I. THE ROLE OF FLOOD HAZARD MAPS TO MITIGATE FLOOD DAMAGE IN MALAYSIA

A.1 Flood Status in Malaysia

Malaysia has along history of flooding, the country being exposed to monsoon winds and heavy conventional rainfall all year round rendering more than about 10% of the country being flood-prone. The annual average rainfall is 2,420 mm for Peninsular Malaysia, 2,630 mm for Sabah and 3,830 mm for Sarawak, with heavier precipitation recorded in the east coast of Peninsular Malaysia and the coastal regions of Sabah and Sarawak.

In the rural areas where farming is the main economic activity, the rainy season and seasonal flooding is in fact good for paddy cultivation. However, the occurrence of flood hazards in urban areas, especially flash floods, is considered a sign of unsustainable development. This is largely due to the rapid development of urban floodplains such as those in Kuala Lumpur, Penang and Sarawak.

The replacement of natural forest with impervious urban areas results in almost all the rainfall entering the rivers in a time. This reduces the capacities of most rivers to drain away excess water. Rivers in urban areas are very constricted and development literally comes to the rivers banks. There is no buffer zone or river reserve leaving no room to maneuvers. Hence, reducing their drainage capacities.

Rapid urbanization of urban floodplains and upstream development of hill land have changed surface characteristics and altered the hydrological cycle, particularly the time in which rains drops enter the rivers and the volume of runoff.

Hill and land development is a form of unsustainable development which often results in accelerated soil erosion and landslides, two forms of environmental hazards. Soil erosion leads to sedimentation and siltation of rivers, contributing to increasing floods hazards of more severe magnitudes.

A.2 Present Countermeasures for Mitigating Flood Damages in Malaysia

From the studies that have been carried out, various structural (curative) as well as non-structural (preventive) measures have been proposed to alleviate flood problems.

Structural measures are actually engineering methods which include the following:

i) Multi Purposes Dams.

The construction of multi purposes dams has been most popular. Dams have been known to be effective as in the case of Linggiu Dam in Johore, which has effectively reduced much of the flooding downstream of Sungai Johor. The Linggiu Dam is an example of a dam built for water supply but also as a flood mitigation dam.

However, dams are expensive and cause a great deal of environmental problems. They also have a life span and pose serious dangers to downstream population, both humans and others.

ii) Bunding of Rivers

The construction of bunds is used to control bank erosion. River meanders exposed to severe erosion are protected by the construction of wall of earth or cement/concrete walls. This reduces rate of river bank erosion which contribute towards siltation and the reduced discharge capacities of rivers.

iii) River Improvement

River improvement involving regularly dredging and deepening major river channels, preventing the dumping of rubbish into the rivers and clearing of rubbish and other obstacles such as tree trunks, boxes and oil drums in the rivers to ensure smooth and swift flow. This includes channel deepening, widening and straightening.

iv) Retention Ponds

Retention ponds are commonly constructed along flooded rivers as low lying areas along rivers can be easily converted into retention ponds which siphon excess discharge during high flows, thus reducing the probability of floods. During normal times, the retention ponds can be used as playing fields or maintained as scenic shallow lakes which contribute to the aesthetic aspects of river corridors.

v) ***Canalisation And Related Works***

Canalisation works include the widening and deepening of channels as well as lining the banks and beds of the channels. They also include the replacement of

undersized structures such as bridges. These works are necessary, as the original channels have become undersized as a result of the increase in flood flows caused by development.

vi) ***Flood Diversion Channel Or Tunnel***

Certain river stretches especially in major city centers, due to intensive development along both riverbanks can no longer be widened or deepened to accommodate the increasing flood discharges through the city. Under such circumstances, excess flood water has to be retained upstream in storage ponds or diverted downstream through a flood diversion channel or tunnel. This is being implemented in Kuala Lumpur where the Storm water Management and Road Tunnel (SMART) Project has become a viable and innovative solution. The SMART system, when completed, will alleviate flooding in the Kuala Lumpur city centre by diverting large volumes of flood water from entering the city centre. The tunnel is designed to incorporate a stormwater channel and a motorway for dual purposes (*Figure 1*)

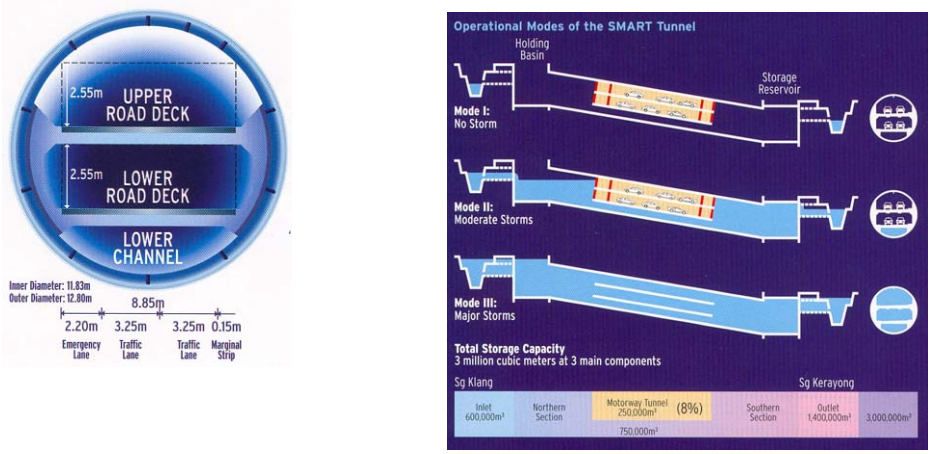


Figure 1: Stromwater Management and Road Tunnel

Non-structural measures, on the other hand, are proposed where engineering measures are not applicable or viable, or where supplemental measures are required. These measures comprise the following:

i) ***Integrated River Basin Management (IRBM)***

Under the concept of Integrated River Basin Management, the whole river basin is planned in an integrated manner and all factors are taken into consideration when a certain development plan is proposed. Factors like zoning for river corridors, riparian areas, natural flood plain, conservation of wetlands, storage ponds etc will be taken

into consideration when preparing flood management plans. The concept of IRBM has been incorporated into and will be implemented starting in the 8th Malaysia Plan.

ii) ***Preparation of Guidelines and Design Standards***

Suitable guidelines and design standards have been prepared, specifying clear requirements, physical as well as technical, for rivers and their reserves, as well as flood mitigation and urban drainage projects. These guidelines and design standards if followed strictly by the public and private sectors will help to minimise the occurrence of floods.

Recently in the year 2000, a new Urban Stormwater Management Manual (MASMA) has been published by DID. The Manual provides control-at-source measures and recommendations on flood fighting by utilising detention/retention, infiltration and purification processes.

iii) ***Resettlement of Population***

One positive measure to reduce damage potential as well as loss of life in flood-prone areas where floods would not be significantly reduced by structural measures is to resettle the population. Since 1971, 1672 families and 2715 families have been resettled in the States of Kelantan and Pahang respectively.

iv) Flood Proofing

This measure consists of implementation of protective works to prevent the entry of flood water into individual houses and specific places, for example, by bunding a building with a wall so that the floor is not submerged during a flood thereby reducing flood damage. In flood-prone cities like Kuala Lumpur and Penang, entrances to basement car parks should incorporate some flood proofing measures.

v) Flood Forecasting and Warning System

The provision of a flood forecasting and warning system is an important, practical and low-cost measure to minimise flood losses. Flood forecasts given early will enable people living in flood-prone areas to be warned so that they can evacuate themselves and their belongings before the arrival of the flood. This can considerably reduce flood loss and damage and above all the loss of human lives. In recent years, a web-based information system on flood warning and flood information can be readily obtained through website.

A.3 The Usefulness of Flood Hazard Map in Malaysia

The Flood Hazard Map is a map that graphically provides information on inundation (predicted inundation areas, inundation depth, etc.), as well as on evacuation (location of evacuation refuges, evacuation routes, dangerous spots on evacuation routes, etc.) in an easy-to-understand format.

The goal is to quickly evacuate local residents in a safe and proper manner in the event of floods and reducing the loss of life as well as cost of damages. It does not mean by having flood hazard maps can stop a disastrous phenomenon. But the effective use of flood hazard maps can decrease the magnitude disasters.

II. ALLOCATION OF ROLES IN MAKING FLOOD HAZARD MAPS IN MALAYSIA

B.1 Main Organization to Develop and Disseminate the Flood Hazard Map

It suggested, the main organization to be responsible for creating and provide the flood hazard map should from Ministry of Natural Resources and Environmental collaboration between Ministry of Local Housing and State Government. Under the Ministry of Natural Resources and Environmental, there are relevant Department which has a capabilities and expertise to provide necessary information in process of creating and preparing flood hazard map.

The map is produced and publicized through a joint effort by those in charge of disaster prevention and those in charge of rivers and hydrology in the respective local municipalities.

The roles of every ministry/department towards providing information and preparing of flood hazard map in Malaysia are as follow:

No	Department/Ministry	Roles
1.0	**Ministry of Finance**	**To provide and approved the allocation for implementing, develop and disseminating flood hazard map**
2.0	**Ministry of Natural Resources and Environmental**	**As a lead ministry to implementing the Flood Hazard Map in Malaysia**
2.a	Department of Survey and Mapping, Malaysia.	- To provide topographical, cadastral, thematic and utility maps for the purposes of planning, management and development of flood hazard map.

No	Department/Ministry	Roles
2.b	National Hydraulic Research Institute of Malaysia	- To provide and conduct both basic and applied research in hydraulic engineering and water resources development for development of flood hazard map.
2.c	Malaysia Meteorological Agency	- Providing weather forecast information due to flood forecasting and warning activities.
2.d	Department of Irrigation and Drainage	- Main departments for planning, preparing and disseminating FHM.
2.e	Malaysian Center For Remote Sensing (MACRES)	- Providing the satellite images due to flood forecasting and warning activities.
3.0	**- State Government** **- Ministry of Local Housing** **- Ministry of Education** **- Ministry of Information** **- Ministry of Internal Affairs**	To Support and provide development allocation for flood mitigation projects at the state level. Dissemination of Flood Hazard Map Provide information on evacuation routes in their region.

III. THE "ACTION PLAN" OF MAKING FLOOD HAZARD MAPS IN MALAYSIA

C.1 Target River Basin

Sg. Damansara Catchments is located west of Kuala Lumpur and has an area of about 148 sq. km. Development within the catchments has been on going over the years. The development has been gradual with areas in the fringes of Kuala Lumpur such as Damansara, Taman Tun Ismail being developed about 30 to 40 years ago. Subsequently Shah Alam was developed as the capital of Selangor replacing Kuala Lumpur as the latter became part of Federal Territory. Sg. Damansara catchment is now estimated to have a population of about 226,000 in the year 2000. The area contains important industries and areas of commercial and economic significance to the state.

Sg. Damansara and its tributaries have no major river regulating structures such as dams or barrages. Most of the river stretches passing urban areas however have been canalized

and straightened (Figure 2)

The government has made various efforts from time to time to mitigate the flood problems. Sg. Damansara and its tributaries were deepened, widened, straightened and thereafter occasionally de-silted. Bunds were constructed at river banks to protect adjacent populated low laying areas such as Kg. Kebun Bunga and Taman TTDI Jaya. Pump stations were added to pump accumulated storm runoff from these areas. Without a master plan and with limited budget, most of the flood mitigation works were carried out in an ad-hoc manner. Flood waters inundated low laying areas comprising residential, commercial and institutional areas.

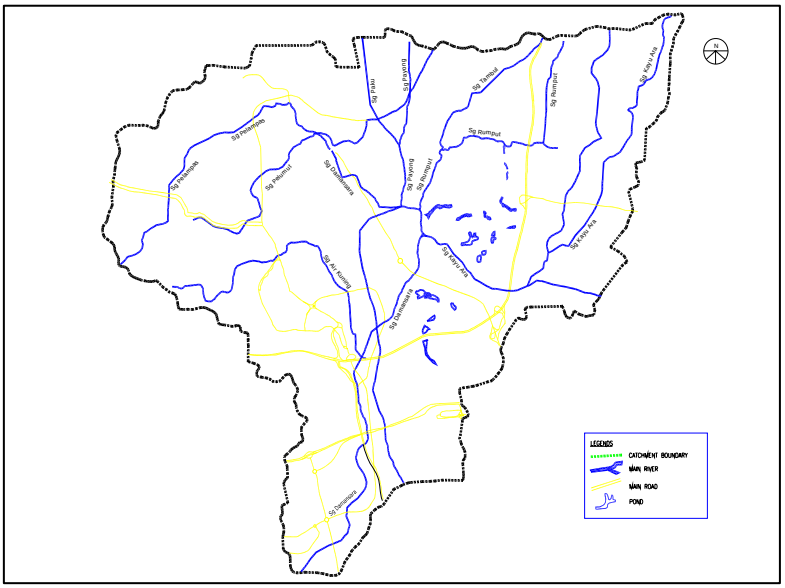


Figure 2 : Sg. Damansara River System

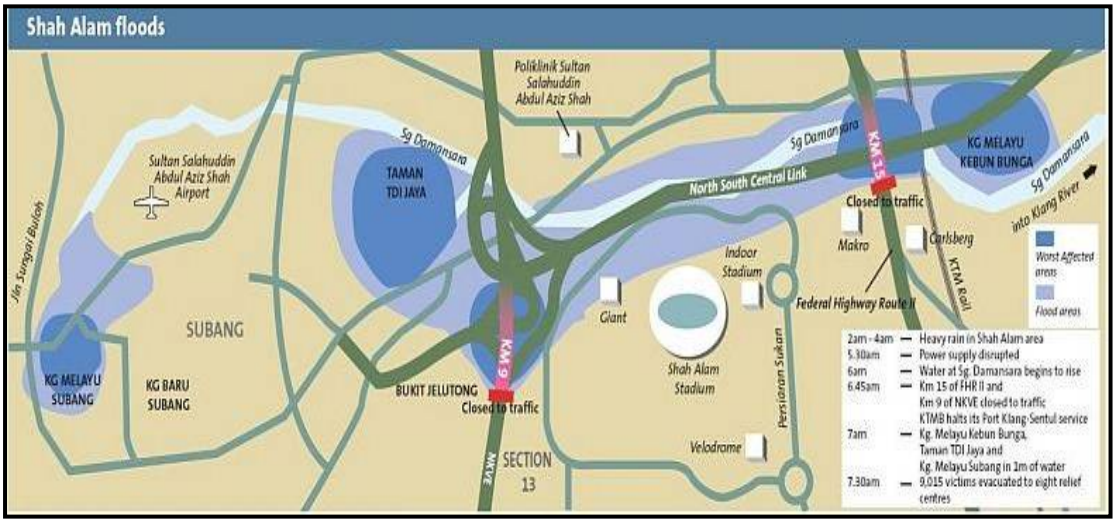


Figure 3: Flooding in Taman TTDI Jaya on February 2006

The most recent severe flood occurred on 26th February 2006. Two hours of heavy rain of around 118 mm had resulted in Sungai Damansara overflowing its banks and inundated about 3,000 houses and forced about 11,000 people to vacate the flooded areas (Figure 3).

C.2 The Usefulness of Flood Hazard Map in Sungai Damansara River Basin

The usefulness of Flood Hazard Map in Sungai Damansara River Basin is as follows:-

i. Provide the residents with information on the range of possible damage and the disaster prevention activities;
ii. Use as the basic materials that the administrative agencies utilize to provide disaster prevention service;
iii. As a tools to establish a warning system and the evacuation system;
iv. As a planning purposes, to inform decisions regarding where to locate new developments, and
v. Technical support to the Director of State Security Department for issuing the evacuation order / recommendation order.

Data of flood event, inundation depth, aerial and satellite image are available in Flood Mitigation Division. The implementing and developing of Flood Hazard Map at the target area will carry out in stages. And as a pilot project, the residential area known as Taman TTDI Jaya have been identified to have its own flood hazard map.

C.3 Five Years Action Plan

Year	Action	Status
2006	• Set up a non-structural unit. • Provide training in developing flood inundation map/FHM (internal/external). • Identified the area for pioneer project.	Done In Progress Done
2007	• Create awareness to state government/others agency on the important of Flood Hazard Map. • Identify method to disseminate information regarding flood hazard map to the public. • Prepare and disseminate the completed FHM to the target area.	

Year	Action	Status
	• Provide training for local government on the use of flood hazard map.	
2008	• Develop survey strategies to acquire information about resident perception toward flood. • Develop flood inundation and hazard map for at least 2 river basins. • Educating people and enhancing their awareness due to flood disaster preparedness.	
2009	• To conduct survey via questionnaire to the target groups with the view to improve the usefulness of the FHM • Disseminate the completed FHM to the target area (River Basin)	
2010	• Develop and improve technique in developing flood hazard map. • Review the approach in developing flood hazard and dissemination. • To review the effectiveness of FHM in terms of reducing cost of damages/loss of life.	

C.4 Problems May A Raise in Making Flood Map in Malaysia

Some of problem which may a raise in making of flood hazard map in Malaysia are as follows:-

i. May not unconditionally acceptable to residents. Land owners and land developers may fear about the fall of land process and oppose to the public release of the maps;

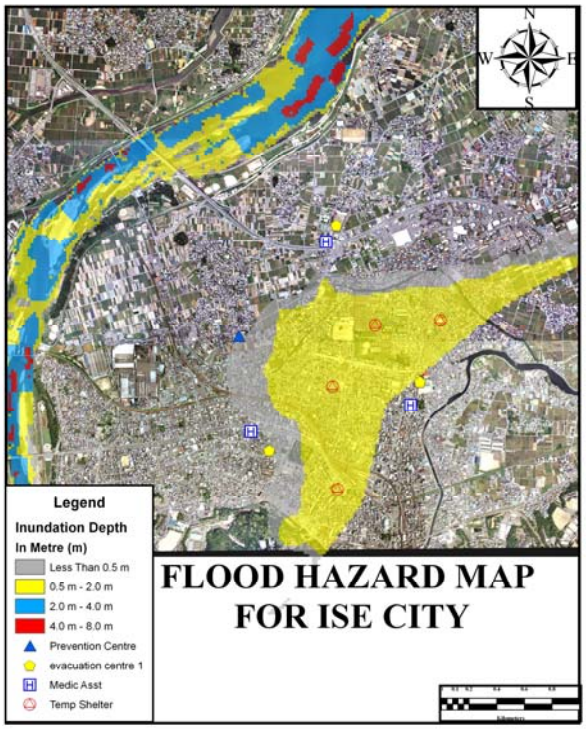
ii. Remote sensing methods based on optical, medium resolution imaging such as Landsat and SPOT, are limited in their applicability;

iii. Temporal limitation of using satellite. For example Landsat only returns over any given location once every 16 days;

iv. Limited of human resources and expertise; and

v. The need for an integrated approach with other agency.

D. IMPROVEMENT TO FLOOD HAZARD MAP ON ISE CITY



The improvement has been made to the former flood hazard map are as follows :-

i. Created in the larger scale;
ii. Simple as possible; and
iii. In English

E. CONCLUSION

i. A flood hazard map is significant only when it is publicly released to residents. They can be used residents in evacuation and when their lives are in danger. It is necessary to furnish residents with school education and training once a year or more and repeatedly disseminate the information through various methods. It is better to plan events which will increase the resident's participation.
ii. Flood hazard maps are not directly related to preventive works, but using flood hazard maps, it is possible to estimate the cost of damages due to a disaster. Further, flood hazard maps can be used for the economic evaluation of a preventive work and for Benefit Cost (B/C) analysis. As a result, the priority order of preventive works can be determined.
iii. It is necessary not only to know the past flood history, but also to collect the data that is statistically significant to estimate the scale of a phenomenon and to determine the criteria for forecasting and warning.
iv. Administrative agencies have to undertake the shared functions that are different

in national, state and village levels. Police, public works, press and transport have individual functions, but tie-ups among these functions are needed.