FLOOD ANALYSIS OF SUNGAI SAP, KUANTAN USING DIFFERENT RAINSTORM HOURS

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ABSTRACT

The purpose of this paper was to analyse flood based on the past event tragedy. Flood is considered the most severe as hazard in Malaysia, due to a wet equatorial climate with heavy rainfall during monsoon season. This study was carried out at Sungai Isap, Kuantan based on different rainstorm hours (2, 3 and 6) for 5, 10, 50, and 100 years of ARI using infoworks RS software. From this analysis, it indicated that Sungai Isap could not withhold the volume of rainfall during the monsoon season. Rainfall patterns and critical areas within the Sungai Isap catchment were also identified. This study could assist in forecasting and preparing for the upcoming flood.

ABSTRAK

Kajian kertas kerja ini adalah untuk menganalisa banjir berdasarkan pada peristiwa banjir yang terdahulu. Banjir dikategorikan sebagai bencana yang paling teruk di Malaysia, negara yang mengalami iklim khatulistiwa diikuti dengan hujan lebat pada musim hujan. Kajian ini telah dilakukan di Sungai Isap, Kuantan berdasarkan jumlah hujan yang turun pada waktu hujan yang berbeza (2, 3 dan 6 jam) untuk analisis 5, 10, 50 dan 100 tahun ARI. Berdasarkan daripada analisis yang telah dibuat, kajian ini menunjukkan bahawa Sungai Isap tidak dapat menampung jumlah hujan yang turun pada musim hujan. Pola data hujan dan kawasan yang kritikal di sepanjang Sungai Isap juga telah dikenalpasti. Ramalan tentang banjir dan persedian yang rapi untuk menghadapi banjir dapat dibuat berdasarkan kajian ini.

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LIST OF ABBREVIATION

NO	ABBREVIATION	
1	**DID**	Department of Irrigation and Drainage
2	**JUPEM**	Department of Survey and Mapping
3	**MACRES**	Department of Remote Sensing Malaysia
4	**DOA**	Department of Agriculture
5	**GIS**	Geographic Information System
6	**MSMA**	Manual SaliranMesraAlam
7	**ARI**	Average Reoccurrences Intensity
8	**CH**	Chainage
9	**Q/ Qp**	Flow Rate of Water (m^3/s) /peak discharge
10	**C**	Runoff Coefficient
11	t_c	Time of Concentration
12	**L**	Length of Flow Path from Catchment
13	**A**	Area of the Catchment
20	**I**	Rainfall Intensity (mm/hr)
21	**P**	Rainfall Depth (mm)
22	$^{R}I_t$	Average Rainfall Intensity for ARI
23	**t**	Duration, time (hr, min, sec)

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CHAPTER I

INTRODUCTION

1.1 Introduction

Kuantan town, Pahang's capital since 1955 is surrounded by rivers. It lies on the east coast and has a population of about 1.4 million people. The urbanization process in this town has changed the land use pattern and the urban structures. A larger portion of former forest and agricultural areas have been cleared and replaced by concrete buildings, roads, and drainage systems which are impermeable.

The rivers and streams running through the urban areas are choked up with sediment as a result of soil erosion from mining, housing, and other development areas. The problem of silting in the rivers and drains coupled with high rainfall intensity causes floods in low-lying areas and in areas with improper drainage facilities, especially those found close to development sites (Boni, et al. 19 April 2006).

Whenever a flood occurs, daily socio-economic activities would be disrupted, and due to its frequency and the number of areas and people affected, it would certainly have an adverse effect on the nation's economy. However, more and more people are living in flood-prone areas (Chin July 2007), such as along riverbeds and in floodplains and that make the chance of flood-related death higher. Besides that, the high costs and maintenance of flood protection systems and structures tends to turn communities off from proposing methods for dealing with this situation.

1.2 Problems Statement

Flash floods exerted a heavy toll on both people in term of lives lost and property or crop damage and the government in terms of money spent on preparedness, rescues and evacuation. Flood estimation or analysis could help to minimize the loss of social economic and environmental impact in Pahang especially in Kuantan which is often experienced flood especially during the monsoon season.

1.3 Objectives

The objectives of this study are:

i. To produce a model of Sungai Isap using actual daily rainfall data and GIS map of Sungai Isap.
ii. To determine the pattern of rainfall based on the hydrograph produced.
iii. To determine the critical sections along Sungai Isap.

1.4 Scope of Study

The scopes of study for this project are summarized as follow:

i. This study was carried out at Sungai Isap, Kuantan (Figure 1.1 and Figure 1.2) using hydrological data which provided by the government agencies.

ii. The simulation of the model was carried out using the Infoworks RS software based on the rainfall data which were December 2009's rainfall, 5, 10, 50 and 100 ARI on 2, 3 and 6 hours storm durations.

iii. Analysis was made based on all the data produced such as rainfall variation, time, the condition of the river's surface and effect of tidal.

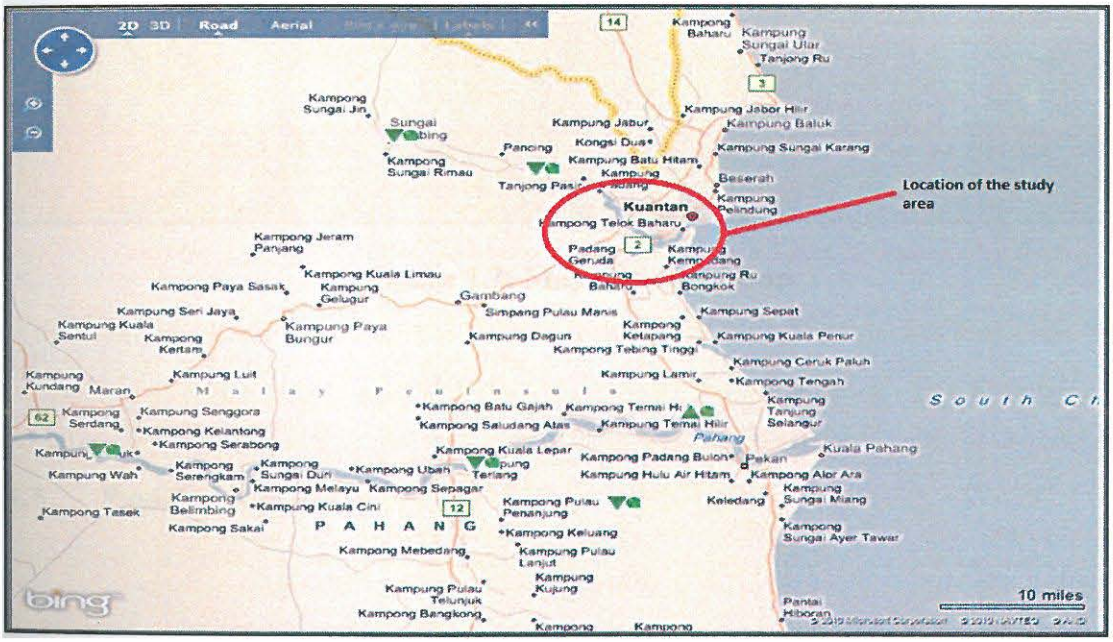

Figure 1.1: Location of The Study Area

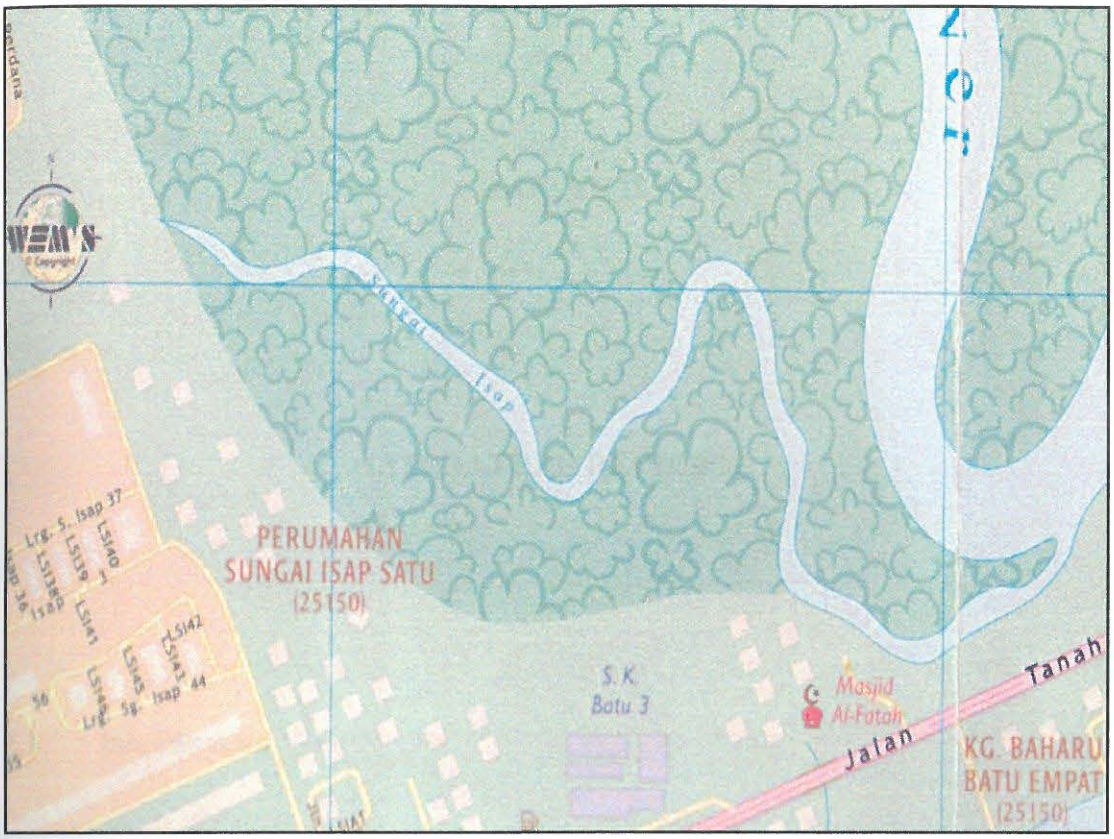

Figure 1.2: Map of Sungai Isap

1.5 Significant of Study

The significant of study for this project are:

i. More accurate data related to the real event were produced in order to improve the system during monsoon season.

ii. Related statistics on the flood were produced based on the results.

iii. Alertness of people and awareness of flood occurrences could be improved

CHAPTER II

LITERATURE REVIEWS

2.1 Introduction

Flood is a natural and recurring event for a river or stream. Flood was a result of heavy or continuous rainfall during storm duration exceeding the absorptive capacity of soil and the flow capacity of rivers, streams, and coastal areas. This causes a watercourse to overflow its banks onto adjacent lands or lands that close to the river. Floodplains are the lands that most subject to recurring floods, situated adjacent to rivers and streams. Floodplains are therefore flood-prone and are hazardous to development activities if the vulnerability of those activities exceeds an acceptable level of amount of its limit (Liu and Chan 2003).

Floodplains can be looked at from several different perspectives and aspects. Based on the topographic perspective, floodplain is quite flat and lies adjacent to a river but from geomorphologically aspect, floodplain is a landform composed primarily unconsolidated depositional material derived from sediments being transported by the related stream. In hydrologically aspect, flood plain can be described as a landform subjected to periodic flooding by a parent stream or river. (Goodarzi April 2010)

Floods are usually described in terms of their statistical frequency. A "100-year flood" or "100-year floodplain" describes an event or an area subject to a probability of a certain size flood occurring in any given year (Jamaluddin n.d.). This does not mean such a flood will occur only once in one hundred years. Whether or not it occurs in a given year has no bearing on the fact that there is still a chance of a similar occurrence in the following year. Since floodplains can be mapped (Figure 2.1), the boundary of the 100-year flood is commonly used in floodplain mitigation programs to identify areas where the risk of flooding is significant and danger. In this case study, another statistical frequency of a flood event had be chosen depending on the degree of risk that is selected for evaluation such as, 5-year ARI, 10-year ARI, 50-year ARI, 100-year ARI (Gisen June 2007).

Frequency of flood occurance depends on the climate, the material that makes up the banks of the river, the channel slope and many others. When substantial rainfall occurs in a particular season each year, or where the annual flood is derived principally from heavy rainfall, the floodplain may be inundated nearly every year, even along large rivers with very small channel slopes (Goodarzi April 2010). In Malaysia especially Kuantan, floods usually occur in the season of highest precipitation which is in the monsoon season where most floods are the result of heavy rainfall, often accompanied by tidal effect from the ocean.

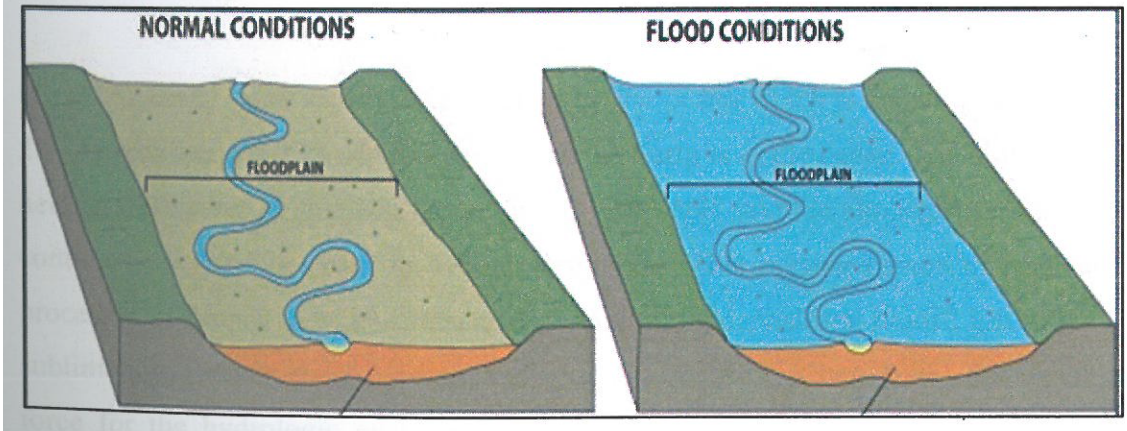

Figure 2.1: Floodplain's Area Along The River (Goodarzi April 2010)

2.2 Hydrology Cycle

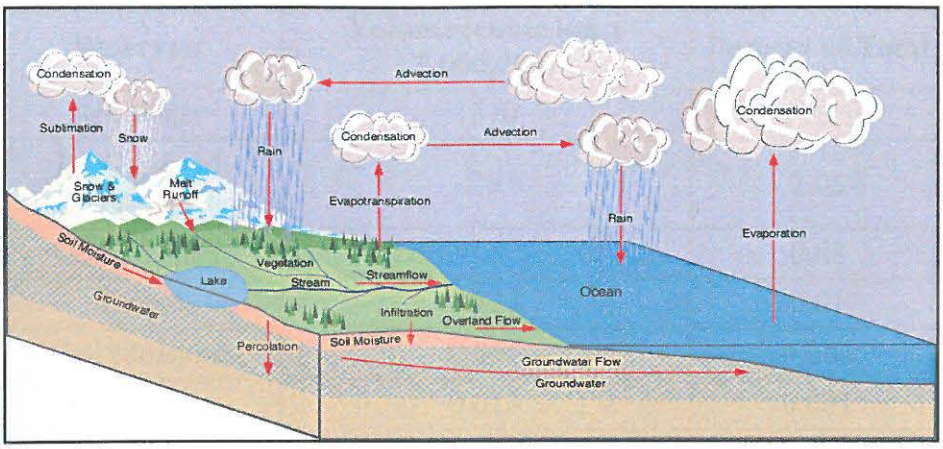

Figure 2.2: Hydrology Cycle (Cuen 1998)

Water is one of our most important natural resources. Without it, there would be no life on earth. Water moves from one reservoir to another reservoir or storage areas by many ways of processes as shown in Figure 2.2. The evaporated water found in the atmosphere is mostly comes from the ocean. Only 91% of the evaporated water is returned to the ocean basins by the way of precipitation and the remaining 9% is transported to area over landmasses. The resulting imbalance between rates of evaporation and precipitation over land and sea water is corrected by runoff and groundwater flow to the ocean (A. Smith, Baeck and J. Miller 6 September 2006).

Overall, water supply is dominated by the ocean which is shown in the Table 2.1. Approximately 97% of all the water on the Earth is in the ocean. The other 3% is held as freshwater in glaciers, groundwater, lakes, soil, and the atmosphere. Water is continually cycled between its various reservoirs. This cycling occurs through the processes of evaporation, condensation, precipitation, deposition, runoff, infiltration, sublimation, transpiration, melting, and groundwater flow (Cuen 1998).The driving force for the hydrologic cycle is the sun, which provides the energy needed for evaporation just as the flame of a gas stove provides the energy necessary to boil water and create steam. Water changes from a liquid state to a gaseous state when it evaporates from the oceans, lakes, streams, and soil.

Table 2.1: Inventory of Water at the Earth's Surface.

Reservoir	Volume (cubic km x 1,000,000)	Percent of Total
Sea Water	1370	97.25
Ice Caps and Glaciers	29	2.05
Groundwater	9.5	0.68
Lakes	0.125	0.01
Soil Moisture	0.065	0.005
Atmosphere	0.013	0.001
Streams and Rivers	0.0017	0.0001

2.3 Type of Flood

Floods are frequent natural disasters that always hit our country. The phenomenon of flooding has become more critical in recent years. Flash flooding is widespread especially in low areas such as area that located near Sungai Isap, Kuantan. The distribution of the types of flooding is based on physical characteristics of the flood. There are four types of flood which were flooding due to melting ice, flooding due to ice blockage, conventional storm floods and cyclonic storm floods. However, in Malaysia there are only two types of flood which were conventional storm floods and cyclonic storm floods.

2.3.1 Conventional Storm Floods

These floods caused by rains that occur as a result of lightning conventional flow of air. Conventional storm floods event is often accompanied by the presence of and thunder and lightning. It occurs in a short period, but could cause flooding in low lying areas that does not have effective drainage systems (Goodarzi April 2010). Water levels of the river will increase quickly and decrease slowly from time to time.

2.3.2 Cyclonic Storm Floods

Cyclonic storm flood is more dependent on the natural occurrence of storms. Cyclone rainfall is usually more wide spread and less dense, but occurs in a longer period than lightning rain (Goodarzi April 2010). The increasing of the water level of the river is slowly but can give great influence to the areas that have width drainage system.

2.4 Causes of Flood

Floods usually caused by several factors. Among them were the results of continuous rain during rainstorm hours. The rain continued without stopping for a few hours would caused flood. Besides that, development impact (urbanization) on the certain area especially in low lying area, lack of open or green space, less effective of drainage systems, and river erosion also caused the flood to occur (De, Roo; A., Schmuck; G., Perdigo; Vanda; Thielen J; 2003).

2.4.1 Rainfall / Storm Duration

Heavy rainfalls are one of the major causes of floods. The level of water in rivers or lakes rises due to heavy rainfalls. When the level of water rises above the river banks or dams, the water starts overflowing, which causes floods. The water overflows to the areas adjoining to the rivers, lakes or dams, causing floods or deluge. The flood water causes havoc and great destruction in the areas where it flows. Floods occur more in the regions that get heavy rainfalls which mean the duration of the storm hours were longer because when the storm become longer than normal, it brings along heavy rainfall which mean that the total volume of the rain will slightly increase that contribute to the flood problems (Jamaluddin n.d.).

2.4.2 Urbanization

Rapid development has resulted in many urban areas expand to meet the needs of local people's lives and to achieve the national goal of a newly industrialized country. Development referred to include the development of

residential, industrial and infrastructure construction. However, the impact of development has become one of the major causes that lead to flood problem in Malaysia (De, Roo; A., Schmuck; G., Perdigo; Vanda; Thielen J; 2003).

The process of urbanization had reduced impervious area (Sinnakaudan, Ab Ghani and Kiat 2001). Forest and land act as an agent that naturally absorbs rain water. When rain falls from the sky, absorbing the functions of the forest and land will extend the rain water to flow into the drainage system, the river sand ditches. Furthermore, most rain water has been absorbed and lived only a small part of rain water into the drainage system. Therefore, the existing drainage system is capable to hold such a volume of water.

When the opening occurred because of forest land development projects, natural surfaces have been converted to impervious surfaces such as cement, tar and concrete. Because of the rain water cannot be absorbed as appropriate, the water will take no time to flow into the drainage system (De, Roo; A., Schmuck; G., Perdigo; Vanda; Thielen J; 2003). The drainage system could not accommodate the volume of water so much and lead to overflow. This is why the flood occurred after a heavy rain.

2.4.3 Lack of Open and Green Space

Lack of open and green space was one of the causes of flooding in a certain area. The paved areas, concrete, bricks, and the tarred road surface are more prevalent compared with the open and green space percentage may be less than 10% of the total area of these two areas (Cuen 1998).

Forest is an example of open and green area that is home to many species of plants and animals. In addition it can also be used as a forest ecosystem balance by lowering the temperature of the world. Forests absorb the rain water to the surface at the rate of two per cent to 20%. Then the water is absorbed and drawn to the root. There is also a process of condensation which is releasing the water droplets into the air as part of the water cycle in nature (Cuen 1998).

Deforestation causes rain continued to fall to the ground without being absorbed by plants. With heavy rain, additional water flow into the river and eventually overflow occurs resulting in flooding.

2.4.4 River Erosion

River erosion is often caused by two factors, erosion occurs naturally and human domestic sewage. Natural factor occurs when a heavy rain flow and erode the river (Goodarzi April 2010). Eventually, the bank will collapse and form sediment on the riverbed. The rivers will then be shallowed. Similarly, human activities like removing domestic waste such as garbage and industrial waste into the river and causes the river becomes shallow and the water flow is blocked. This situation, the water will lead to overflow the banks of the river and the flood will occur.

2.4.5 Less Effective of Drainage Systems

Drainage system is considered as one of the reasons causing flooding because lack of drainage system was built and it is too small and shallow and often blocked. The amount of water causes a lot of water flowing out of the ditch causing flash floods occur. The existing drainage system is not big enough and should be repaired in accordance with the current situation in line with the development nowadays. When there is heavy rain fall into the drains, it cannot coped with a lot of water, then the water flowing out of the ditch causing flash floods occurs (De, Roo; A., Schmuck; G., Perdigo; Vanda; Thielen J; 2003)