

# EXTRACTION OF RIVER NETWORKS FROM DIGITAL ELEVATION MODEL FOR THE ROMPIN RIVER BASIN

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## **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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## **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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Thesis submitted in fulfillment of the requirements  
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## **ABSTRAK**

Pemetaan dan visualisasi topografi telah menjadi lebih mudah kerana kemajuan teknologi dalam sistem informasi geografi (GIS). Peningkatan kemajuan dalam teknologi pemetaan melalui pertambahan ketersediaan Model Elevasi Digital (DEM) yang juga dikenali sebagai penyedia data spatial digital. Ciri-ciri hidrologi yang diekstrak daripada DEM adalah tepat dan ianya boleh dilakukan dengan lebih cepat berbanding kaedah tradisional. Tujuan kajian ini adalah untuk menggambarkan jaringan sungai dan mengekstrak ciri-ciri hidrologi daripada DEM bagi Sungai Rompin. Shuttle Radar Topografi Misi DEM (Data Elevasi SRTM 1 Arc-Global) dengan resolusi 30 m digunakan sebagai DEM untuk kajian ini. Pengekstrakan ciri-ciri fizikal yang diperlukan telah dilakukan dengan menggunakan aplikasi bersepadu ArcGIS-HEC-GeoHMS. Validasi jaringan sungai simulasi dibuat dengan membandingkan dengan ianya bersama jaringan sungai digital daripada Google Earth. Berdasarkan hasil validasi dapat disimpulkan bahawa DEM 30 m adalah mencukupi untuk menggambarkan dan menganggarkan jaringan sungai dan ciri-ciri fizikal Sungai Rompin dengan ketepatan yang dapat diterima.

## **ABSTRACT**

Mapping and topography visualization of an area of interest has become more convenient due to the advancement of technology in the geographical information system (GIS). The advancement in the mapping technology is enhanced by the increasing availability of the Digital Elevation Model (DEM) also known as the digital spatial data provider. The hydrological features of a basin extracted from the DEM is precise and can be done faster compared to the traditional method. The purpose of this study are to delineate the river network and extract the physical hydrological characteristics from DEM dataset for the Rompin River Basin. Shuttle Radar Topography Mission digital elevation model (SRTM 1 Arc-Second Global Elevation Data) with 30 m resolution was used as the DEM for this study. The extraction of the physical characteristics required was performed by using ArcGIS application integrated with HEC-GeoHMS extension. For the validation of the simulated river network, the results obtained were compared with the digitized river network from Google Earth. Based on the validation outcome, it is concluded that DEM of 30 m is sufficient to delineate and estimate the river network and physical characteristics of the Rompin River Basin with acceptable precision.

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## LIST OF SYMBOLS

$O_i$	Observed coordinate (meter)
$S_i$	Simulated coordinate (meter)
$n$	Number of points

## LIST OF ABBREVIATIONS

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
DEM	Digital Elevation Model
DID	Department of Irrigation and Drainage
DSM	Digital Surface Model
DTA	Digital Terrain Analysis
DTM	Digital Terrain Model
GDEM	Global Digital Elevation Map
GIS	Geographic Information System
GRASS	Geographic Resources Analysis Support System
HMS	Hydrologic Modelling System
IFSAR	Interferometric Synthetic Aperture Radar
ILWIS	Integrated Land and Water Information System
JPL	Jet Propulsion Laboratory
LIDAR	Light Detection and Ranging
NASA	National Aeronautics and Space Administration
NED	National Elevation Dataset
NGA	National Geospatial-Intelligence Agency
RMSE	Root Mean Square Error
RRB	Rompin River Basin
SRTM	Shuttle Radar Topography Mission
USGS	United States Geological Survey

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Malaysia is fortunate since it is free from natural disasters such as earthquake, volcano, and typhoon. The most devastating problems faced in this country are only flood and drought. Historically, Pahang is one of the state in Malaysia that has serious problems related to flooding as in many places in the world including the study area in this research, the Rompin River Basin. The Rompin River Basin experiences tropical climate all year-round which consists of wet and dry season. In December 2013, there were massive flash flood in the Rompin District. A total of 3,615 flood victims from 958 families were placed in 10 flood relief centres (Bernama, 2013). Some homes and roads were inundated and closed down in the area. Despite flood disaster, prolong drought was also affecting the area attributed to the El Nino phenomenon, which lasted between 6 to 18 months. According to the Department of Irrigation and Drainage, the water levels in most rivers have dropped drastically, including Sungai Rompin. Therefore, there is a need to delineate the river basins in an integrated way for better water resources management.

With the advancement of technology in the recent years, researchers and water managers have migrated from adopting the traditional method to computerized technology in analysing and extracting topographical dataset (Balasubramani, Saravanabavan, and Kandasamy, 2012). The computerized tool that is widely used is the Geographic Information System (GIS). GIS tool is designed to store, edit, analyse, and visualizes the spatial or geographic information of an area from DEM datasets (Bharata, Darshan, Pavan, and Shanubhog, 2014). Today GIS has served as one of the most powerful technology in hydrology and water resources development. There are several open-source GIS software including ArcGIS, GRASS GIS, OpenJUMP GIS, QGIS and many more that are available for GIS-based watershed delineation. The best-

known amongst them is the ArcGIS Hydrology tools which are useful to describe the physical components of a surface by identifying sinks, calculating flow direction and accumulation, stream order, delineating watershed and creating stream network (Alqaysi and Almuslehi, 2016). One of the most important applications of GIS is the delineation of watershed.

The input satellite data used in GIS application is the Digital Elevation Model (DEM). DEM has become popular in the field of hydrology due to its simplicity such as data structure, storage, and calculation. This elevation model provides 3D representation of a terrain surface, which is widely utilized in hydrological analyses including watersheds delineation (Fattah and Yuce, 2015). The data of terrain is stored in a square of grid for elevation values and topographic information such as slope properties, flow direction, flow accumulation, stream network and watershed attributes can be extracted. The key advantages of DEM are its ability to provide more precise measurement and faster than traditional manual delineation method (Mondal and Gupta, 2015).

In this study, ArcGIS is used to extract the river network and physical characteristics. For the validation of the simulated river network, the result obtained will be compared with the digitized river network from Google Earth. Meanwhile, for the physical characteristics, the validation is done by comparing the estimated result with the manual calculation. Finally, the results obtained from the delineated river network can be used as the topographic and hydrologic input for the hydrological study in water resource management work.

## **1.2 Problem Statement**

Since decades, flood and drought generally have become the most significant natural disasters in Malaysia, especially the east coast of Peninsula. The Rompin River Basin which is one of the district on the east coast has high potential to be affected by massive flood and drought. In flood and water resources study, topography information is important to identify the low-lying land and high land. Flood risk is generally higher at the low lying residential areas and agriculture lands. Moreover, these lands are also the highly populated areas in which leading to high water supply demands.



For a long river such as the Rompin River, extracting river network and hydrological information can be tedious and time consuming if the traditional method is implemented. Hence, it is essential to utilize the computerized technology available to categorize the topography elevation and delineate the river network in the Rompin River Basin. Furthermore, the lack of hydrological information regarding the Rompin River Basin shall be tackled to ease future research and modelling process.

### **1.3 Objectives**

This study aims to:

- To delineate river networks and watershed for the Rompin River Basin.
- To extract the physical characteristics for developing hydrologic models.

### **1.4 Scope and Limitation of Study**

This study covers only the Rompin River Basin as shown in the Figure 1.1. For the river network result comparison, the river network was digitized by tracing the streamline in Google Earth Pro Application (version 7.3.0.3832). Meanwhile, for the delineated river network, watershed analyses were done via extracting topographic datasets from DEM by using ArcGIS Hydrology tools. Extraction of physical characteristics include topography slope, roughness, sub stream and others. The DEM used in this study is the Shuttle Radar Topography Mission digital elevation model (SRTM 1 Arc-Second Global Elevation Data) with 30 m. This DEM map was selected because it can be downloaded from the United States Geological Survey (USGS) Earth Explorer without charges. Furthermore, it is the highest free version of DEM available online.

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