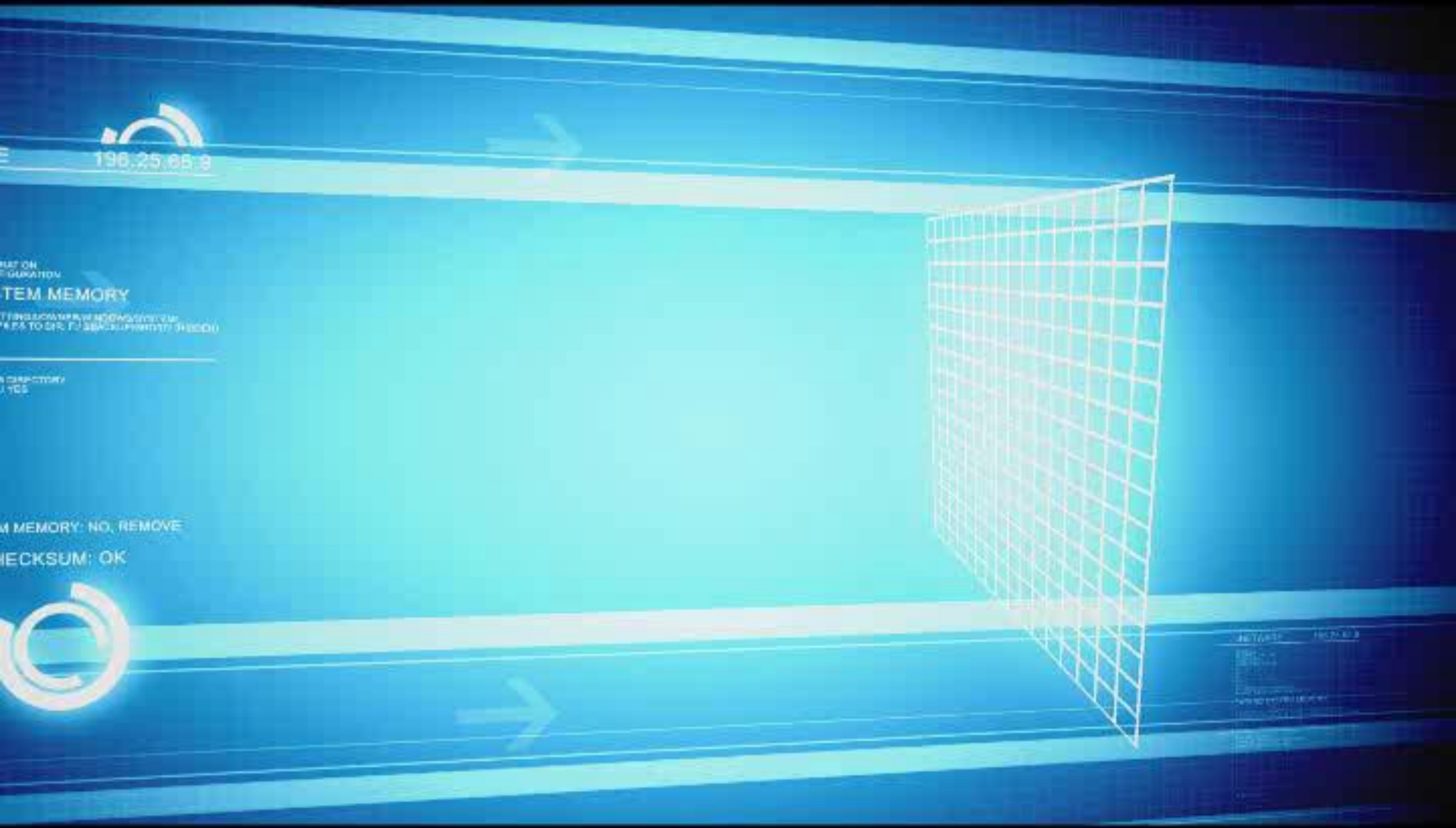
- The values of water level (depth) can be derived from flow models (2D and 1D) for river flooding, from statistical analyses or from observations.
- Normally in rivers numerical models have to be used and for lakes and sea statistical methods can be used. There is a wide range of applications of such maps :
 - Serve as a basic product to establish danger and flood damage maps
 - City and village planning
 - Risk management (evacuation)

Jan 07 Flood Depth Map for Kota Tinggi



Flow Velocity and Flood Propagation Map

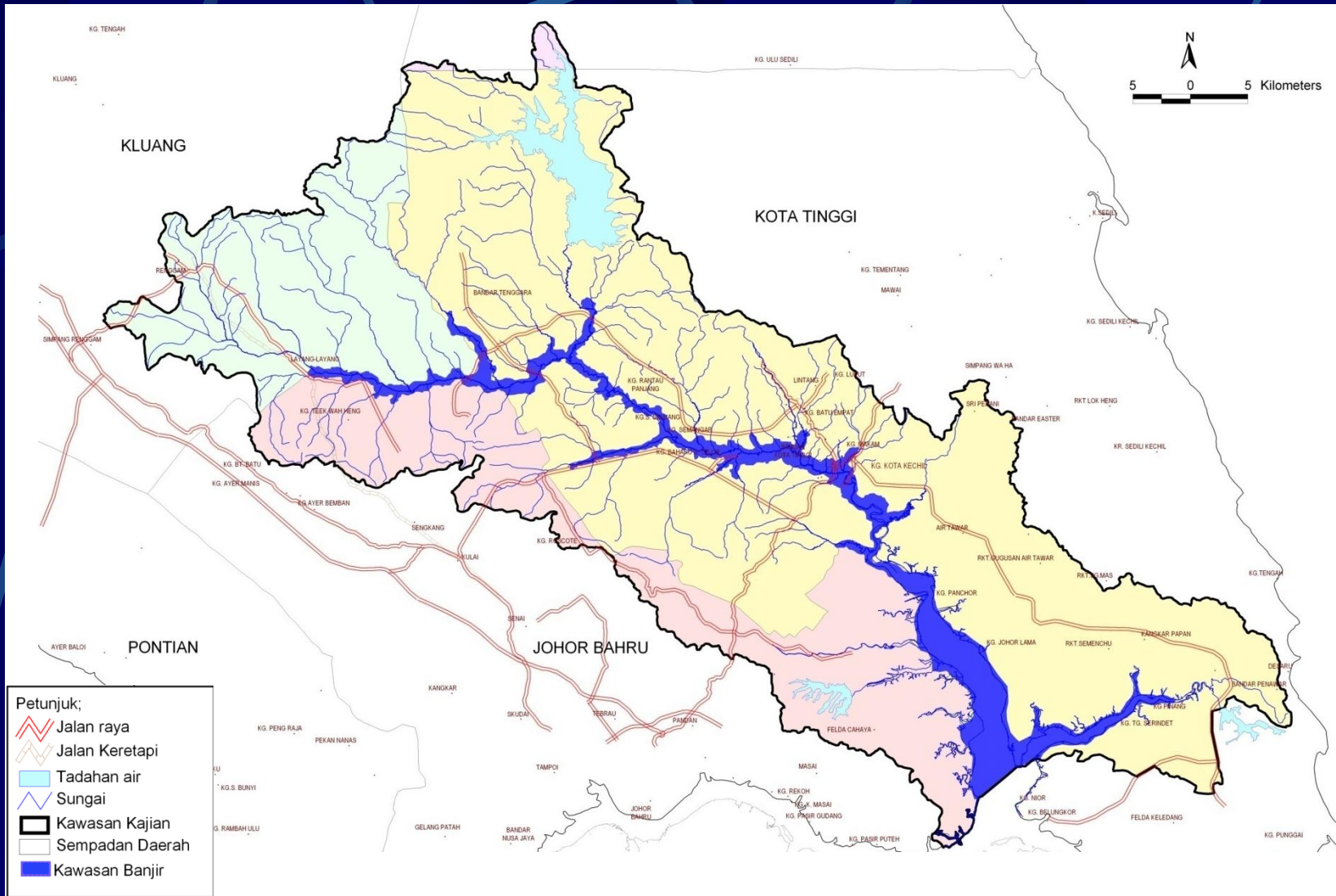
- Flow velocity information is much more difficult to get than water depth information.
- Normally reasonable flow velocity information can be derived only from 2D-flow models and in some cases also from 1D-flow models :
 - Flow velocity: planning of flood defence measures or any structure within the flood area.
 - Flood propagation: Planning tool for emergency response. Evacuation schemes, implementation of temporal flood protection measures. The information requires a well-functioning early warning and alert system.



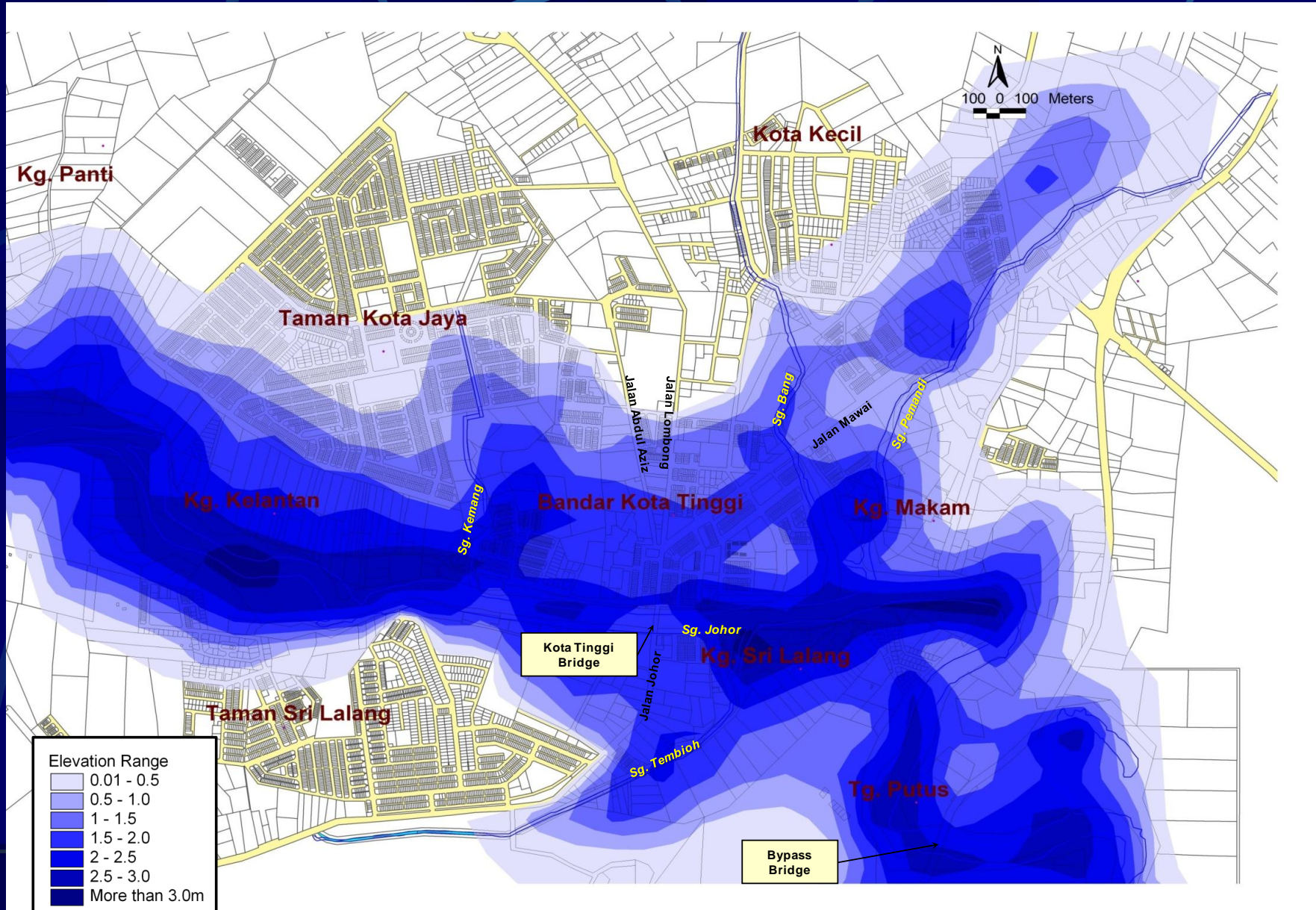
Flood Hazard Map

- The flood hazard map combines various flood parameters to form a level (degree) of danger (depth, velocity, debris often combined with recurrence interval).
- The information can be of qualitative or quantitative type. The colour scheme utilised is of particular importance as the colours represent also the level of severity, i.e. a direct link to possible impact :
 - Planning tool on town/village level. Direct implementation of danger levels into land-use plans is possible.
 - Awareness rising
 - Emergency response

Flood Extent for Sungai Johor Catchment



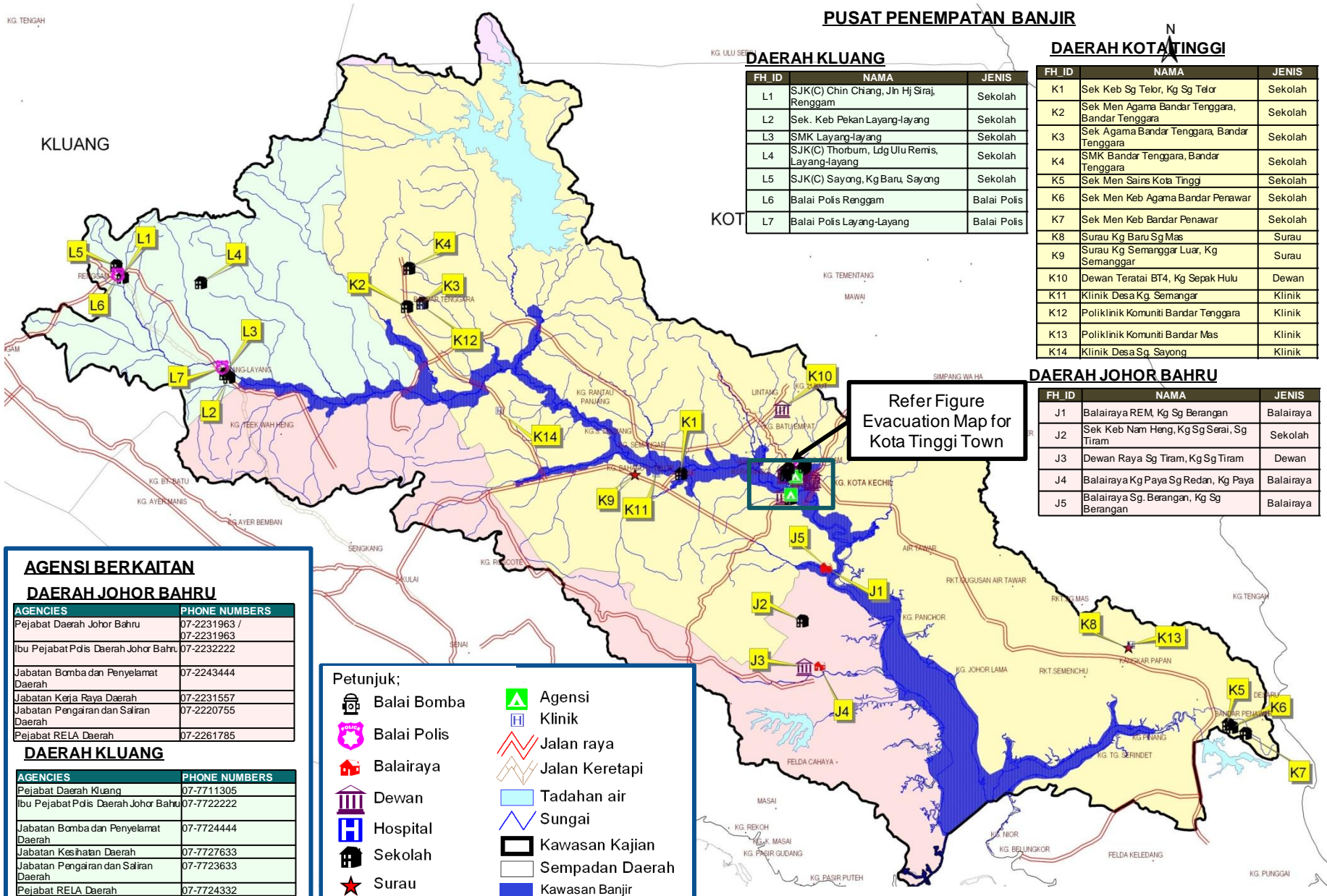
Flood Hazard Map (Kota Tinggi Town)



EVACUATION MAP FOR OVERALL SUNGAI JOHOR CATCHMENT)

KG. TENGAH

KLUANG



PUSAT PENEMPATAN BANJIR

DAERAH KLUANG

FH ID	NAMA	JENIS
L1	SJK(C) Chin Chiang, Jln Hj Sraja, Renggam	Sekolah
L2	Sek. Keb Pekan Layang-layang	Sekolah
L3	SMK Layang-layang	Sekolah
L4	SJK(C) Thorburn, Ldg Ulu Remis, Layang-layang	Sekolah
L5	SJK(C) Sayong, Kg Baru, Sayong	Sekolah
L6	Balai Polis Renggam	Balai Polis
L7	Balai Polis Layang-Layang	Balai Polis

DAERAH KOTA TINGGI

FH ID	NAMA	JENIS
K1	Sek Keb Sg Telor, Kg Sg Telor	Sekolah
K2	Sek Men Agama Bandar Tenggara, Bandar Tenggara	Sekolah
K3	Sek Agama Bandar Tenggara, Bandar Tenggara	Sekolah
K4	SMK Bandar Tenggara, Bandar Tenggara	Sekolah
K5	Sek Men Sains Kota Tinggi	Sekolah
K6	Sek Men Keb Agama Bandar Perawar	Sekolah
K7	Sek Men Keb Bandar Penawar	Sekolah
K8	Surau Kg Baru Sg Mas	Surau
K9	Surau Kg Semanggar Luar, Kg Semanggar	Surau
K10	Dewan Teratai BT4, Kg Sepak Hulu	Dewan
K11	Klinik Desa Kg Semanggar	Klinik
K12	Poliklinik Komuniti Bandar Tenggara	Klinik
K13	Poliklinik Komuniti Bandar Mas	Klinik
K14	Klinik Desa Sg Sayong	Klinik

DAERAH JOHOR BAHRU

FH ID	NAMA	JENIS
J1	Balairaya REM, Kg Sg Berangan	Balairaya
J2	Sek Keb Nam Heng, Kg Sg Serai, Sg Tiram	Sekolah
J3	Dewan Raya Sg Tiram, Kg Sg Tiram	Dewan
J4	Balairaya Kg Paya Sg Redan, Kg Paya	Balairaya
J5	Balairaya Sg. Berangan, Kg Sg Berangan	Balairaya

Refer Figure Evacuation Map for Kota Tinggi Town

AGENSI BERKAITAN

DAERAH JOHOR BAHRU

AGENCIES	PHONE NUMBERS
Pejabat Daerah Johor Bahru	07-2231963 / 07-2231963
Ibu Pejabat Polis Daerah Johor Bahru	07-2232222
Jabatan Bomba dan Penyelamat Daerah	07-2243444
Jabatan Kerja Raya Daerah	07-2231557
Jabatan Pengairan dan Saliran Daerah	07-2220755
Pejabat RELA Daerah	07-2261785

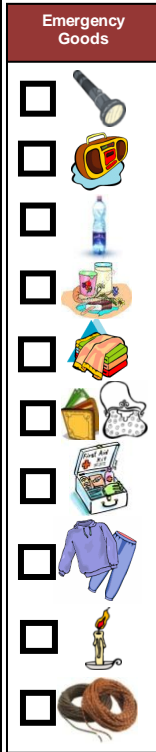
DAERAH KLUANG

AGENCIES	PHONE NUMBERS
Pejabat Daerah Kluang	07-7711305
Ibu Pejabat Polis Daerah Johor Bahru	07-7722222
Jabatan Bomba dan Penyelamat Daerah	07-7724444
Jabatan Kesihatan Daerah	07-7727633
Jabatan Pengairan dan Saliran Daerah	07-7723633
Pejabat RELA Daerah	07-7724332

Petunjuk;

- Balai Bomba
- Balai Polis
- Balairaya
- Dewan
- Hospital
- Sekolah
- Surau
- Agensi
- Klinik
- Jalan raya
- Jalan Keretapi
- Tadahan air
- Sungai
- Kawasan Kajian
- Sempadan Daerah
- Kawasan Banjir

EVACUATION MAP FOR KOTA TINGGI TOWN (100 yr ARI FLOOD)



Legend

	Fire Station
	Police Station
	Community Hall
	Hospital
	School
	Mosque
	Agency
	Clinic
	Road
	Railway
	Water body
	River

Elevation Range

	0.01 - 0.5
	0.5 - 1.0
	1 - 1.5
	1.5 - 2.0
	2 - 2.5
	2.5 - 3.0
	More than 3.0m

Ketua Kampung

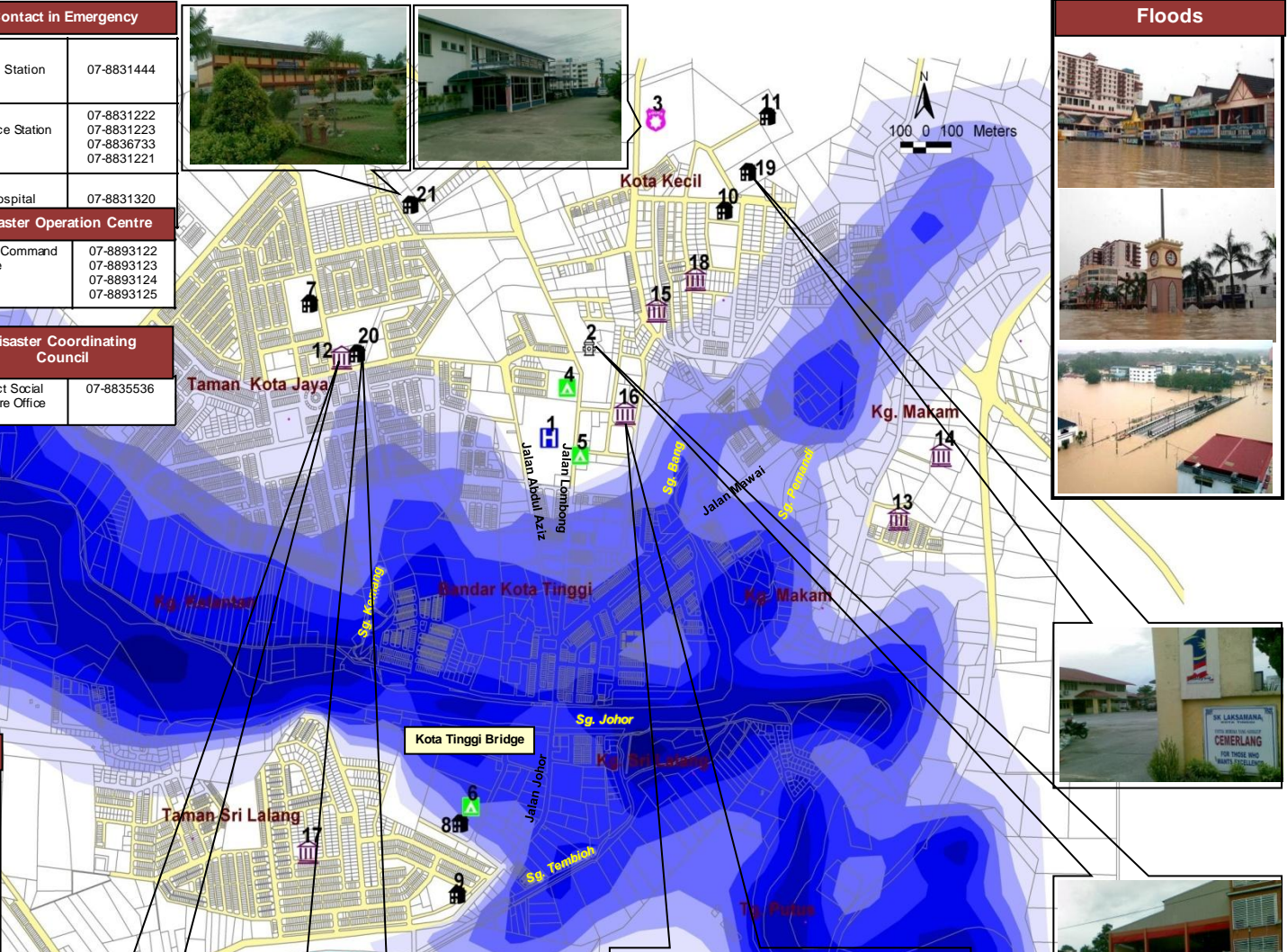
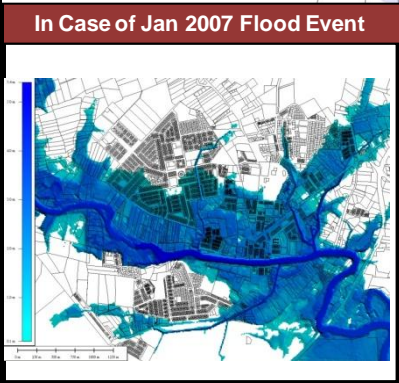
Your Evacuation Centre

Contact in Emergency

Fire Station	07-8831444
Police Station	07-8831222 07-8831223 07-8836733 07-8831221
Hospital	07-8831320
Disaster Operation Centre	
Flood Command Centre	07-8893122 07-8893123 07-8893124 07-8893125

Disaster Coordinating Council

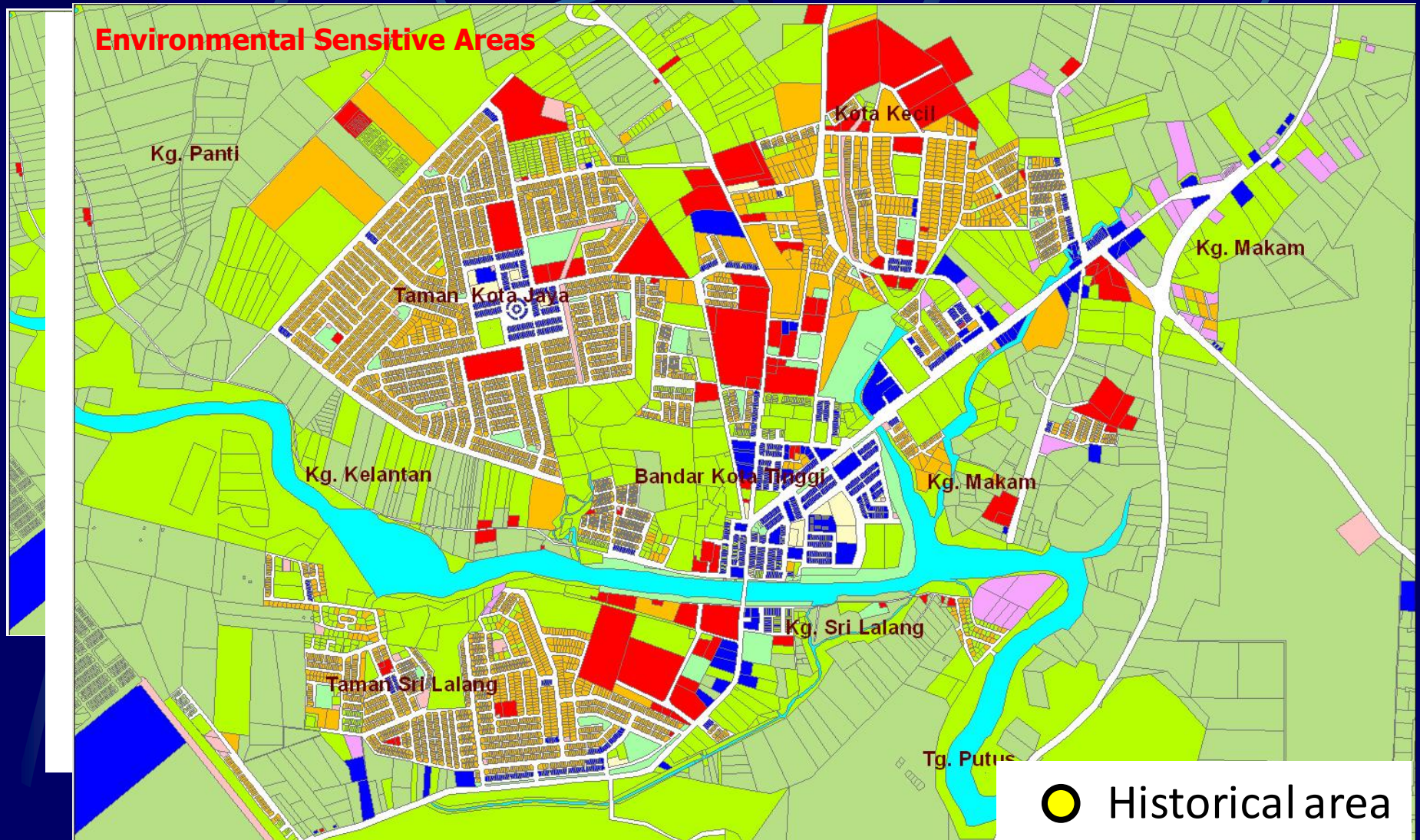
District Social Welfare Office	07-8835536
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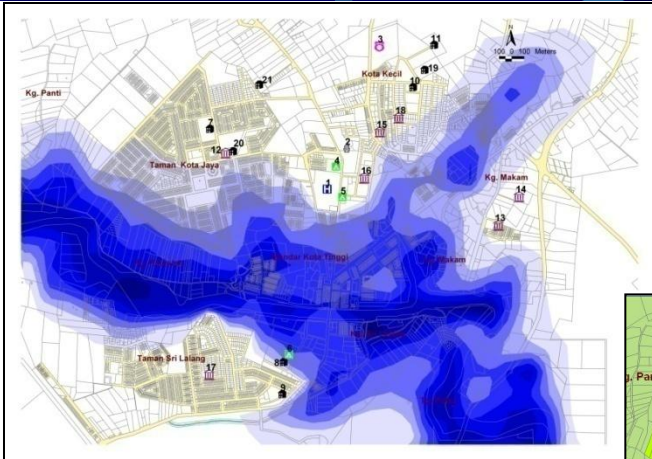


Mapping Assets at Risk (Vulnerability Maps)

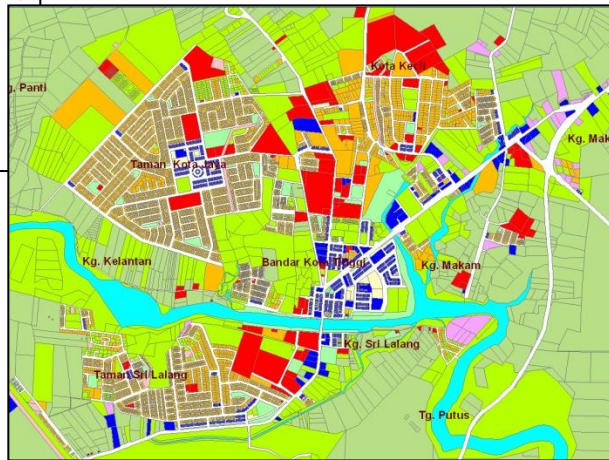
- Mapping the assets at risk means provide information (vulnerability parameters) such as population, assets and economic activity, and environmental issues, potentially affected by a flood.
- The usages of the map are :
 - Basic product to determine damage and risks
 - Emergency management
 - Flood expert (planning of flood defence measures)
 - Land-use planning and land management
 - On small scale (large areas): priority setting

Development of Vulnerability Map





Flood hazard map
~ inundation simulation



Vulnerability Map
~ socio-economic and
environmental condition



**FLOOD
RISK
MAP**

**To identify and
rank the
endangered
areas**

Flood Risk Map

- Flood risk map is the map showing the combination of the probability of a flood event and of the potential adverse consequences to human health, the environment and economic activity associated with a flood event.
- Generally, the risk may be calculated as follows:

Risk (loss per unit area in a given period of time)

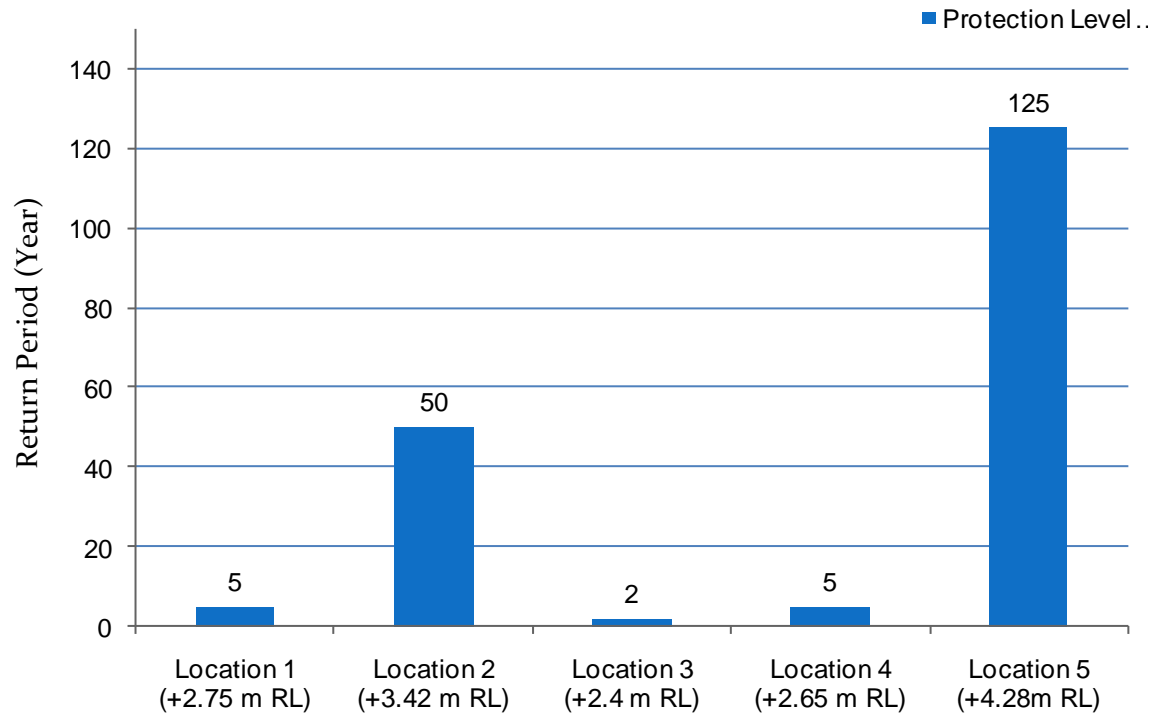
= Vulnerability (C) x probability of the flood hazard (P)

where C (flood damage; loss per unit area) = $V \times S \times E$

V = value of the element at risk: in money terms or human life

S = susceptibility: damaging effect on element at risk (as a function of magnitude of hazard; e.g. depth-damage and damage-duration curves). The susceptibility ranges from 0 to 1.

E = exposure: the probability of the element at risk to be present while the event occurs. The exposure ranges from 0 to 1.



HIGH RISK

- Location 1 - the centre of Kota Tinggi Town along Jalan Abdul Aziz,
- Location 3 - Kampung Makam

MEDIUM RISK

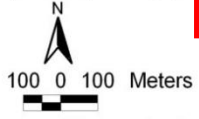
- Location 2 - Taman Kuso
- Location 4 - Kampung Kelantan

LOW RISK

- Location 5 - Taman Kota Jaya

THE BASELINE RISK ASSESSMENT RESULTS

Flood Risk Map (Kota Tinggi Town)



Kg. Pant

Kota Kecil

Kg. Makam

Taman Kota Jaya

Kg. Kelantan

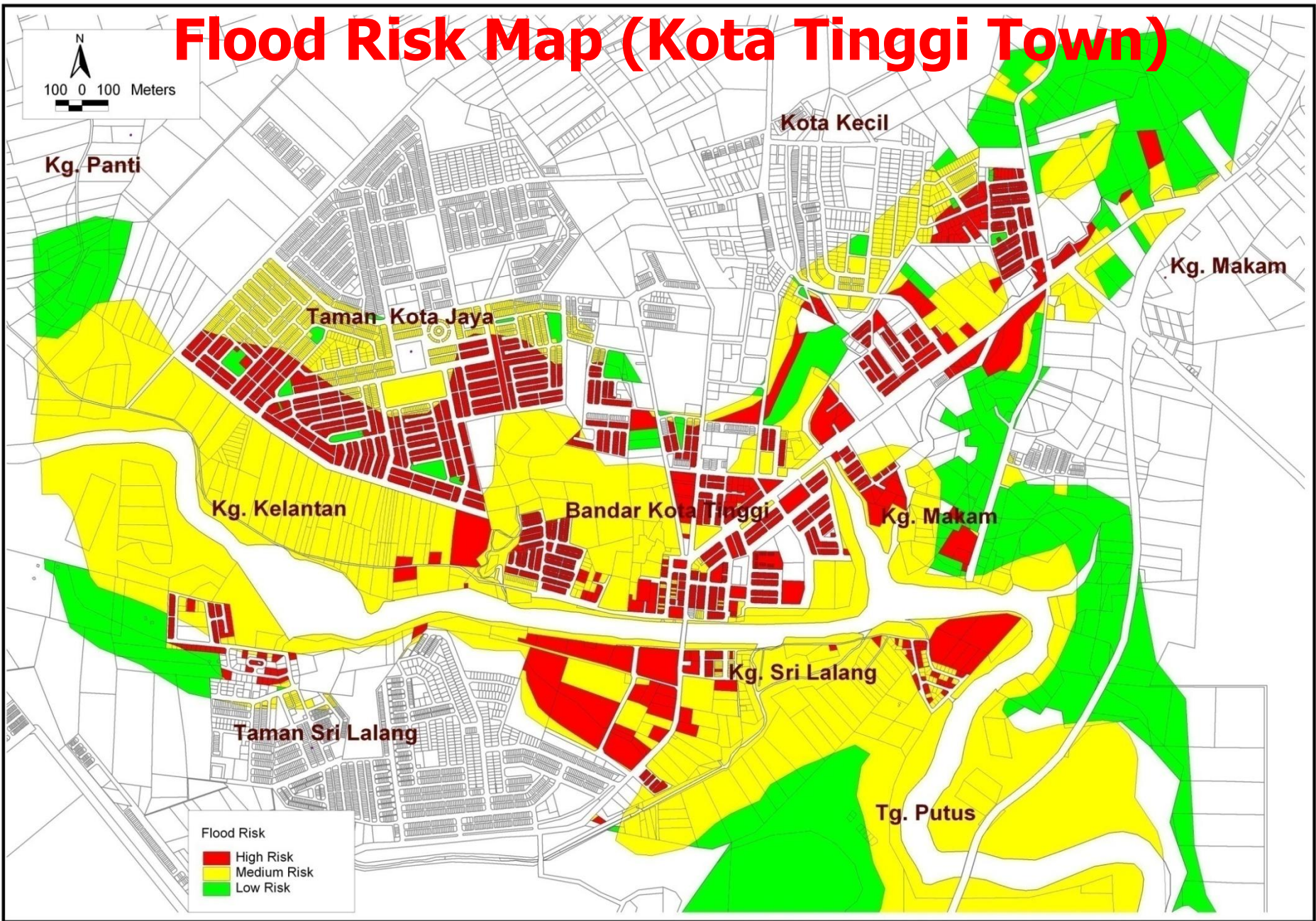
Bandar Kota Tinggi

Kg. Makam

Kg. Sri Lalang

Taman Sri Lalang

Tg. Putus

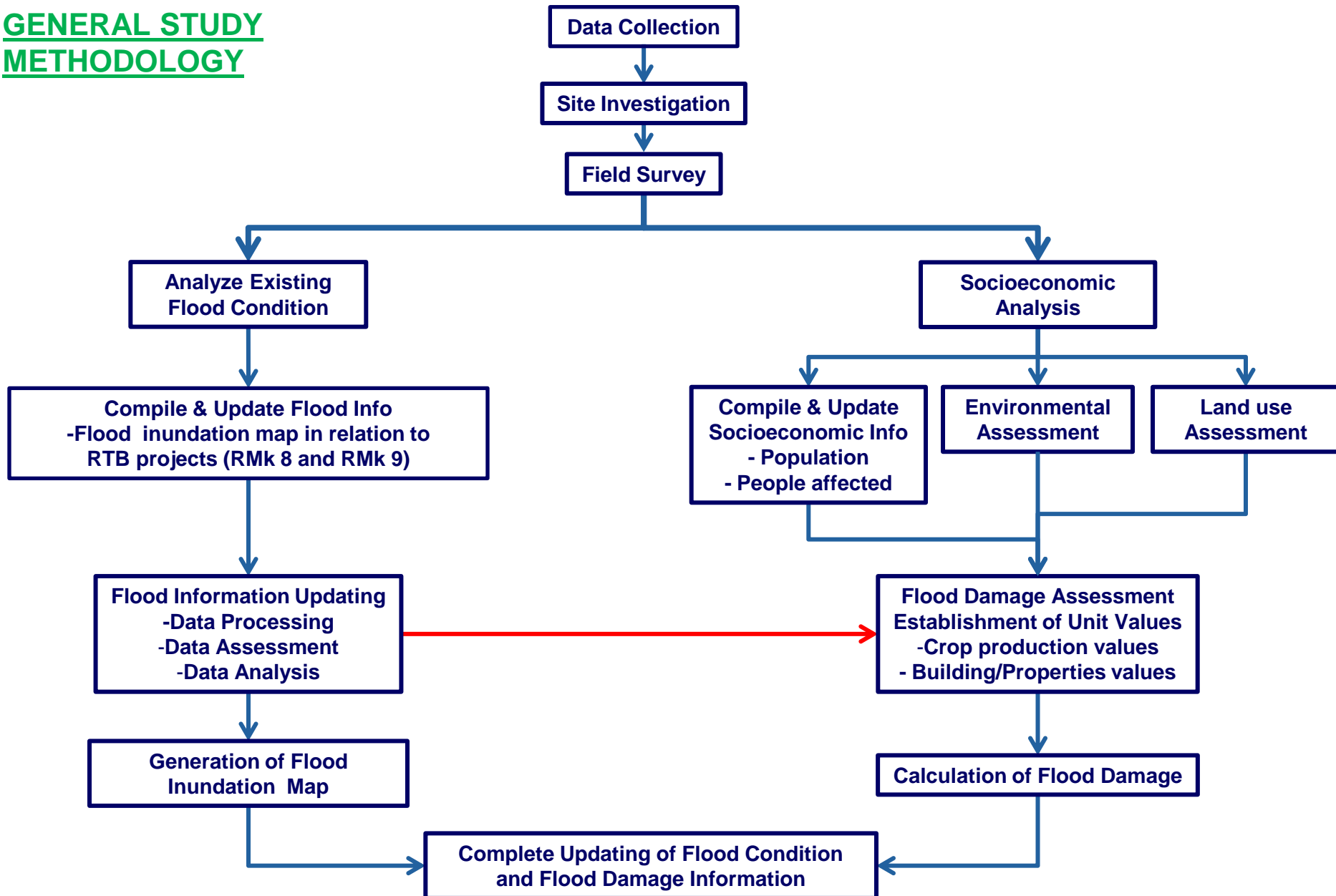


Flood Damage Map

- The flood damage map represents the potential damage caused by a particular flood event (having a certain probability of occurrence) and giving the number of casualties or damage (value) per land unit.
- The usages of the map are :
 - Flood risk management, decision making & priority setting for measures
 - Select the best options and range of measures to reduce flood risk like spatial planning and control of development, flood mitigation management , flood preparation, flood incident management and response and recovery
 - Emergency and crisis management at national / local level: number of people involved, evacuation route, safe havens/temporary refuge centres, hospital response plans, transport disruption (roads & rail)

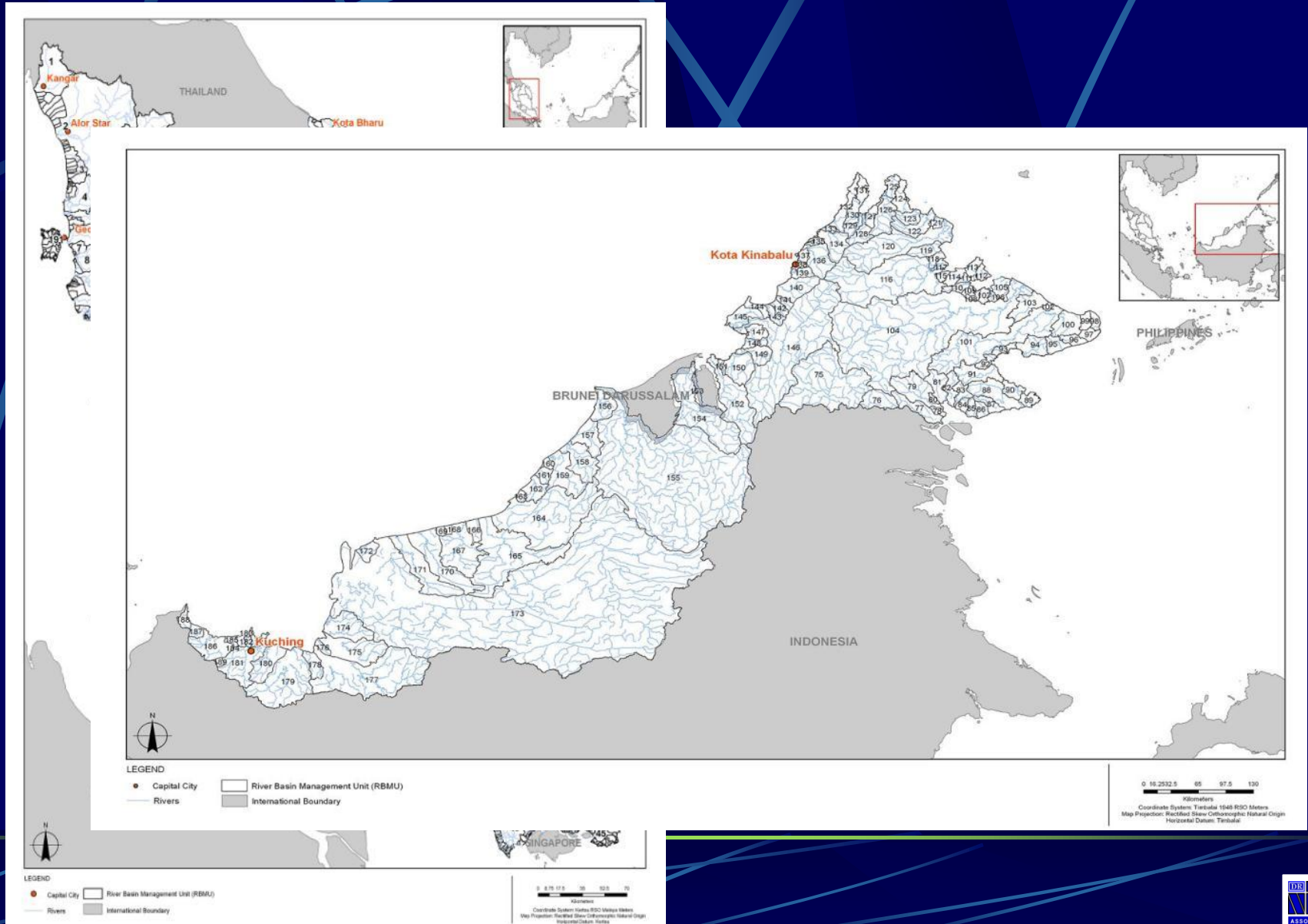
UPDATING OF CONDITION OF FLOODING AND FLOOD DAMAGE ASSESSMENT IN MALAYSIA

GENERAL STUDY METHODOLOGY



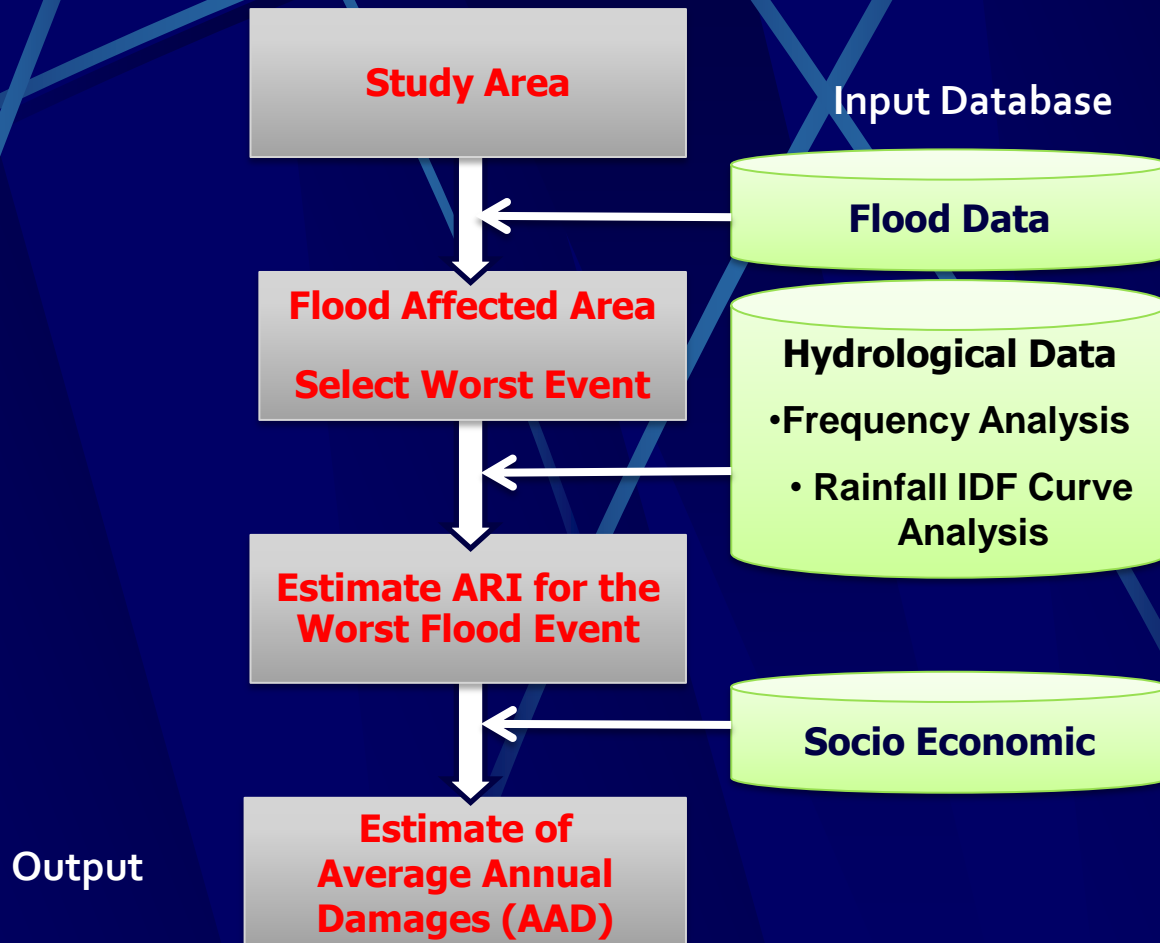
UPDATING OF CONDITION OF FLOODING AND FLOOD DAMAGE ASSESSMENT IN MALAYSIA

River Basin Management Units (RBMU) – 191 RBMU



UPDATING OF CONDITION OF FLOODING AND FLOOD DAMAGE ASSESSMENT IN MALAYSIA

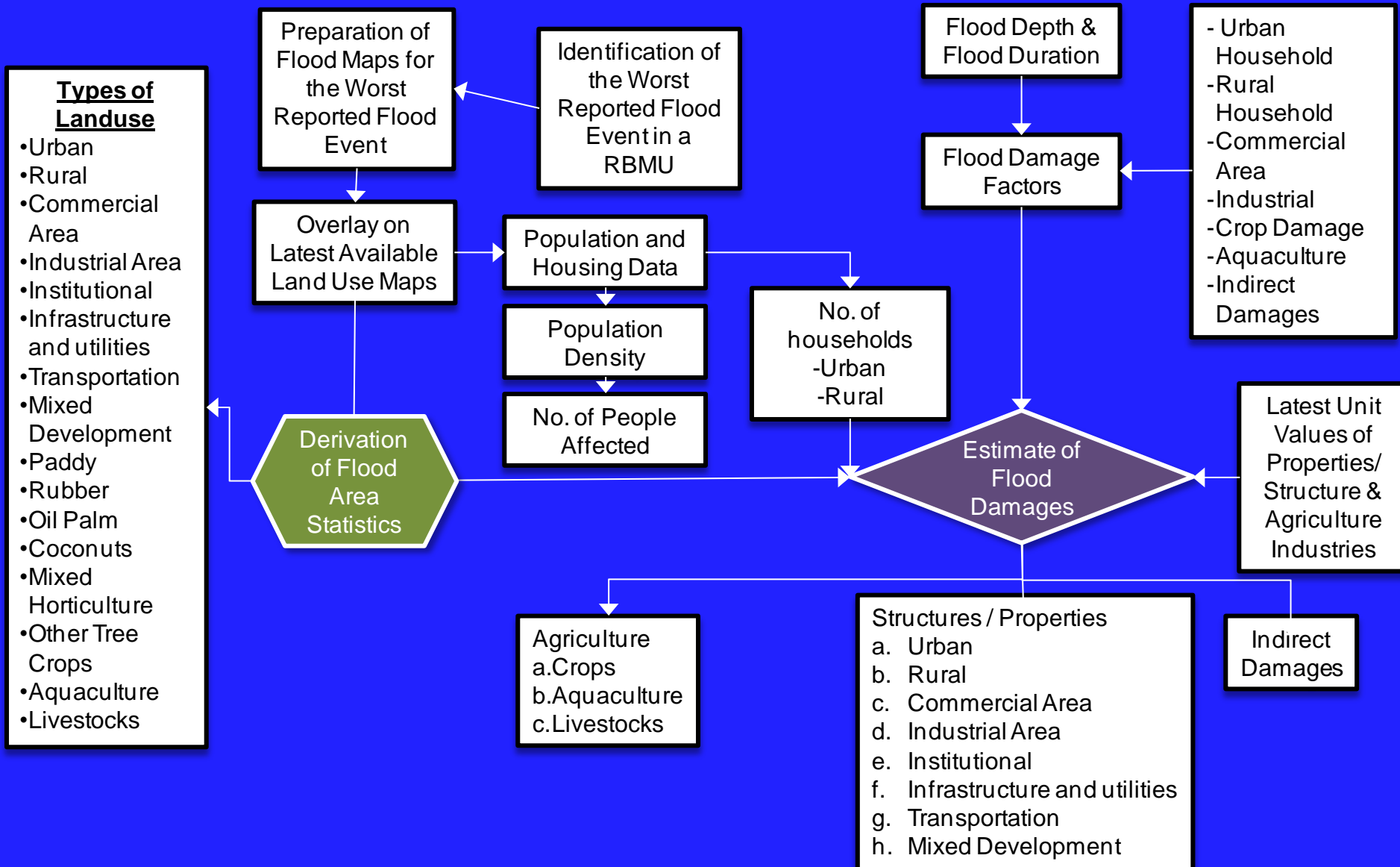
Hydrological Analysis



FLOW CHART OF HYDROLOGICAL ANALYSIS

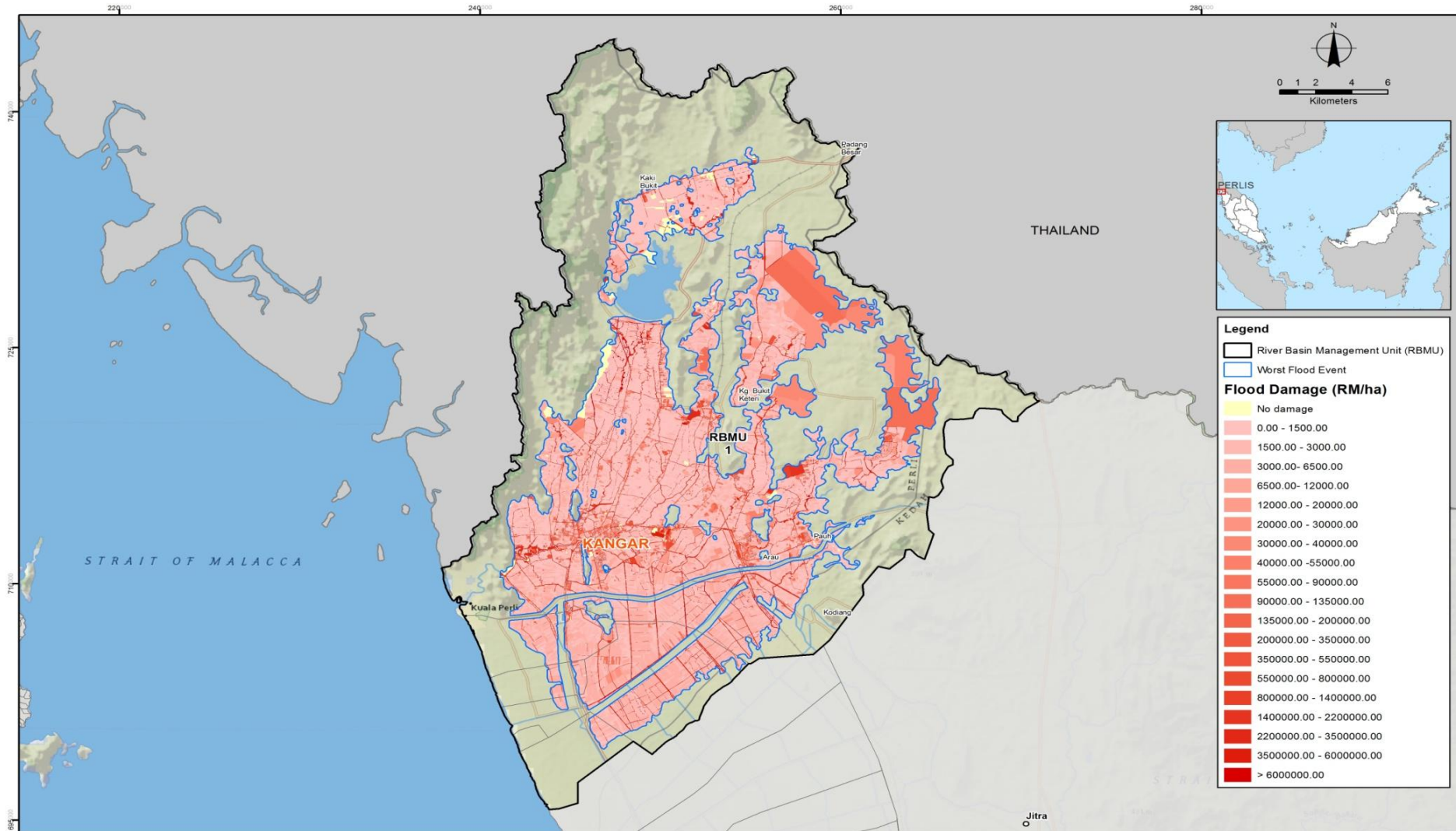
UPDATING OF CONDITION OF FLOODING AND FLOOD DAMAGE ASSESSMENT IN MALAYSIA

FLOW CHART OF FLOOD DAMAGE COMPUTATION



UPDATING OF CONDITION OF FLOODING AND FLOOD DAMAGE ASSESSMENT IN MALAYSIA

EXAMPLE OF FLOOD DAMAGE MAP



Flood Map Dissemination

- The dissemination of maps basically addresses to groups of users:
 - ✓ General public - The primary purpose of public dissemination of flood maps is to increase public awareness. This is to empower individuals to take appropriate preparatory and response measures, and to inform them regarding decisions such as the purchase or otherwise of a property, or the assignment of use, layout and design of an area of land. Normally via the Internet although hard copies of maps should also be available in public offices.
 - ✓ Professional users - Internet, with restricted access if necessary, is considered to be the most appropriate media. Maps can generally be downloadable in GIS (for integration into the existing GIS of the relevant organisation) or PDF format.

Constraints in Flood Mapping

- The necessary information does not exist in the required accuracy (basically a question of scale)
- The information is not made available by other levels of government because it is considered to be sensitive information
- The information is not available in digital form.
- Risk is unlikely to remain constant in time and it is often necessary to predict changes in risk in the future, to make better decisions. Some causes of change are well recognised for example:
 - Vulnerability parameters can rapidly change such as development, changing value of assets at risks, land use, behaviour of people during the flood, capacity for recovery as well as permanent, semi-permanent or non-permanent flood defences (deterioration, maintenance, new works)
 - The hazard parameters can change due to climate change, environmental and land use change, human intervention, etc.

Uncertainty

- There are two types of uncertainty - related to natural phenomena, hydrology, climate; and associated with data, modelling, measurement
- In using it to assist the decision making processes and particularly those with potentially significant impacts, it is important to know how reliable the information is therefore, it may be useful to define levels of confidence or degrees of uncertainty associated with the flood information presented on the flood maps, such as flood extents, levels, flows, etc.
- In general the methodology for the assessment of flood maps has to fit state-of-the-art, based on a reasonable expense. It has to be considered, that the uncertainty of a result is generally dependent on the “weakest link in a chain”.
- The smaller scale map is used, the more generalized background map must be used. An adequate instrument to express the uncertainty of the information in flood maps is the use of classes and intervals.

Conclusions

- Flood map is very useful tool for land use planning and flood management as well as an important factor in various policy settings and investment decisions as well as for security reasons
- Couple with GIS and various spatial information, flood map is one of the most informative layers in the decision support system , right from the top government level to general public
- Production and usage of flood maps require accurate historical data as well as up-to-date data, state-of-the-art simulation method, proper integration with other information, thorough editing and screening , concise presentation and appropriate dissemination tools.
- Flood maps need to be updated at regular interval or after certain significant events so that the reliability and relevancy of the maps are maintained



Thank you

Introduction

- It is essential that people recognise flooding as part of their environment.
- If persons concerned have not yet experienced flooding, knowledge about the risk must be passed on with the help of the flood hazard maps, other information and education
- The authorities should ensure that the information concerning flood prevention and protection plans is transparent and easily accessible to the public. This can achieve by:
 - ✓ Flood hazard maps point out areas at risk and are necessary for planning. Flood maps should be used for the reduction of damage potential by integrating its outputs into spatial planning and emergency planning.
 - ✓ Information based on Geographic Information Systems (GIS) should be widely diffused and explained. Media plans should be prepared, following an agreed procedure.

1) Flood Risk Management Strategy

- Flood risk management requires appropriate strategies and plans for the effective and efficient implementation of flood risk reduction measures. The following parameters are required:

Level / scale	Use of flood maps	Readership / Complexity	Content of flood maps:	
			Essential parameters	Desirable parameters
National / regional 1:100,000 - 1:1,000,000	<ul style="list-style-type: none"> Broad-scale planning / prioritisation of flood risk management measures / strategies Flood risk management within the river basin Delineation of strategic flood storage zones (retention areas, wash lands) 	<ul style="list-style-type: none"> Decision makers Technical services Easy to understand, simplified maps 	<ul style="list-style-type: none"> Flood extent Flood risks Sites of environmental vulnerability Pollution risks Assets at risk 	<ul style="list-style-type: none"> Indicative vulnerability
Local 1:5,000 - 1:50,000	<ul style="list-style-type: none"> Planning, design and evaluation of localised / specific flood management measures 	<ul style="list-style-type: none"> Decision makers Technical services Complex maps possible 	<ul style="list-style-type: none"> Flood extent Water depth Other flood parameters (if appropriate, e.g. velocity) 	<ul style="list-style-type: none"> Vulnerability Risk (economic assessment) Environmental impacts

1) Flood Risk Management Strategy

- For flood risk management planning and decision making, flood maps can provide :
 - Areas that have the greatest risk
 - Areas should be target investment first to prioritise the works.
 - Seek the best return on any investment across a range of social, environmental and economic benefits; support the business case for funding in competition with other demands on resources.
 - Select the best options and range of measures to reduce flood risk. Not just defences but also other activities such as spatial planning and control of development (avoidance), asset system management (defences, flood storage areas, river systems, estuaries and coasts – managing the pathways), flood preparation (flood detection, forecasting, emergency planning) and flood incident management and response (flood warning, actions of emergency services, healthcare providers and flood risk management authorities, public, community support organisations), and recovery (insurance, local authorities, reconstruction)

2) Land-Use Planning

- Risk-conscious land-use planning and land management is an important contribution to sustainable development.
- The geographical level (national/regional, local) decides on the necessary scale.

Level / scale	Use of flood maps	Readership / Complexity	Content of flood maps:	
			Essential parameters	Desirable parameters
National / regional 1:100,000 - 1:500,000	<ul style="list-style-type: none"> • High-level spatial planning • Allocation of land for development • Suitability of land for different types of development • Planning of national infrastructure 	<ul style="list-style-type: none"> • Decision makers • Land-use and spatial planners • Simplified maps 	<ul style="list-style-type: none"> • Flood extent • Flood risks • Sites of environmental vulnerability • Pollution risks • Assets at risk 	<ul style="list-style-type: none"> • some indicators (to define) allowing to evaluate the hazard (considered useful if available or derivable, although a requirement in some contexts)
Local 1:5,000 - 1:25,000 (cadastre level)	<ul style="list-style-type: none"> • Specific city or village planning • Watershed management • Meeting specific needs of planners as a basis or guidance for decisions (e.g., provide for land zoning that forms the basis of planning decisions, support local flood risk assessments for development, determine appropriate land uses and development types, assessment of individual planning applications). 	<ul style="list-style-type: none"> • City, village planners • Rural planners • Local authorities • Simplified maps 	<ul style="list-style-type: none"> • Flood extent (typically for a range of event probabilities) either ignoring flood defences or assume a breach of defences 	<ul style="list-style-type: none"> • Various flood parameters (e.g., depth, velocity, duration, erosion and debris accumulation, defended areas, etc.) and / or Hazard classes (in terms of probability and intensity), particularly where the planning process is linked to this type of information

3) Emergency Planning

- Emergency management units require specific flood information for the planning process as well as for the management of an on-going crisis. The following parameters are required:

Level / scale	Use of flood maps	Readership / Complexity	Content of flood maps:	
			Essential parameters	Desirable parameters
National / regional 1:100,000 - 1:500,000	<ul style="list-style-type: none"> Broad-scale planning for major emergencies that may require national or regional intervention (including flood defences distribution) 	<ul style="list-style-type: none"> Spatial planners Emergency planners Politicians and high level decision makers 	<ul style="list-style-type: none"> Flood extent Flood risk indicators (such as number of people potentially affected) Utility infrastructure affected Road/rail and other communication infrastructure) 	<ul style="list-style-type: none"> Other relevant data (such as summary of vulnerability or risk data, although this does not necessarily need to be mapped, but may be presented in database / tabular format) Information of disruption of infrastructures or utilities with a national or regional impact (e.g. power supply, traffic, water supply, functions of importance for society)
Local 1:5,000 - 1:25,000	<ul style="list-style-type: none"> Planning of localised emergency response (e.g., evacuation and access routes, road closures, etc.). 	<ul style="list-style-type: none"> Emergency planners Politicians and local level decision makers Emergency services Health authorities 	<ul style="list-style-type: none"> Flood extent and depth (for different return periods) and other flood parameters as relevant to location Vulnerability (incl. social and other risks) Risks (significant assets requiring specific attention, incl. sensitive infrastructure, installation which might cause accidental pollution in case of flooding, historical heritage, etc.) 	<ul style="list-style-type: none"> Real-time information (e.g. extent, remotely sensed) is useful where / when available

4) Public Awareness Raising

- Flood maps for public awareness should provide information to anyone to enable to find out whether risks from flooding exist. The maps for flood awareness should cover the populated areas of the country:

Level / scale	Use of flood maps	Readership / Complexity	Content of flood maps:	
			Essential parameters	Desirable parameters
Local 1:10,000 - 1:25,000	<ul style="list-style-type: none"> Developed at Local Scale (i.e., to provide local information) 	<ul style="list-style-type: none"> Public Professional advisors Easy to read 	<ul style="list-style-type: none"> Flood extent (for different probabilities) (and depth?), defended areas? Ignoring flood defences or assume a breach of defences 	<ul style="list-style-type: none"> Historic flood event information (extents, depths, photographs) as point of reference Flood depth, velocity, rate of onset, erosion and debris hazard, etc. as appropriate and where significant

- The national or regional scale of mapping is generally not required for public awareness, as members of the public tend to be interested in the flood risk that directly applies to them.
- Where the public is involved in FRM decision making it may need to understand the risk to better understand the decision.

5) Insurance

- For this domain all consequences (everything that is potentially insured) have to be addressed:
 - ✓ Exposure (financial loss) of houses and contents
 - ✓ Loss of life (life insurance)
 - ✓ Exposure of installations (business premises, business continuity and disruption insurance)

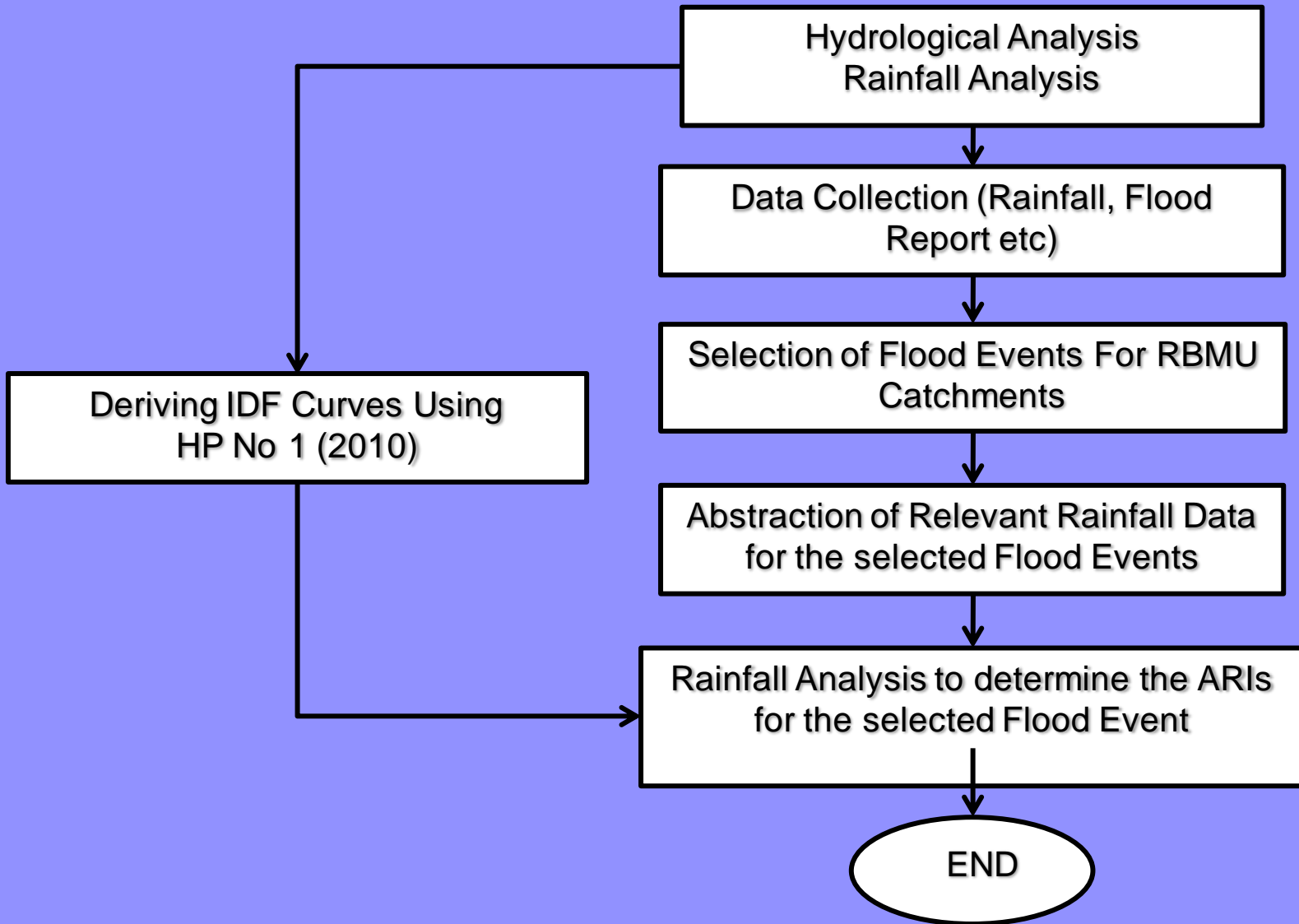
Level / scale	Use of flood maps	Readership / Complexity	Content of flood maps:	
			Essential parameters	Desirable parameters
National / regional 1:10,000 - 1:25,000	<ul style="list-style-type: none"> • Insurance assessments and pricing, underwriting, claims / portfolio assessments, incentive at prevention • Re-insurance: Portfolio exposure assessment at a broader level (i.e. national or regional level) 		<ul style="list-style-type: none"> • Extent (for different return periods or probabilities) 	<ul style="list-style-type: none"> • Water depths, velocity (if significant)

- It is noted that information on public, critical infrastructures and networks at risk may be useful for business interruption coverage assessment.

Flood Map Basic Information

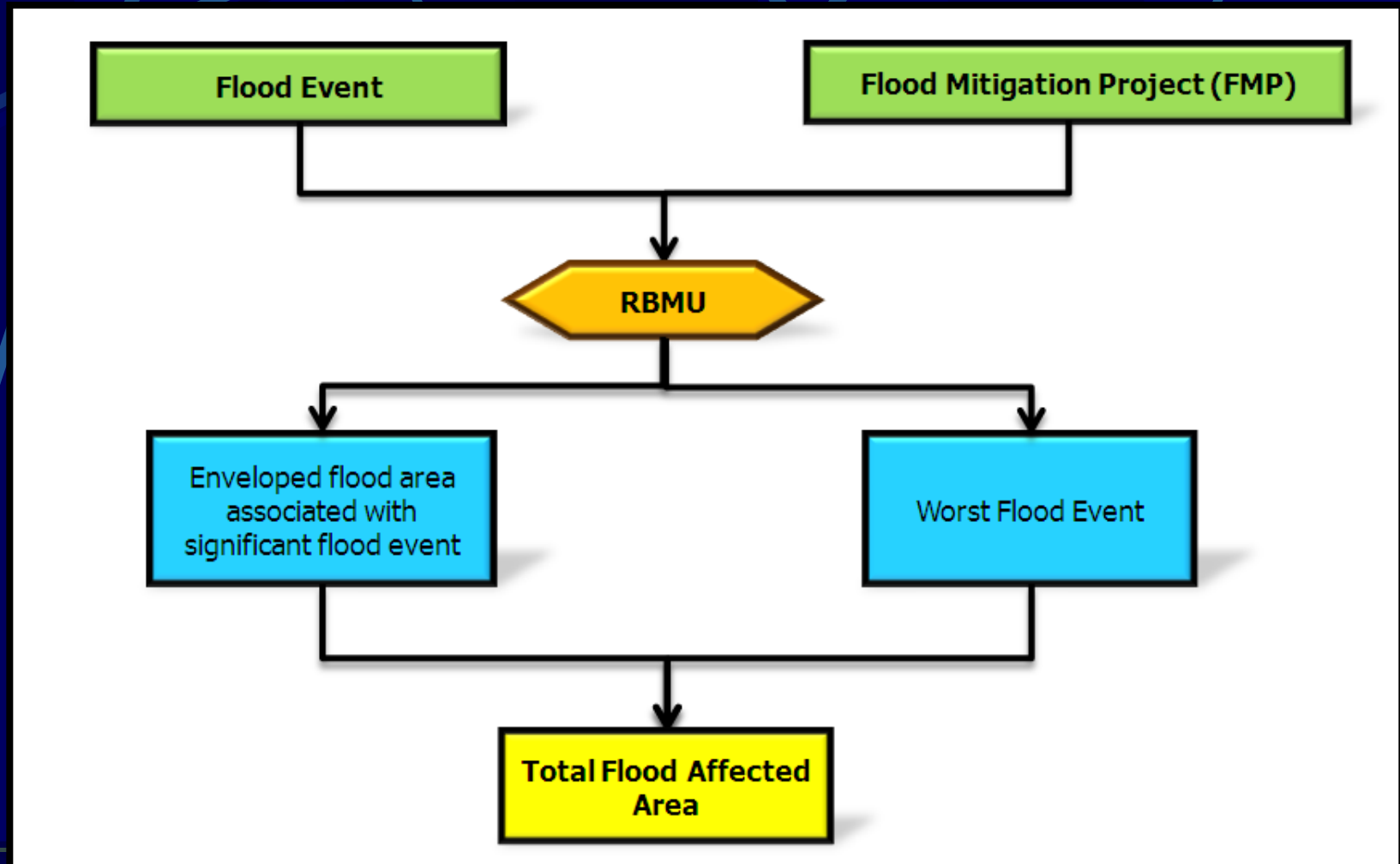
- Title of the map: making clear reference to the map content such as
 - Flood parameter: Flood extent, depth, flow velocity, past event
 - Probability consideration: defining more precisely what mean low , medium and high probability of occurrence,
- Location of the map as part of the catchment or country: provision of a small inset map
- Legend: - parameters shown on the map with easy to read symbols or colour schemes and class or ramp for numerical values
- North and scale: preferably using scale bar as this allows for changes in page size
- Responsible authority or institute with address, website (and/or telephone number)
- Base date for the data and date of publication
- If necessary: a disclaimer, including remarks on the quality of information can be added.

HIDROLOGICAL ANALYSIS WORK FLOW



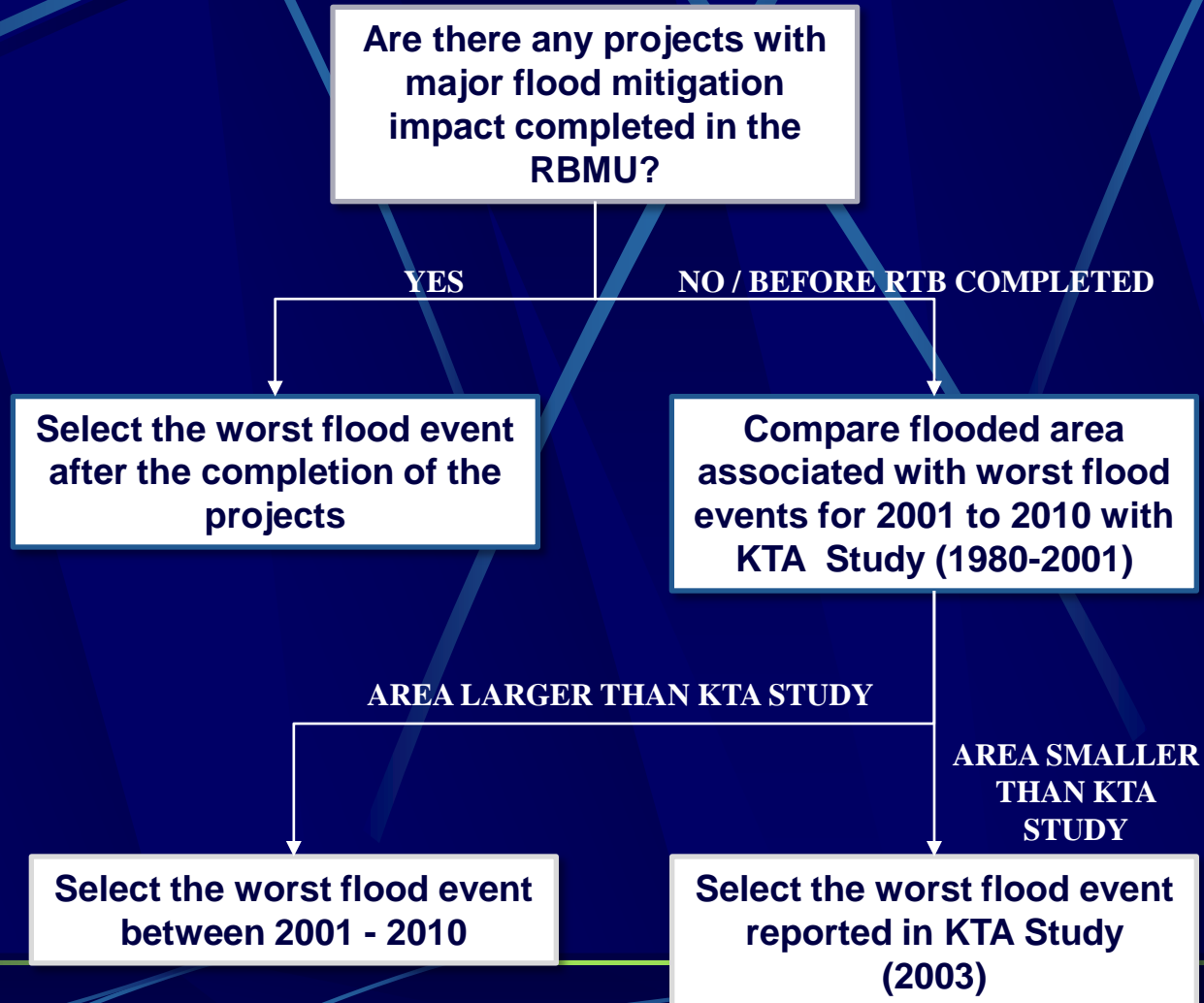
Flood-affected Area Assessment

TOTAL FLOOD AFFECTED AREA



Flood-affected Area Assessment

FLOW CHART TO SELECT THE WORST FLOOD EVENT

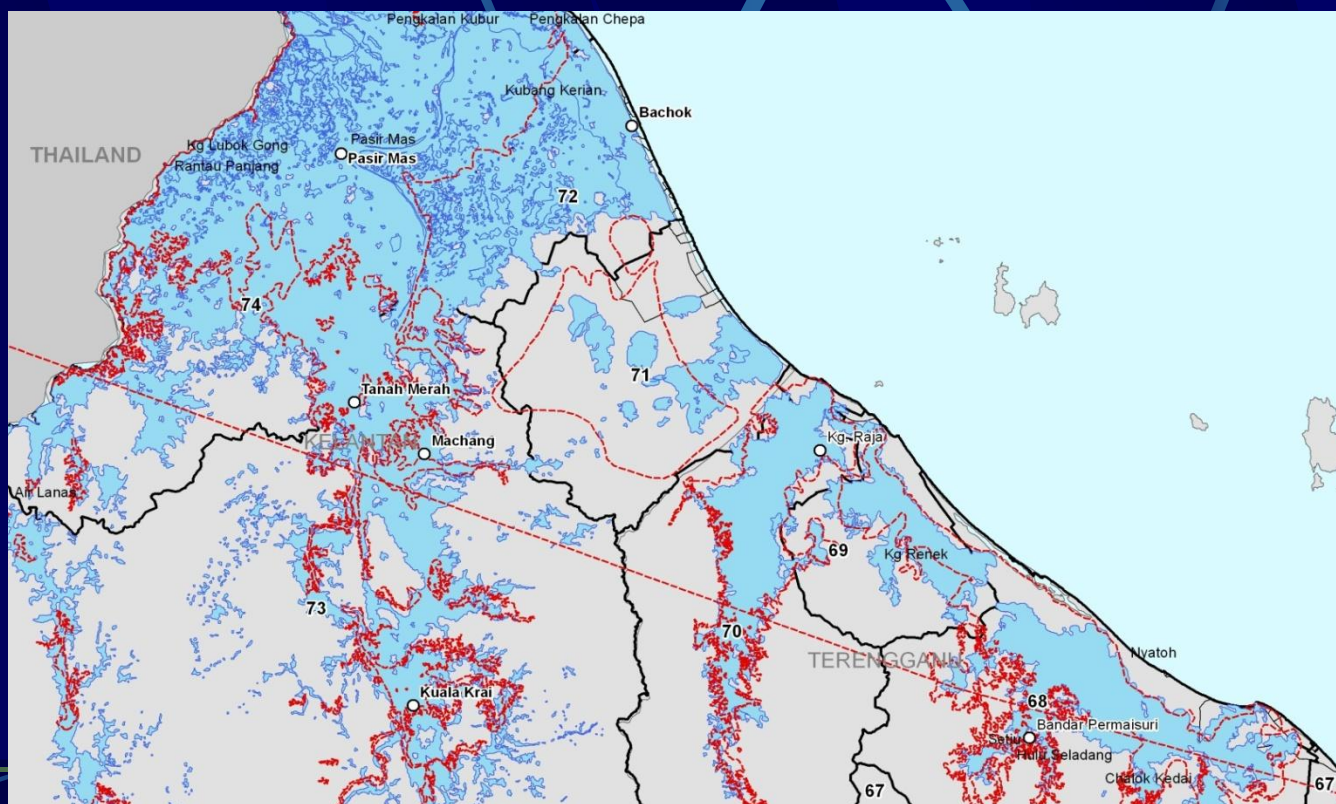


COMPREHENSIVE INCEPTION ACTIVITIES AND DATA COLLECTION EXERCISE

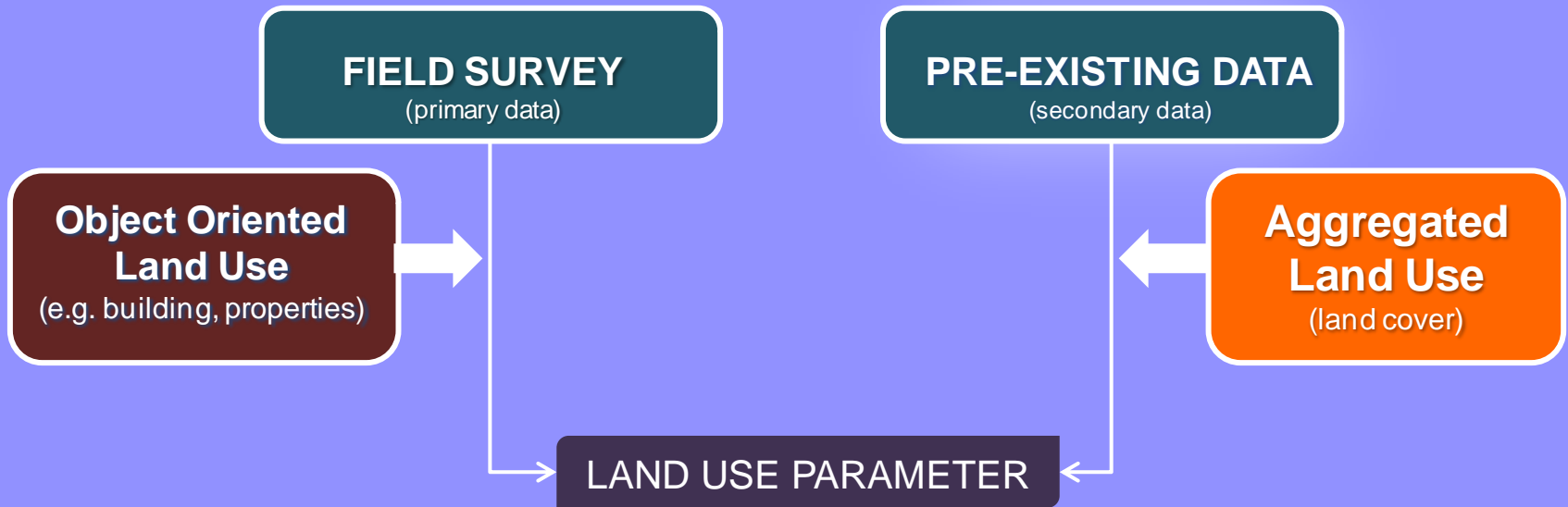


EXAMPLE OF SUMMARY EVENT FOR SG.KELANTAN

RBMU Name	RBMU No.	Date of RTB Completion	Selected Worst Flood Event (KTA, 2003)		Worst Flood Event in 2001 - 2010 (DNA, 2012)		Selected Worst Flood Event (DNA, 2012)	
			Flood Event	ARIs	Flood Event	ARIs	Flood Event	ARIs
KELANTAN								
Sungai Semerak	71	20-Jan-10	21-25 Nov 2000	20	21-23 Nov 2009	100	21-23 Nov 2009	100
Sungai Kemasin	72	-	21-25 Nov 2000	20	11-Jul-09	2	21-25 Nov 2000	20
Sungai Kelantan	73	18-Jun-08	1967	40	28-30 Nov 2008	2	28-30 Nov 2008	2
Sungai Golok	74	22-May-09	1967	40	Year 2010		Year 2010	



Land Use Assessment Flowchart



Land Use Mapping	Land Use Classification	Land Use Data Compilation	Flood-Sensitive Public Facilities	Flood Hazard on Heritage	Zoning Data Compilation
Identifying land use conditions within the study area as compared to areas impacted by floods	Identifying land use classifications based on available GIS database and field verification	Compilation of base-mapping information, including roads, municipal and district boundaries and land use	Identifying flood-sensitive public facilities: <ul style="list-style-type: none"> • schools • religious buildings • hospitals • government departments • libraries and • nursing homes 	Built heritage, cultural heritage, archeological sites and other endangered environments	Zoning the area based on land use compatibility with flood condition and socioeconomic conditions

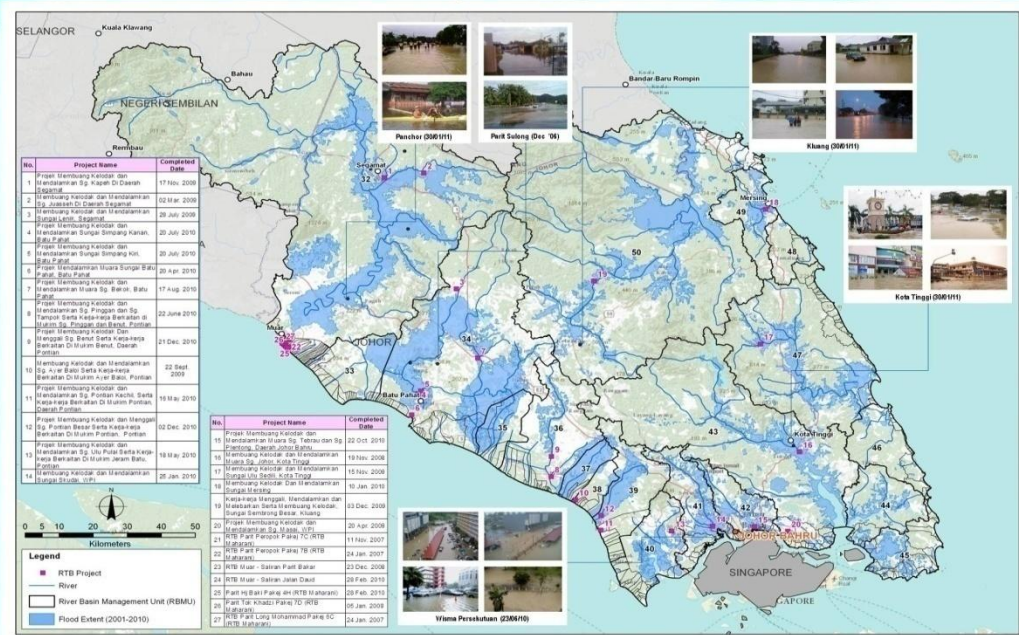
Environmental Assessment

Some of the environmental areas related to flooding and flood damage

Item	Environmental issues
Forest Resources	Watershed and species diversity may be impacted. Inundation vegetation may lead to loss valuable timber, important resources and rare species. This may also affect water quality and air quality.
Aquaculture	Water living organism can be killed by toxic materials released into river or urban run-off flow. Flood can also damage the aquaculture area.
Agriculture	Flooding can potentially damage the crops and plantations because of oversaturation.
Eco-tourism	Natural recreational, historical and archaeological resources may be damaged.
Population area	Floods impact the human community either directly through contact with water or indirectly through the damage and diseases spread into the water system. Floods can also cause erosion and landslide, which subsequently destroy property, houses and other building.

Updating of Condition of Flooding and Flood Damage Assessment in Malaysia

JOHOR



Compile & Update Socioeconomic Info
- Population
- People affected

Environmental Assessment

Land use Assessment



No. R/SB02	Item	2002 Study (RTA)	2003	2004	2005	2006	2007	2008	2009	2010
32	Lembangan Sg. Muar	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
33	Lembangan Sg. Seremban Berau	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
34	Lembangan Sg. Batu Pahat	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
35	Lembangan Sg. Mengayau	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
36	Lembangan Sg. Bantolan	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
37	Lembangan Sg. Sanglang	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
38	Lembangan Sg. Ayer Bahru	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
39	Lembangan Sg. Pengerang Besar	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
40	Lembangan Sg. Pulus	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32

No. R/SB02	Item	2002 Study (RTA)	2003	2004	2005	2006	2007	2008	2009	2010
41	Lembangan Sg. Muar	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
42	Lembangan Sg. Seremban	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
43	Lembangan Sg. Juhar	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
44	Lembangan Sg. Labuan	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
45	Lembangan Sg. Sempang	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
46	Lembangan Sg. Kuching	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
47	Lembangan Sg. Seremban Besar	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
48	Lembangan Sg. Mengayau	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
49	Lembangan Sg. Bantolan	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32
50	Lembangan Sg. Pulus	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32	11,241.32

