

**UNIVERSITI MALAYSIA PAHANG**

**DECLARATION OF THESIS AND COPYRIGHT**

Author's full name : Nur Insyirah Izzati binti Omar

Date of birth : 8<sup>th</sup> November 1993

Title : Study on Bed Load Pattern at Lebir After 2014 Flood

Academic Session : 2015/2016

I declare that this thesis is classified as:

**CONFIDENTIAL** (Contains confidential information under the Official Secret Act 1972)\*

**RESTRICTED** (Contains restricted information as specified by the organization where research was done)\*

**OPEN ACCESS** I agree that my thesis to be published as online open access (Full text)

I acknowledge that Universiti Malaysia Pahang reserve the right as follows:

1. The Thesis is the Property of University Malaysia Pahang
2. The Library of University Malaysia Pahang has the right to make copies for the purpose of research only.
3. The Library has the right to make copies of the thesis for academic exchange.

\_\_\_\_\_  
SIGNATURE OF STUDENT

93110811420

\_\_\_\_\_  
SIGNATURE OF SUPERVISOR

Mdm.Nadiatul Adilah Bt Ahmad Abdul Ghani

Date: 23<sup>rd</sup> June 2016

Date: 23<sup>rd</sup> June 2016

**NOTES:** If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization with period and reasons for confidentiality or restriction

STUDY ON BED LOAD PATTERN AT LEBIR RIVER AFTER 2014 FLOOD

NUR INSYIRAH IZZATI BINTI OMAR

Report submitted in partial fulfilment of the  
requirements for the award of the degree of B.Eng  
(Hons.) of Civil Engineering

Faculty of Civil Engineering and Earth Resources  
UNIVERSITI MALAYSIA PAHANG

JUNE 2016

**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 degree of Bachelor of Civil Engineering (Hons)

Signature :  
Name of main supervisor : Mdm. Nadiatul Adilah Bt Ahmad Abdul Ghani  
Position : Lecturer  
Date : 23<sup>rd</sup> JUNE 2016

**STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature :

Name : Nur Insyirah Izzati bt Omar

ID Number : AA12202

Date : 23<sup>rd</sup> JUNE 2016

## TABLE OF CONTENT

<b>DESCRIPTION</b>	<b>PAGE</b>
<b>SUPERVISOR'S DECLARATION</b>	ii
<b>STUDENT'S DECLARATION</b>	iii
<b>DEDICATION</b>	iv
<b>ACKNOWLEDGEMENTS</b>	v
<b>ABSTRACT</b>	vi
<b>ABSTRAK</b>	vii
<b>TABLE OF CONTENTS</b>	viii
<b>LIST OF TABLES</b>	xii
<b>LIST OF FIGURES</b>	xiv
<b>LIST OF SYMBOLS</b>	xvi
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>
1.1	Introduction 1
1.2	Background 2
1.3	Problem Statement 2
1.4	Objectives 3
1.5	Scope of Study 3
1.6	Significance of Study 3
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>
2.1	Sediment Transport and Properties at Lebir River 4
2.2	Analysis Sediment Load 5
	2.2.1 Incipient Motion 5
	2.2.2 Meyer Peter Muller 7
	2.2.3 Schoklitsch 8
	2.2.1 Duboys 9

2.3	Sediment Pattern	10
	2.3.1 Alluvial Channel	10
2.4	Cross Section of River	11

### **CHAPTER 3                    STUDY AREA AND METHODOLOGY**

3.1	Introduction	12
3.2	Map Location	13
3.3	Site Location	14
3.4	Point 1	15
3.5	Point 2	15
3.6	Point 3	16
3.7	Point 4	16
3.8	Point 5	17
3.9	Research Methodology	18
3.10	Sediment Sampling for Bed Load	18
	3.10.1 Field Test	18
	3.10.2 Measuring Flow Depth	18
	3.11.3 Measuring Width	19
	3.12.4 Measuring Flow Velocity	19
	3.13.5 Manning's Roughness Coefficient	20
3.11	Experiment Study	20
	3.11.1 Preparation of Sieve Analysis	20
	3.12.2 Sieve Analysis	21
	3.13.3 Sieve Analysis Calculation	24
3.12	Particle Density Analysis	25

### **CHAPTER 4                    RESULT AND DISCUSSION**

4.1	Introduction	28
4.2	Data Collection at Lebir River	29

4.3	Results on Experiments Conducted	29
4.3.1	Particle Distribution at Point 1	29
4.3.2	Particle Distribution at Point 2	31
4.3.3	Particle Distribution at Point 3	33
4.3.4	Particle Distribution at Point 4	35
4.3.5	Particle Distribution at Point 5	37
4.3.6	Effective Diameter versus Mean Velocity	39
4.4	River Bed Pattern at Point 1	40
4.5	River Bed Pattern at Point 2	42
4.6	River Bed Pattern at Point 3	43
4.7	River Bed Pattern at Point 4	44
4.8	River Bed Pattern at Point 5	46
4.9	Results on Particle Density	47
4.10	Median Grain Size and Mean Critical Stress	49
4.11	Mean Velocity and Mean Flow Rate	52
4.12	Bed Load Transport Analysis	53
4.12.1	Meyer Peter Muller	53
4.12.2	Schoklitsch	54
4.12.3	Dubois	56
4.13	Bed Load by Three Methods	57
4.14	Discussion of Bed Load Transport	58
4.15	Extreme Rainfall and Sediment Transport	59
4.15.1	Rainfall Event at Lebir in August 2014	60
4.15.2	Rainfall Event at Lebir in September 2014	61
4.15.3	Rainfall Event at Lebir in October 2014	62
4.15.4	Rainfall Event at Lebir in November 2014	63
4.15.5	Rainfall Event at Lebir in December 2014	64
4.16	Discussion on Rainfall Event and Sediment Transport	64
4.17	Incipient Motion and Its Relation with Bed Load	65

**CHAPTER 5 CONCLUSION AND RECOMMENDATION**

5.1	Conclusion	66
5.2	Recommendation	67

<b>REFERENCE</b>	<b>66</b>
------------------	-----------

**APPENDICES**

A	Data Collection at Each Point	71
B	Udden Wentworth Scale	72
C	Incipient Motion	73
D	Viscosity Tables	75
E	Sieve Analysis Results and Calculation	77
F	Particle Density and Calculation	82
G	Example Flow Rate Calculation	84
H	Example Conversion Unit from SI Unit to Imperial Unit	85
I	Geometric Mean Diameter Calculation	86
J	Geometric Standard Diameter Calculation	87
K	Rainfall Data from August to December 2014	87



## LIST OF TABLES

<b>Table No.</b>	<b>Title</b>	<b>Page</b>
3.1	Specific Density Calculation	25
4.1	Sieve Analysis at Point 1	29
4.2	Sieve Analysis at Point 2	31
4.3	Sieve Analysis at Point 3	33
4.4	Sieve Analysis at Point 4	35
4.5	Sieve Analysis at Point 5	37
4.8	Effective Particle Diameter Size versus Mean Velocity	39
4.9	River Bed Pattern at Point 1	40
4.10	RiverBed Pattern at Point 2	42
4.11	River Bed Pattern at Point 3	44
4.12	River Bed Pattern at Point 4	46
4.13	River Bed Pattern at Point 5	47
4.14	Particle Density Result for First Experiment	49
4.15	Particle Density Result for Second Experiment	50
4.16	Particle Density Results	50
4.17	Median Grain Size against Mean Critical Shear Stress	52
4.18	Mean Velocity against Mean Flow Rate	57
4.19	Bed Load Transport by Three Methods	56
A1	Data Analysis at Each Point	71
B1	Udden Wentworth Scale	72
C1	Incipient Motion Data at Each Point	73
E1	Sieve Analysis Result at Point 1	77
E2	Sieve Analysis Result at Point 2	78
E3	Sieve Analysis Result at Point 3	79
E4	Sieve Analysis Result at Point 4	80

E5	Sieve Analysis Result at Point 5	81
F1	Particle Density Results for First Experiment	82
F2	Particle Density Results for Second Experiment	82
K1	Sungai Lebir (4922001) Rainfall Data	88

## LIST OF FIGURES

<b>Figure No.</b>	<b>Title</b>	<b>Page</b>
2.1	Shields Diagram	6
3.1	Map of study area, along Lebir River from Google Maps	13
3.2	Locations of stations from Google Earth Organization Chart	14
3.3	View of Point 1 at Lebir River	15
3.4	View of Point 2 at Lebir River	15
3.5	View of Point 3 at Lebir River	16
3.6	View of Point 4 at Lebir River	16
3.7	View of Point 5 at Lebir River	17
3.8	Samples at 5 Points before oven dry	20
3.9	Samples at 5 Points after oven dry	21
3.10	Sieves are assemble in the ascending order	22
3.11	The samples is being crushed	21
3.12	The samples is being placed in mechanical shaker	23
3.13	Specific Density Bottle	26
3.14	Bottle and content in the vacuum desiccators	27
3.15	Content of the bottle and clean and refilled with water	27
4.1	Grain Distribution at Point 1	30
4.2	Mean Particle Size at Point 1	30
4.3	Grain Distribution at Point 2	32
4.4	Mean Particle Size at Point 2	32
4.5	Grain Distribution at Point 3	34
4.6	Mean Particle Size at Point 3	34
4.7	Grain Distribution at Point 4	36
4.8	Mean Particle Size at Point 4	36
4.9	Grain Distribution at Point 5	38
4.10	Mean Particle Size at Point 5	38

4.11	Effective Diameter Size versus Mean Velocity	39
4.12	River Bed Pattern at Point 1	40
4.13	RiverBed Pattern at Point 2	42
4.14	River Bed Pattern at Point 3	44
4.15	River Bed Pattern at Point 4	46
4.16	River Bed Pattern at Point 5	47
4.17	Particle Density Graph	51
4.18	Median Grain Size against Critical Stress	52
4.19	Mean Velocity against Mean Flow Rate Graph	53
4.20	Bed Load Transport Curve by Three Method	57
4.21	Rainfall hydrological station in Kelantan	59
4.22	Location of Hydrological Station for Lebir River	60
4.23	Rainfall Event at Lebir River in August 2014	60
4.24	Rainfall Event at Lebir River in September 2014	61
4.25	Rainfall Event at Lebir River in October 2014	62
4.26	Rainfall Event at Lebir River in November 2014	63
4.27	Rainfall Event at Lebir River in December 2014	64
D1	Table of Viscosity	75

**LIST OF SYMBOLS**

Q	Flow Rate of Water ( $\text{m}^3/\text{s}$ )
A	Area ( $\text{m}^2$ )
V	Velocity (m/s)
mm	Millimetre
km	Kilometre
m	Meter (m)
g	Gravitational Force ( $\text{m}/\text{s}^2$ )
$n_s$	Manning Coefficient
$\tau_c$	Critical Shear Stress
$\tau_0$	Actual Shear Stress
$D_s$	Mean Diameter (mm)
$\nu$	viscosity ( $\text{m}^2/\text{s}$ )
$\gamma$	Specific Weight ( $\text{N}/\text{m}^3$ )
S	Slope
Gs	Bed Load Discharge (lb/sec-ft)
d	Depth of River
B	Width of River

STUDY ON BED LOAD PATTERN AT LEBIR RIVER AFTER 2014 FLOOD

NUR INSYIRAH IZZATI BINTI OMAR

Report submitted in partial fulfilment of the  
requirements for the award of the degree of B.Eng  
(Hons.) of Civil Engineering

Faculty of Civil Engineering and Earth Resources  
UNIVERSITI MALAYSIA PAHANG

JUNE 2016

## ABSTRACT

The purpose of this research was to identify the size and types of sediment at Lebir River after 2014 flood, to analyse the bed load discharge of Lebir River using selected method and to identify the sediment pattern/bed load pattern due to sedimentation process. The study conducted at 5 stations at Lebir River. The rainfall precipitation in December 2014 showed that the maximum rainfall event will cause the high amount of rainfall precipitation and will increase the production of bed load transport. Therefore, the surface erosion also gives contribution to the increase of sediment transport and had become the one of main problem at Lebir River after flood in December 2014. The bed load pattern at each point were identified through the sedimentation process. The bed load pattern gave the variation of sediment transport modes at Lebir River. The bed load discharge were evaluated using three different formulas which were Meyer Peter and Muller, Schoklitsch and Duboys equation. From the analysis of the results of each of the formula, Meyer Peter and Muller can be used to predict bed load transport for Lebir River.

## ABSTRAK

Tujuan kajian ini adalah untuk mengenal pasti saiz dan jenis mendapan di Sungai selepas banjir pada tahun 2014 untuk menganalisis pelepasan beban dasar di Sungai Lebir dengan menggunakan kaedah yang tertentu dan untuk mengenal pasti corak corak mendapan / beban dasar yang disebabkan oleh proses pemendapan. Kajian dijalankan di 5 stesen di Sungai Lebir. Taburan hujan pada bulan Disember 2014 menunjukkan bahawa peristiwa hujan maksimum akan menyebabkan jumlah hujan yang tinggi dan akan meningkatkan pengeluaran pengangkutan beban dasar. Oleh itu, hakisan permukaan juga memberikan sumbangan kepada peningkatan pengangkutan mendapan dan telah menjadi salah satu daripada masalah utama di Sungai Lebir selepas banjir pada Disember 2014. Corak beban dasar pada setiap titik telah dikenal pasti melalui proses pemendapan. Corak beban dasar memberi perubahan mod pengangkutan mendapan di Sungai Lebir. Beban dasar telah dinilai menggunakan tiga formula yang berbeza yang iaitu Meyer Peter dan Muller, Schoklitsch dan Duboys. Daripada analisis keputusan setiap formula, Meyer Peter dan Muller boleh digunakan untuk meramalkan pengangkutan beban dasar untuk Sungai Lebir.



## **CHAPTER 1**

### **INTRODUCTION**

#### **1.0 INTRODUCTION**

Sediment is natural earth material which consists of soil particles that are ranging in sizes from the smallest which are mud and sand to the larger sizes which include the gravels, cobbles and boulders. Sediment can move and deposited in a new location. Sediment can move from one place to another through the process of erosion. Erosion is the process of removal and transportation of rock or soil.

Sediment can be transported by a flow of water. Sediment transport can be in the form of bed-load and suspended load, which are depending on the size of the bed material particles and the flow conditions. Some factor which influence the sediment transport are flow conditions, sediment size and sediment density. Usually, the greater the flow of water, the more sediment will be transported while the movement of sediment will control the size and shape of bed forms.

The sediment load is varies from river to river. The velocity of the water is important in determining the way of how sediment is being transported. Bed-load transport depends on the flow characteristics and sediment properties, such as shear stress, surface roughness, and

particle size, density, and shape. Bed-load transport is the main connection between river hydraulics and river form and has a significant effect on restoring the channel geometry.

## **1.1 BACKGROUND OF STUDY**

Lebir River is located in Kelantan, Malaysia. The river is located at the latitude and longitude coordinates of 5.516667 and 102.2. Lebir River is the main river that joins Sungai Galas to form Sungai Kelantan at Kuala Krai. Records from the Kelantan Department of Irrigation and Drainage (JPS) indicated heavy rainfall in Ulu Kelantan from Dec 16 to 24, 2014 and the amount of rain recorded within the period at the Gunung Gagau Station was almost half of the state's annual rainfall (Hoong, 2007).

Human interference is one of the effects of sediment transport process that gives impacts on sediment load and bed load pattern. Vegetation removal from agricultural, logging activities, are the factor that will increase erosion and sediment loads of rivers. Erosion will cause the bed load to increase at the river. Therefore, the depth of river will decrease. When the depth of the river decreases, the volume of the flow rate remain same, and it will cause the flood.

## **1.2 PROBLEM STATEMENT**

Each year, usually flood is often to occur in Kelantan. In year 2014, it can be considered as one of the worst flood and Lebir River is one of the most affected areas in Kelantan by flood. Erosion of sediment is one of main cause that begins the process of sediment transport which also can cause bed load in river to increase. Once a particle has been eroded, water becomes the “principal vehicle for transport of the eroded material,” (Linsley al., 1975). Through this study, bed load pattern through the sedimentation process at Lebir River can be determined.

### **1.3 OBJECTIVES**

The objectives of this research are:

- To identify the size and types of sediment at Lebir River
- To analyse the bed discharge of Lebir River using selected method
- To identify the sediment pattern/bed load pattern due to sedimentation process

### **1.4 SCOPE OF STUDY**

The study will focus at 5 Points at Lebir River. The methods for bed load equation that will be used are Meyer-Peter and Muller, Schoklitsch, Duboys, Einstein. The methods will be selected based on their suitability for the river.

### **1.5 SIGNIFICANCE OF STUDY**

This study can give data of bed load that can be used for future research at Lebir River. The bed load pattern will be identified at Lebir River. It is crucial to know the pattern of sediment erosion and deposition so that it can become reference for upcoming study about the Lebir River.