STUDY ON CHARACTERISTICS OF SEDIMENT AND SEDIMENTATION RATE IN KENAU RIVER FOR YEAR 2008, 2016 AND 2019

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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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ABSTRAK

Kajian ini dijalankan di Sungai Kenau, Sungai Lembing, Kuantan. Objektif kajian ini dijalankan adalah untuk menentukan perubahan ciri-ciri sedimen di Sungai Kenau dari tahun 2008 ke 2019. Ujian makmal telah dilakukan untuk mengenalpasti perubahan sifat-sifat sedimen melibatkan saiz, ketumpatan dan halaju sedimen. Pengagihan saiz zarah telah dijalankan untuk mengklasifikasikan sifat-sifat sampel tanah. Berpandukan ujian klasifikasi tanah, tanah di kawasan ini dikenalpasti sebagai tanah kerikil iaitu tanah dan lumpur halus. Objektif kedua adalah untuk menentukan persamaan terbaik untuk meramal sedimen di Sungai Kenau. Keratan rentas tasik telah diukur dan dibandingkan untuk melengkapkan objektif kajian. Sungai Kenau telah mengalami banyak perubahan sepanjang tempoh 11 tahun. Ciri-ciri di Sungai Kenau diperlukan untuk mengenal pasti kerana ia boleh menjejaskan aliran sungai semasa hari biasa dan peristiwa banjir. Kajian yang dijalankan melibatkan lima lokasi kajian yang berbeza. Hasil ujian pengamatan sampel sedimen diklasifikasikan menggunakan Sistem Klasifikasi Tanah Bersepadu (USCS). Klasifikasi tanah di Sungai Kenau diklasifikasikan sebagai Pasir Gred Rendah (SP). Data kadar alir air direkodkan menggunakan meter arus berkipas. Kadar aliran tertinggi dicatatkan kira-kira 2.940 m^3/s terletak di Stesen 2. Kadar aliran terendah yang direkodkan adalah kira-kira 1.523 m^3/s yang terletak di Stesen 4. Persamaan terbaik untuk digunakan bagi menentukan kadar sedimen di Sungai Kenau ialah persamaan Ackers-White untuk pengangkutan sedimen.

ABSTRACT

This study was conducted at Kenau River at Sungai Lembing, Kuantan. The objective of the study is to determine the changes of sediment characteristics at Kenau River from year 2008 to year 2019. In order to determine the change of sediment properties regarding size, density and fall velocity, several related were conducted in the laboratory. Particle size distribution was carried out to classify properties of the soil sample. From the soil classification test, this soil is gravel soil with fine soil and silt. The second objective is to determine the best equation to predict the sediment at Kenau River. The cross section of river had measure and compare. It overcome huge changes after 11 years. The characteristics at Kenau River required to identify because it may affect the flow of the river during a usual day and flood event. This study involves five location of study area. The sediment sample sieving test results was classified using Unified Soil Classification System (USCS). The soil classification at Kenau River for every station is almost entirely classified as Poorly Graded Sands (SP). The flow rate data also had record for every location by using current mer. The highest flow rate was recorded about 2.940 m^3/s located at Station 2. The lowest flow rate recorded is about 1.523 m^3/s located at Station 4. The best equation to be used to determine sediment rate at Kenau River is Ackers-White equation for sediment transport.

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LIST OF SYMBOLS

N	North
E	East
mm	Milimeter
%	Percent
ϕ	Phi
in	Inch
D	Diameter
ρ_s	Mass per unit volume (g/cm^3)
R	Hydraulic radius (m)
n	Total manning roughness
lb	Pound
ft	Feet
G_s	Bed load discharge (lb/sec)
g_s	G_s /$_{Tw,}$ Bed load discharge per unit width (lb/sec/ft)
b	Width (m)
d	Depth (m)
V	Flow velocity (m/s)
A	Area (m^2)
$\boldsymbol{\tau}_o$	γdS, Bed shear stress (lbs/ft^2)
$\boldsymbol{\tau}_c$	Critical bed shear stress (lb/ft^2)
ψ	Coef. depending on mean size of bed material (ft^3/lb/sec)
γ	Specific weight of water (lb/ft^3)
S	Slope (m/m)
Q	Flow rate or discharge (m^3/s)
D_{si}	Mean grain size (ft)
q	Discharge per unit width
D_{50}	50 percent finer by weight in the size distribution curve
°C	Temperature in celcius

LIST OF ABBREVIATIONS

UMP	Universiti Malaysia Pahang
UNESCO	United Nations Educational, Scientific and Cultural Organizations
DMS	Degree, Minutes and Seconds
GPS	Global Positioning System
Dec	December
Sept	September
Jan	January

CHAPTER 1

INTRODUCTION

1.1 Introduction

Sediments are the fragments of rocks and minerals that comes from the weathering of rock and are carried and deposited by wind, water or ice. When the rainfall occur, the materials are dislodged and transported on the land surfaces. Rivers and streams will act as a passage for the movement of sediments and deposition will occur when there is no enough energy to transport the sediments. These passages will carry the sediment as they flow depending on the sediment supply along their course.

Water is the main transportation types for sedimentation which called as fluvial processes. Besides water, wind or Aeolian processes also one of the types of transportation for the sedimentation process. Sedimentation is accomplished when the velocity of the water treated is decreased under condition which the particles will no longer remain suspension.

The sedimentation rate is the process to design of classifier which also used to separate solids by their size and density under free and hindered settling condition. The total sedimentation rates are estimated annually along established by direct survey of the river bottom.

Sediment transport or sediment load deals with the interrelationship between flowing water and sediment particles, which means the material in suspension and or in transport. Typically, the greater the flow, the more sediment will be transported. During transport in water body, the total sediment load are divided into two categories, which are wash load and bed-material load. While in term of movement, the sediment can be identified as bed load transport and suspended load. The several factors affecting the

sediment transport are velocity, depth of flow, particle sediment size, geometry cross section and course of river flow.

Once the sediment has entered waterways, it is difficult and expensive tasks to remove where engineering solutions and heavy equipment are required. A question on how much sediment would be carried by a river under a given hydraulic condition makes the study of sediment transport is one of great engineering importance using the suitable methods or functions.

1.2 Background of Study

Sediment movement is a natural part of a functioning freshwater ecosystem, human activities around waterways such as dam or road construction or land use change from native forest to pasture can greatly increase the amount of sediment that enters the system. This situation can have considerable effects on water quality; plant and animal live there, and water level. The addition of sediment to rivers and streams above normal levels is a serious issue. This means, the study of sedimentation rate is quite important since the problem related to our human society such as floods and water quality can be avoided. For example, the depth of river become shallow if the sedimentation occurred. It will make the quantity of aquatic life will reduced and the area will face flooding because the river become overflow due to sedimentation process.

At the same time, when the sediments in river system are high and it is still behind a dam, the sediments will sink to the bottom of the reservoir. This situation refers to reservoir sedimentation. Then, as the sediment are accumulated in the reservoir, the dam will rapidly reduce its usefulness or lifespan to store water. This accumulation of sediment in reservoirs may have several effects such as reduce the useful storage volume, change water quality, increase flooding level upstream and influence stability of the stream at downstream of dam.

Sediment transport is important in the field of sedimentary geology, geomorphology, civil engineering and environmental engineering. It is movement of solid particles, typically due to a combination of gravity acting on the sediment, and/or

the movement of the fluid in which the sediment are entrained. Knowledge of sediment transport is most often used to determine whether erosion or deposition will occur, the magnitude of this erosion or deposition, and the distance over which it will occur.

Total sediments transport in streams or rivers is categorized into bed load, which are transported near or along the bed by rolling, bounding and sliding, and suspended load, which are carried in suspension through water column. The total sediment transport processes in a river system are varies across river catchment which depends on the interaction among sediment size, discharge energy, channel bed conditions and channel obstructions. There are several equations or functions, which have been developed for estimating sediment, transport in an alluvial channel. However, because of the sediment transport, processes are sensitive to a number of variables representing the strength of the flow, the fluid and the sediments; so that the sediment transport potential can be, vary by an order of magnitude depending on the similarity of material and hydraulic parameters between the rivers and developed functions.

The sediments are basically fragments of rock and minerals that come from the weathering of rock. When the rain falls, materials are disloged and these materials are transported on the land surface, streams and rivers act as passage for the movement of sediments. When there is not enough energy to transport the sediments, deposition occurs. Rivers and streams carry sediment supply as they flow depending on the sediment supply along their course. Depending on settling velocity, drag and lift force, these sediment are carried along the river in either suspended form or bed load. At the same time, these factors are broadly classified in affecting sediment transport such as hydrology and climate, topography, geology and land use.

The transportation of sediment depends not only on the characteristics of the flow involved, but also on the properties of the sediment itself. Those properties of most importance in the sedimentation processes can be divided into properties of the particles and of the sediment as a whole. The most important property of the sediment particle or grain is its size. In most of the river sediment studies, average size alone has been used to describe the sediment as a whole. To obtain more accurate results, a more precise description of sediment is required.

REFERENCES

Ahmad Abdul Ghani, N. A., Othman, N., & Baharuddin, M. K. (2013). Study on Characteristics of Sediment and Sedimentation Rate at Sungai Lembing, Kuantan, Pahang. *Procedia Engineering*, 81-92.

Ali, H. L., Mohammed , T. A., Yusuf, B., & Aziz, A. A. (2016). Testing The Accurancy of Sediment Transport Equations using Field Data. *Malaysian Journal of Civil Engineering 28 Special Issue (1)*, 50-64.

Ariffin, J., Abd Ghani, A., Zakaria, N. A., & Yahya, A. S. (2002). Evaluations of Equations on Total Bed Material Load. *Innternational Conference on Urban Hydrology for 21st Century*, 321-327.

Bang Namin, N. S. (2017). *Study on Bed Material Characteristics and Bed Load Concentration in Sungai Jemberau at Tasik Chini.* Univeristi Malaysia Pahang.

Barry, J. J., Buffington, J. M., Goodwin, P., M. ASCE, King, J. G., & Emmett, W. W. (2008). Performance of Bed-Load Transport Equations Relative to Geomorphic Significance: Predicting Effective Discharge and Its Transport Rate. *Journal of Hydraulic Engineering Vol. 134, Issue 5*.

Bettes, R. (2008). *Sediment Transport and Alluvial Resistance in Rivers.* Bristol, United Kingdom: Enviroment Agency.

Bidorn, B., A. Kish, S., F. Donoghue, J., Bidorn, K., & Mama, R. (2016). Sediment transport characteristics of the Ping River basin, Thailand. *Procedia Engineering 154*, 557-564.

Bong, C. H., Lau, T. L., & Ab. Ghani, A. (2014). Sediment Size and Deposition Characteristics in Malaysian Urban Concrete Drains - A Case Study of Kuching City. *Urban Water Journal Vol 11, No. 1*, 74-89.

Chan Chun Kiat, A. A. (2011, April 26). *Sediment Transport in Kulim River, Kedah, Malaysia, Sediment Transport Book by Silvia Susana Ginsberg.* Retrieved from IntechOpen: https://www.intechopen.com/books/sediment-transport/sediment-transport-in-kulim-river-kedah-malaysia

Chavan, B. S., & Prakash, H. (2016). Prediction of Sediment Inflow in Reservoirs. *International Journal of Innovative Research in Computer Science & Technology (IJIRCST) Volume-4, Issue-1*, 19-23.

Gao, P. (2011). An Equation for Bed-Load Transport Capacities in Gravel-Bed Rivers. *Journal of Hydrology*, 297-305.

Garcia, M. H. (2008). *Sedimentation Engineering: Processes, Measurements, Modelling and Practice.* American Society of Civil Engineers.

Government of Wsetern Australia, D. o. (2000, January 1). *Water Notes: Sediment in Streams*. Retrieved from Department of Water, Western Australia Website: www.water.wa.gov.au/__data/assets/pdf_file/0017/3158/11444.pdf

H. Hassanzadeh, S. F. (2011). Estimate if Sediment Transport Rate at Karkheh River in Iran using Selected Transport Formulas. *World Applied Sciences Journal 13 (2)*, 376-384.

Habibi, M. (1994). Sediment transport estimation methods in river systems. *Universities of Wollongong Thesis Collection*, 27-66.

Haddadchi, A., H. Omid, M., & A. Deghani, A. (2013). Bedload Equation Analysis using Bed Load-Material Grain Size. *J. Hydrol. Hydromech, 61*, 241-249.

Hassanzadeh, Y. (2012, March 14). *Hydraulics od Sediment Transport, Hydrodynamics Book by Jin Hai Zheng.* Retrieved from IntechOpen: https://www.intechopen.com/books/hydrodynamics-theory-and-model/hydraulics-of-sediment-transport

Hirsfield, F., & Sui, J. (2011, April 26). *Changes in Sediment Transport of the Yellow River in the Loess Plateau.* Retrieved from IntechOpen: https://www.intechopen.com/books/sediment-transport/changes-in-sediment-transport-of-the-yellow-river-in-the-loess-plateau

Holmes, R. R. (2010). Measurement of Bedload Transport in Sand-Bed Rivers: A look at Two Indirect Sampling Methods. *U.S Geological Scientific Investigation Report*, 236-252.

Iwuoha, P. O., Adiela, P. U., Nwannah, C. C., & Okeke, O. C. (2016). Sediment Source and Transport in River Channels: Implications for River Structures. *The International Journal of Engineering and Science (IJES)*, 19-26.

Kiat, C. C., Ab. Ghani, A., Abdullah , R., & Zakaria, N. A. (2011, April 26). *Sediment Transport in Kulim River, Kedah, Malaysia.* Retrieved from IntechOpen: https://www.intechopen.com/books/sediment-transport/sediment-transport-in-kulim-river-kedah-malaysia

Kiat, C. C., Ab. Ghani, A., Zakaria, N. A., Abu Hassan, Z., & Abdullah , R. (2004). Measurement of Bed Load Transport for Selected Small Streams in Malaysia. *1st International Conference on Managing Rivers in the 21st Cnetury: Issues and Challenges*, 236-241.

Kuhnle, R. A., Wren, D. G., & Langendoen, E. J. (2014). Predicting Bed Load Transport of Sand and Gravel on Goodwin Creek. *Journal of Hydro-environment Research 8*, 153-163.

M. Nawawi, M. A. (2017). *The Study of Sediment Behaviour Changes at Sungai Lembing between 2008 and 2016.* Universiti Malaysia Pahang.

Mays, L. W. (2010). *Water Resources Engineering Second (2nd) Edition: Chapter 18 Sedimentation and Erosion Hydraulics.* John Willey and Sons Inc.

Md. Ali, Z., Tjahjanto, D., Rahmat, N., Mohamad Masirin, M. I., Musa, S., & Abd Manan, I. (2008). A study od Sediment Load: Case Study at Parit Botak Channel, Batu Pahat, Johor, Malaysia. *International Coference on Enviroment 2008 (ICENV 2008)*, 1-8.

Mohamad Prim, F. A., & Ahmad Abdul Ghani, N. A. (2013). Preliminary study on sediment load at Sungai Galing, Kuantan, Pahang. *Malaysia Technical Universities Conference on Engineering & Technology (MUCET)*.

Mohd Nor, N., Mat Peah, K., & Hamzah, M. Z. (n.d.). *Civil Engineering Laboratory Manual (3rd Edition)*. Faculy of Civil Engineering & Earth Resources, Universiti Malaysia Pahang.

Papalaskaris, T., Dimitriadou, P., & Hrissanthou, V. (2016). Comparison between Computations and Measurements of Bd Load Transport Rate in Nestos River, Greece. *Procedia Engineering 162*, 172-180.

Raja Idnan, R. I. (2016). *Study On Sediment Size And Discharge At Lebir River Due To 2014 Flood.* Universiti Malaysia Pahang.

Schumm, S. A. (1985). Patterns of Alluvial Rivers. *Annual Reviews Earth Planet Science 13*, 5-27.

Shannon, & Wilson. (2009, June). *Lower Puyallup River Flood Protection Investigation Without-Project Analysis: Chapter 4 Sediment Transport and Deposition.* Retrieved from Pierce County Web site: https://www.co.pierce.wa.us/

Stop Mining Activities at Tasik Chini. (2012, August 15). Retrieved from Transparency International Malaysia: http://transparency.org.my/what-we-do/forest-governance-and-integrity/stop-all-mining-activities-immediately-at-tasik-chini/

Till, B., & Trayler, K. (2000, January 1). *Water Notes: Sediment in Streams.* Retrieved from Department of Water, Western Australia Website: www.water.wa.gov.au/__data/assets/pdf_file/0017/3158/11444.pdf

Tipper, J. C. (2016). Measured rates of sedimentation: What exactly we estimating and why? *Science Direct: Sedimentary Geology 339*, 151-171.

Toriman, M. E., Kamaruddin, M. K., Hj. Idris, M., Jamil, N. R., Gazim, M. B., & Abd Aziz, N. A. (2009). Sediment Concentration and Load Analyses at Chini River, Pekan, Pahang, Malaysia. *Research Journal of Earth Sciences 1 (2)*, 43-50.

Vlab. (n.d.) Ackers-White online, Retrieved from *http://onlinecalc.sdsu.edu/onlineackerswhite.php*

Vlab. (n.d.) Engelund-Hansen online, Retrieved from *http://onlinecalc.sdsu.edu/onlineengelundhansen.php*

Wentworth, C. K. (1922). A Scale of Grade and Class Terms for Clastic Sediments. *The Journal of Geology, Vol 30, No. 5*, 337-392.