OPTIMIZATION OF RAINFALL GAUGING SYSTEM FOR RAINFALL-RUNOFF FOR LIPIS RIVER

NUR WAHIDA BINTI MOHD ZAWAWI

B. ENG (HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

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Thesis submitted in fulfillment of the requirements for the award of degree of Bachelor of Civil Engineering (Hons)

Faculty of Civil Engineering and Earth Resources UNIVERSITI MALAYSIA PAHANG

JUNE 2016

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project report and in my opinion this project is satisfactory in terms of scope and quality for the award of Bachelor (Hons.) of Civil Engineering.

Signature	:
Name of Supervisor	: DR. BAMBANG WINARTA
Position	: LECTURER
Date	: 23 JUNE 2016

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Signature	:
Name of Student	: NUR WAHIDA BINTI MOHD ZAWAWI
ID Number	: AA12108
Date	: 23 JUNE 2016

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LIST OF ABBREVIATIONS

HEC-HMS	Hydrologic Engineering Center – Hydrologic Modeling System
IDF	Intensity Duration Frequency
SCS	Soil Conservation Service
Sg.	Sungai
UH	Unit Hydrograph
RMSE	Root Mean Square Error

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ABSTRACT

This study is focused on optimization of rainfall gauging system for rainfall runoff at Lipis River, Pahang. The rainfall-runoff model is simulated using Hydrological Modelling System (HEC-HMS) version 3.5. HEC-HMS is software for use in analyzing, planning, and simulating the process of rainfall and runoff. HEC-HMS 3.5 is used in this study to simulate discharge for Lipis River. This study uses rainfall data and stream flow data from January 2008 to December 2014. There are eleven rainfall stations and one stream flow station in Lipis River catchment area. The results of simulation can be generated in form of hydrograph, summary table, and time series table. Root Mean Square Error (RMSE) calculated to show the relationship of the simulated flow and the observed flow. If the RMSE value is lesser, it would indicate that the variables are positively linear related. During evaluation of model, the best value of RMSE value is 11.36 m³/s which is a low value. It shows that the simulated models were fit with the observed data and proves that the HEC HMS is suitable to predict and analyse rainfall-runoff relationship at Lipis River.

ABSTRAK

Kajian ini adalah tertumpu kepada pengoptimuman sistem hujan pengukuran untuk air larian hujan di Sungai Lipis, Pahang Model hujan-air larian adalah simulasi menggunakan sistem permodelan hidrologi (HEC-HMS) versi 3.5. HEC-HMS 3.5 digunakan dalam kajian ini untuk menjalankan simulasi pergerakan air untuk Sungai Lipis. Kajian ini menggunakan data air hujan dan aliran sungai dari Januari 2008 hingga Disember 2014. Terdapat sebelas stesen hujan dan satu stesen aliran sungai di kawasan tadahan Lipis River. Keputusan simulasi boleh dihasilkan dalam bentuk hidrograf, jadual ringkasan, dan jadual siri masa. Root Mean Square Error (RMSE) dikira untuk menunjukkan hubungan aliran simulasi dan aliran diperhatikan. Jika nilai RMSE adalah lebih rendah, ia menunjukkan bahawa pembolehubah adalah linear secara positif berkaitan. Semasa penilaian model, nilai-nilai RMSE yang terbaik ialah 11.36 m³/s itulah nilai yang rendah. Ia menunjukkan bahawa HEC-HMS adalah sesuai untuk meramalkan dan menganalisis hubungan hujan-air larian di Sungai Lipis.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Flood is unusual high stage of a river that overflows the natural or manmade banks thus spreading water to its floodplains that are thickly populated due to obvious advantage of water supply and irrigation (Patra, 2008). Flood is the one of the most serious natural disasters (Kim, 2004) compared to other natural disasters, flooding is regarded as one of the most frequent events and causes the greatest amount of economic loss. On the other hand, flood disasters have directly affected human's lives such as traffic confusion, properties damage, loss of life and inconvenience to the residents. The water resources around the world are under increasing pressure due to rapid population and economic growth, aggravated by lack of coordinated management and governance. This problem has somehow become more critical over the years when more physical development taking place in the upstream area of the river basin.

Massive flooding normally occurred in protracted consequence of the rain northeast rainy season in everywhere and covers big area. States often facing this season are Pahang, Terengganu, Kelantan, Sabah and Sarawak. Occasional flooding is a problem to homeowners and to entire cities. Crops do not grow at the optimum rate when soil is either too wet or too dry. Manufacturing operations require a constant water supply over time for a variety of purposes, such as to provide cooling water and to assimilate wastes. Thus, although earth's total volume of water may be adequate meet all needs, problems are created by variations in both the spatial and temporal distributions of water availability. Extreme problems, including life-threatening situations, can result from extreme variations in either the spatial or temporal distribution of water, or both.

In Malaysia, the major problem due to hydrological problem is flooding. A flood is an unusually high stage in a river, normally the level at which the river overflows its bank and inundates the adjoining area. Flooding happens due to heavy rainfall and rivers do not have the capacity to convey excess water. Besides that, it can occur due to dam failure and results in flooding of the downstream area, even in dry weather conditions.

Hydrological modeling is a commonly used tool to estimate the basin's hydrological response due to precipitation. It allows to predict the hydrologic response to various watershed management practices and to have a better understanding of the impacts of these practices (Kadam, 2011). It is evident from the extensive review of the literature that the studies on comparative assessment of watershed models for hydrologic simulations are very much limited in developing countries (Kumar and Bhattacharya, 2011). There is bare necessity to undertake study on hydrologic simulation through development of a suitable watershed model. The Hydrologic Engineering Centers Hydrologic Modeling System (HEC-HMS) is a popularly used watershed model to simulate rainfall runoff process.

The importance in this study is being able to predict the hydrologic model of the Lipis River using HEC-HMS. This study will determine the rainfall-runoff when optimizing the rainfall station derived from the HEC-HMS computer program. HEC-HMS was developed to predict rainfall data and to determine runoff process. The parameter estimations in HEC-HMS hydrologic model are structure of the model, analysis of sensitivity, results obtained from the data and calibration and verification procedures. By using HEC-HMS hydrologic model, the rainfall-runoff relationship can be obtained by producing a hydrograph.

1.2 PROBLEM STATEMENT

Monsoon floods are not a new phenomenon in Malaysia, where each year-end east coasters face heavy rain falls, which result in flash flooding. Most floods that occur are a natural result of cyclical monsoons during the local tropical wet season that are characterized by heavy and regular rainfall. Inadequate drainage in many urban areas also enhances the effects of heavy rain, though efforts are underway to resolve it. Flood disaster causes loss of life, disease outbreak, property damage, crop loss of earning and broken transport relationship among other problem. Lipis River which is one of the rivers which can contribute to this problem. To prevent the occurrence of flood, HEC-HMS is used to analyze the hydrologic process and to determine the optimization rainfall-runoff process of Lipis River. The software includes hydrologic analysis procedures such as infiltration, unit hydrographs, and hydrologic routing.

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