GEOLOGY AND GEOCHEMISTRY OF WATER DISCHARGES FROM THE SAND MINING AT KAMPUNG SAT, TANAH MERAH KELANTAN

by

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A report submitted in fulfillment of the requirements for the degree of Bachelor of Applied Science (Geoscience) with Honours

FACULTY OF EARTH SCIENCE
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2017

DECLARATION

I declare that this thesis entitled "Geology and Geochemistry of water discharges from the sand mining at Kampung Sat, Tanah Merah Kelantan" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : _____

Name : _____

Date : _____

ACKNOWLEDGEMENT

First and above all, praise is to Almighty Allah, the Most Merciful and the Most Beneficent for providing me this opportunity, strength and granting me the capability to proceed successfully. This thesis appears in its. Only due to His blessings I could finish my thesis.

I am very grateful and I would like to express my deepest appreciation and special thanks to my supervisor Dr Nor Shahida Binti Shafiee@Ismail who have contributed a lot her time to proofreading and correcting my mistakes in this thesis. I am sincerely thankful for her continuous support, valuable guidance, advice and motivation during this amazing journey. I also remain indebted for all of her contribution, without her help I would not be able to finish my thesis successfully.

I would also like to extend my sincere gratitude to all lecturers and members of the staff of the University Malaysia Kelantan (UMK) for their direct and indirectly contribution on my studies especially to laboratory assistant Mr. Mohammad Rohanif bin Mohamed Ali who helped me throughout the entire studies period. I also would like to express my deep thanks to all my friend, especially Nurnatasha and Adziana Aryanti who help and teach me a lot during the entire period of these studies.

I would also like to take this opportunity to sincerely thank my lovely parents, Mohd Sabri Bin Jusoh and Azizah Binti Mohammed Lazim for everything that they have done for me. Their prayer, love, sacrifice and hard work is indebtedness. I am very grateful to have loving and supportive parents by my side.

Lastly I would like to thanks person which contributes to my final year project directly or indirectly. I would like to acknowledge their comments and suggestions, which was crucial for the successful completion of this study.

Geology and Geochemistry of water discharges from the Sand Mining at Kampung Sat, Tanah Merah, Kelantan

ABSTRACT

The study of general geology and geochemistry of water discharge in kg Sat, Tanah Merah, Kelantan was conducted in area of approximately 25km^2. The objective of the study area was to produce the geological map of the study area with scale 1:25000. For geochemistry the objective is to identify the water quality and the heavy metal concentration level of the kg. Sat river base on INWQS guideline for Malaysia This study was conducted to identify the effects of sand mining on water quality and increase the heavy metals in the river. The five samples was taken and at the same time the water quality was measure in situ using HATCH YSI 556 multi parameter and for heavy metal concentration was measure at the laboratories using chemical. Then the sample concentration of heavy metal was identify using HACH DR 900 colorimeter at laboratory. Then the result of the water quality and heavy metal concentration level was compared with the INWQS guideline for Malaysia to classify its class and to determine the water river was safe or not for daily use. From all the result shows that the water quality of the river was in controlled condition which is can be used for daily life but need treatment to reduce the turbidity and another particle. The heavy metal concentration was still at normal level and still safe to use. This research also can conclude that the water quality and heavy metal concentration level in the river was not causes by the sand mining alone. It is also caused by other factors that contribute to the degradation of water quality and increase the concentration of heavy metals.

Keyword: geology, water quality, heavy metal, parameters

Geologi dan Geokimia pelepasan air dari perlombongan pasir di Kampung Sat, Tanah Merah, Kelantan.

ABSTRAK

Kajian geologi am dan geokimia pelepasan airdaripada perlombongan pasir di kg Sat, Tanah Merah, Kelantan telah dijalankan di kawasan kira-kira 25km^2. Objektif kawasan kajian ini adalah untuk menghasilkan peta geologi kawasan kajian dengan skala 1: 25.000. Untuk geokimia objektif kajian adalah untuk mengenal pasti kualiti air dan tahap kepekatan logam berat yang di dalam sungai kg.sat padamerujuk kepada panduan yang dikeluarkan oleh INWQS untuk kualiti air di Malaysia. Kajian ini dijalankan untuk mengenal pasti kesan-kesan perlombongan pasir kepada kualiti air dan kandungan logam berat di dalam sungai . Lima sampel telah diambil dan pada masa yang sama kualiti airdi uji mengunakan alat in situ HATCH YSI 556 multiparameter dan kepekatan logamdi uji di makmal menggunakan bahan kimia. Kemudian kepekatan sampel logam berat adalah dikenal pasti menggunakan HACH DR 900 kolorimeter di makmal. Maka hasil daripada tahap kualiti air dan kepekatan logam berat yang telah dibandingkan dengan garis panduan INWQS bagi Malaysia untuk mengklasifikasikan kelas dan untuk menentukan air sungai itu selamat atau tidak untuk kegunaan harian. Dari semua keputusan menunjukkan bahawa kualiti air sungai masih berada dalam keadaan terkawal yang boleh digunakan untuk kehidupan harian tetapi memerlukan rawatan untuk mengurangkan kekeruhan dan zarah lain. Kepekatan logam berat masih di paras normal dan masih selamat untuk digunakan. Kajian ini juga boleh disimpulkan bahawa kualiti air dan tahap kepekatan logam berat di dalam sungai itu bukan sebab oleh perlombongan pasir sahaja. Ia juga disebabkan oleh faktor-faktor lain yang menyumbang kepada penurunan kualiti air dan peningkatan kepekatan logam berat.

Keyword: geologi, kualiti air, logam berat, parameter

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CHAPTER 1

INTRODUCTION

1.1 General background

General geology and geochemistry of water discharge from sand mining at Kampung Sat; Tanah Merah Kelantan is a research about the geology at the study area and the content of heavy metal that contain in Kelantan River. In general geology the research will focus on the type of rock and the formation of the rock at the study area. It also studies about the mineral that contain in the rock at the study area. The mineral can be identifying using the thin section that come from the rock sample at the study area. This research also identify its geomorphology at the study area which is according to the dictionary of geology, geomorphology is the science of earth that study about its landform, their description, classification, distribution, origin, and significance of the study area.

This study will focus on heavy metal from sand mining water discharge that contain in the Kelantan River in kampong sat. This study has been specifically given coordinate which is located in three areas that run sand mining activity along the Kelantan River in Kampung Sat which is the river that passing through important towns such as Kuala Krai, Tanah Merah, Pasir Mas and Kota Bharu, the state capital, before discharging into the South China Sea. The study area was located at Tanah Merah, Kelantan. The Kelantan River is formed from the combination of the Galas River (Sungai Galas) and the Lebir River (Sungai Lebir) near Kuala Krai.

Sand mining is the processes that harvest the sand from the river bed. Before the sand was mine from the river the employer must comply the policy and guideline

that produce by ministry of natural resources and environment through department of irrigation and drainage Malaysia. There have seven policies that the employer needs to follow such as they need to ensure conservation of the river equilibrium and its natural environment. Then, avoid aggradation at the downstream reach especially those with hydraulic structures such as jetties, water intakes and ensure the rivers are protected from bank and bed erosion beyond its stable profile. The sand maining company also needs to avoid interfering the river maintenance work by the Department of Irrigation and Drainage (DID) or other agencies and no obstruction to the river flow and water transport. After that, avoid pollution of river water leading to water quality deterioration.(Ministry of natural resources and environment department of irrigation and drainage malaysia, n.d.).

According to Peck yen and Rohasliney (2013) there are approximately 128 sand mining operations along the Kelantan River from Kuala Krai to Tumpat (Peck Yen and Rohasliney, 2013). The volume of sand mining activity along the Kelantan River increases each year because of the high demand of sand for industry and construction. There are two types of sources that sand is mined from, terrestrial and marine deposits. The most common terrestrial sources are river channel deposits, floodplain alluvial deposits and residual soil deposits. According to the Kelantan land and mine department (PTG) there are 84 active sand mining activities along Kelantan river science year 2014.

Sand is usually a composed of mineral grain. Sand has many used in daily life such as for glass manufacturing. Sand contains quartz mineral that can be the ingredient in the manufacturing to make glass. Natural river sand is the most preferred choice as a fine aggregate material in concrete. River sand is a product of

natural weathering of rock over a period of million years. River sand is far superior for construction purpose than any other sand used in construction.

Heavy metal is a natural component that contain in earth crust. Some of them cannot be destroyed or degraded such as cadmium. The word of heavy metal was refer to the any metallic chemical element that have high density and poisonous at low concentration. The examples of heavy metal are mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), thallium (TI), aluminium (Al), magnesium (Mn), iron, zinc (Zn), manganese and lead (Pb). Some heavy metals are essential to maintain the metabolism of the human body but if the concentration is higher it will lead to the poisoning. Heavy metals can enter a water supply by industrial and consumer waste, or even from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers, and groundwater.

1.2 Problem statement

This study area does not have the geological map and there has development at the study area that need to put into the geological map. The studies in this area are to identify the heavy metal especially aluminium (Al), zinc (Zn), manganese (Mn), and iron in water discharge from sand mining activity at the Kelantan River and its water quality level using physical and chemical parameters. In the study area there are settlements that use river water as a source of water for daily use if the supply of clean water is cut off.

1.3 Objective

i. To produce a geological map of Kampung Sat tanah merah Kelantan at scale 1:25000.

ii. To analyze the water quality based on national water quality standard through physical and chemical analysis.

iii. To analyze the heavy metal contaminations in Water discharge from sand mining activity.

1.4 Study area

The study area was located at kampong sat Tanah Merah Kelantan. These areas have sand mining activities and agriculture activities near the river. At the another area have construction activities that discharge their water to ther small river that flow to the main river. These study areas also have an outcrop that suitable for rock sampling to produced thin section in general geology studies. Figure 1.1 shows the the study area Figure 1.2 shows the base map of the study area and Figure 1.3 show the sand mining activity in the study area. Figure 1.4 shows the sand mining activity in Kelantan.

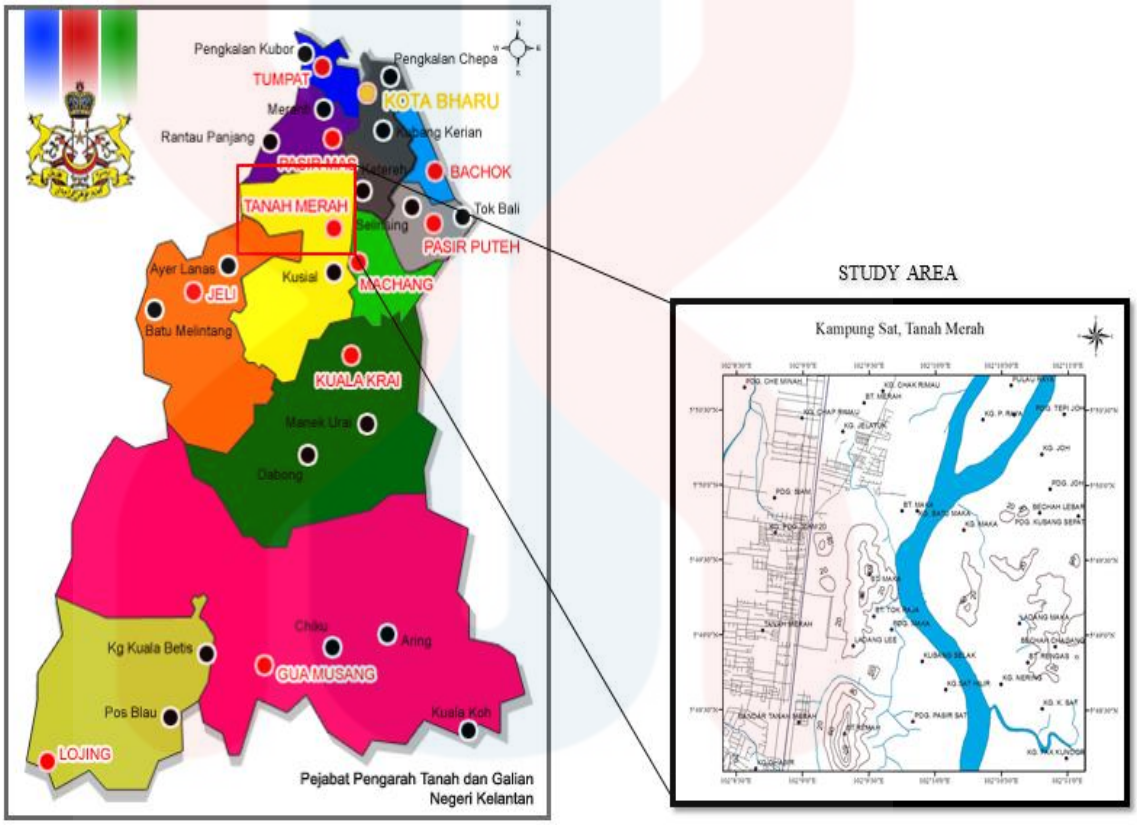


Figure 1.1: The study area

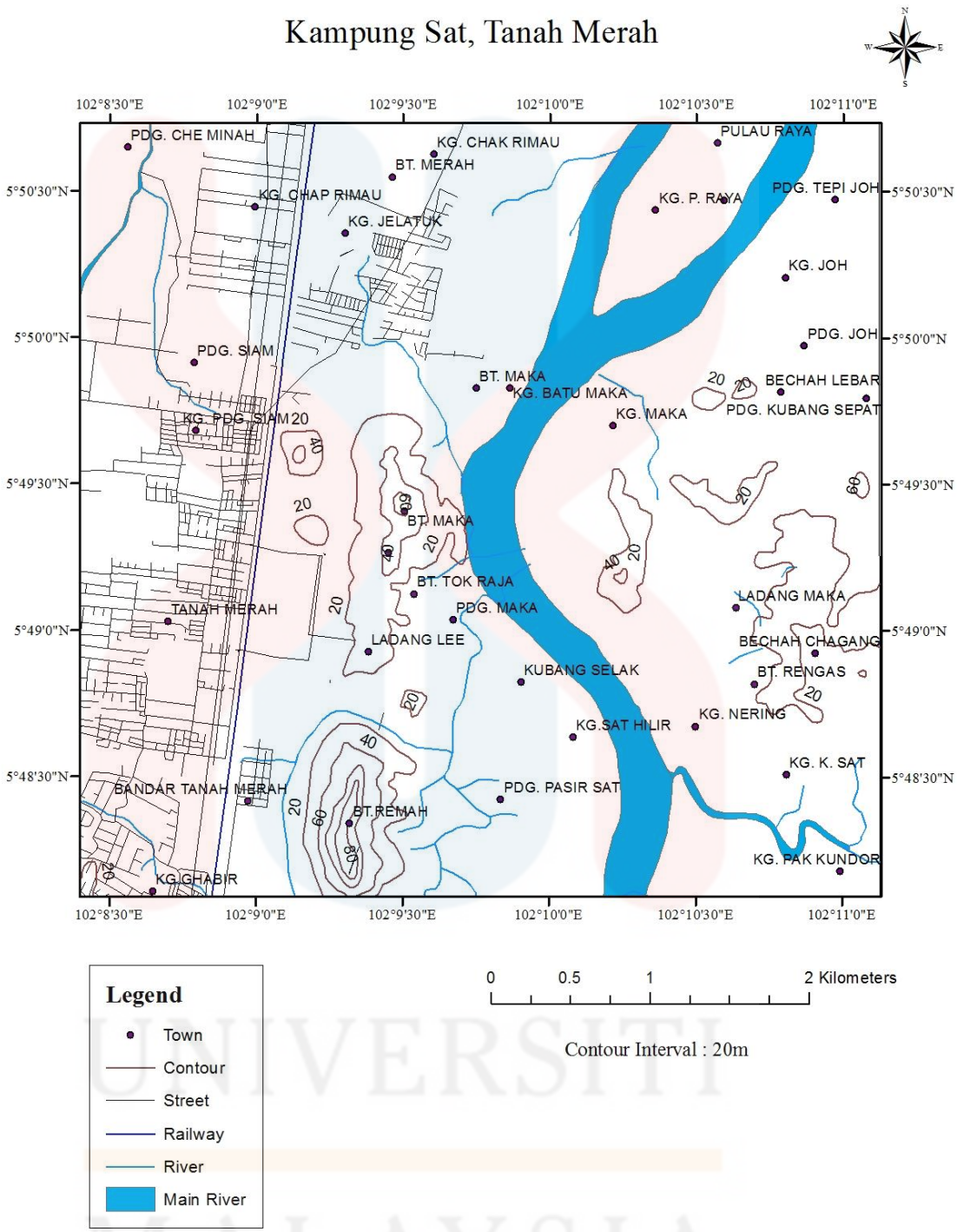


Figure 1.2: Base map of study area

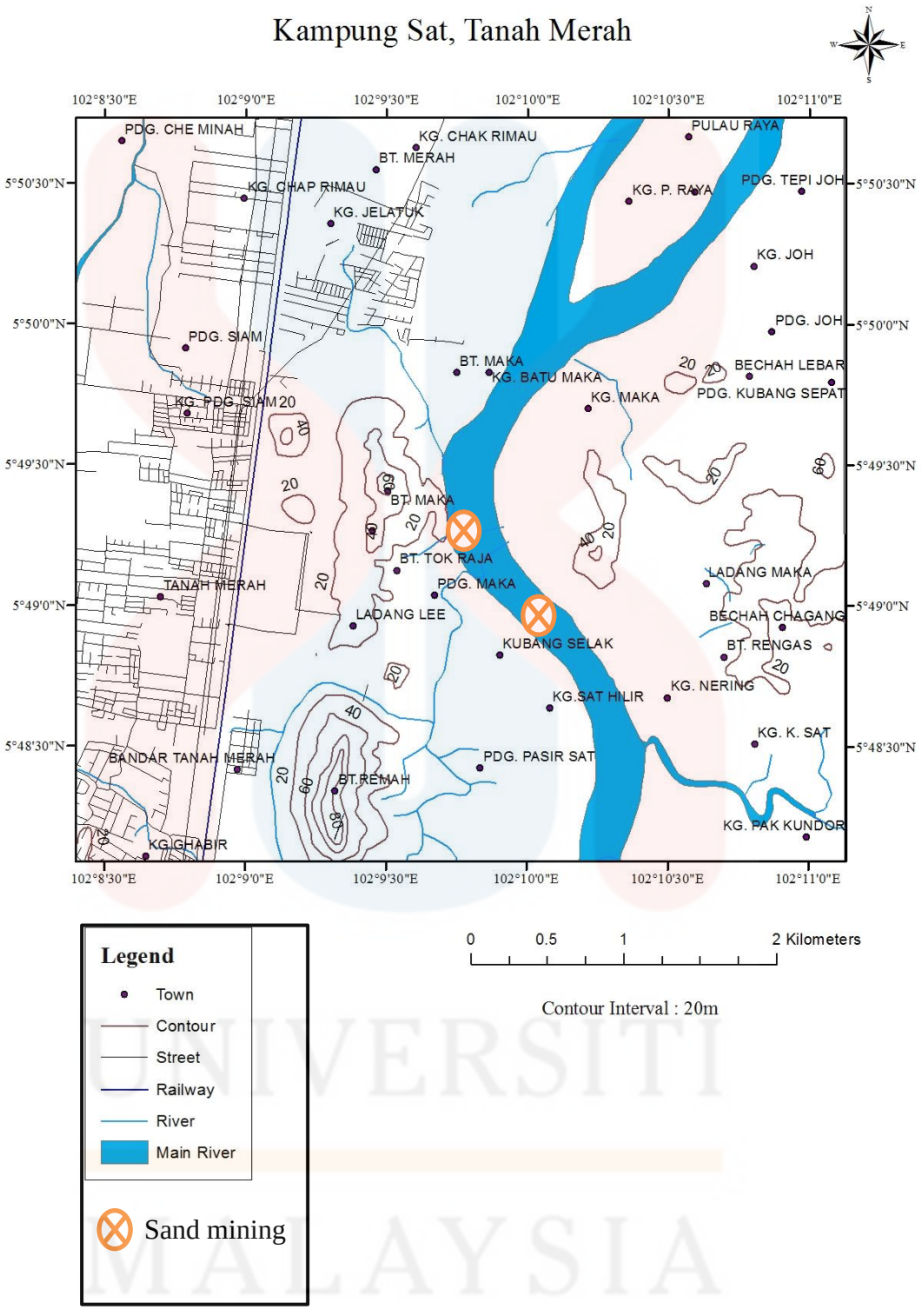


Figure 1.3: Map of sand mining area

Figure 1.4: The map of sand mining area for Kelantan

1.4.1 Demography

i. People distribution

According to the district council of Tanah Merah the people distribution in Tanah Merah at year 2010 are 133,400 people then, the number of people in Tanah Merah at 2014 was increase by 13,300 that equal to 146,700.

ii. Rain distribution

Table 1.1 shows the view for temperature and precipitation per month at Tanah Merah kelantan. Figure 1.5 shows the average days with precipitation per month and Figure 1.6 shows precipitation amount at Tanah Merah Kelantan.

Tabular view for temperature and precipitation per month

	Temperature			Precipitation
Months	**Normal**	**Warmest**	**Coldest**	**Normal**
January	25.6°C	-	-	8
February	26.1°C	-	-	5
March	26.9°C	-	-	6
April	27.8°C	-	-	5
May	28.0°C	-	-	9
June	27.5°C	-	-	9
July	27.1°C	-	-	11
August	26.9°C	-	-	12
September	26.7°C	-	-	14
October	26.6°C	-	-	14
November	25.9°C	-	-	20
December	25.6°C	-	-	17

Table 1.1: temperature and precipitation per month at Bandar Tanah Merah Kelantan (Kelantan online rainfall data. 2015)

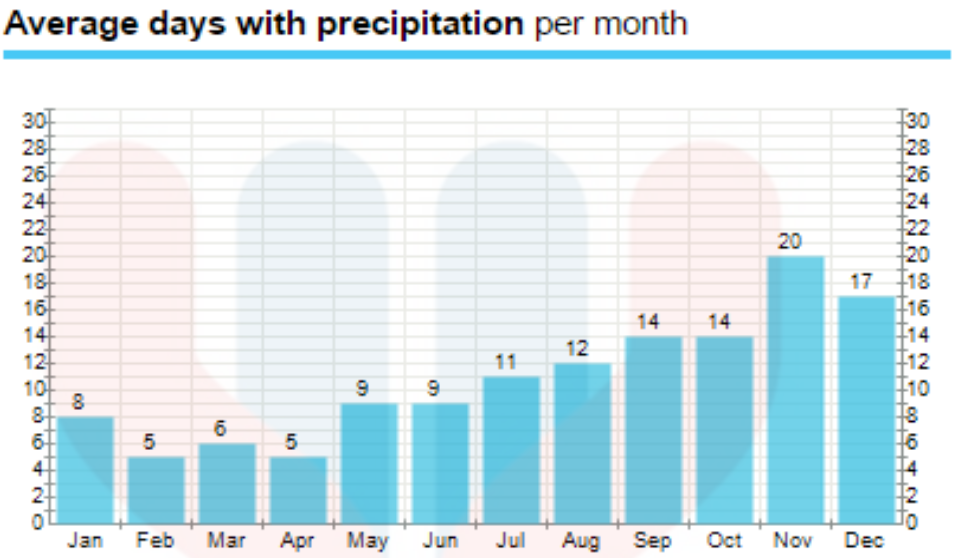


Figure 1.5: average days with precipitation per month at Bandar Tanah Merah Kelantan (Kelantan online rainfall data, 2015)

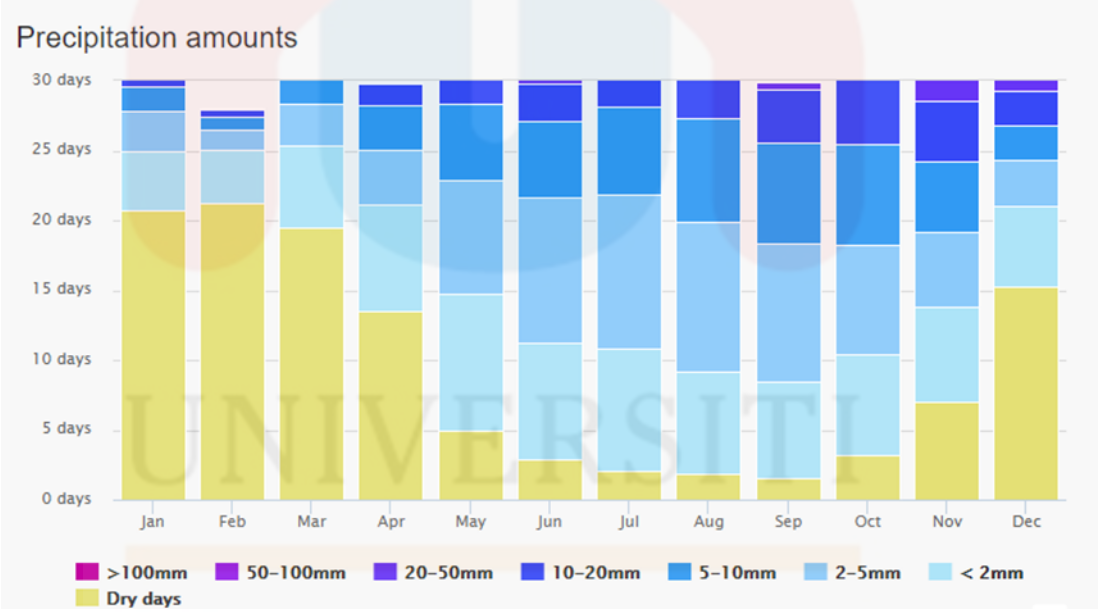


Figure 1.6: precipitation amount at tanah merah kelantan. (Kelantan online rainfall data, 2015)

iii. Soil use

Current land use at tanah merah:

Tanah Merah with an area of 86.760 hectares is located in the heart of State Kelantan. It is bounded by some other districts of Pasir Mas on the north, east Machang, Kuala Krai in south and Jeli in the west. In addition, it is also bounded Colony Country Thailand (Buketa) in the Northwest which is the main entrance to the State party Kelantan. Overall land use during 2010 for Tanah Merah is agricultural land. Agricultural land use is made of rubber, oil palm and rice. It was followed by forestry land area of and in order to vacant land which is land that is not / has not worked. Tanah Merah area also has a residential area while commercial and industrial areas is increasing because of the Tanah Merah area is located between Jeli and Kota Bharu.("JILID I : PERNYATAAN BERTULIS Tanah Merah .)

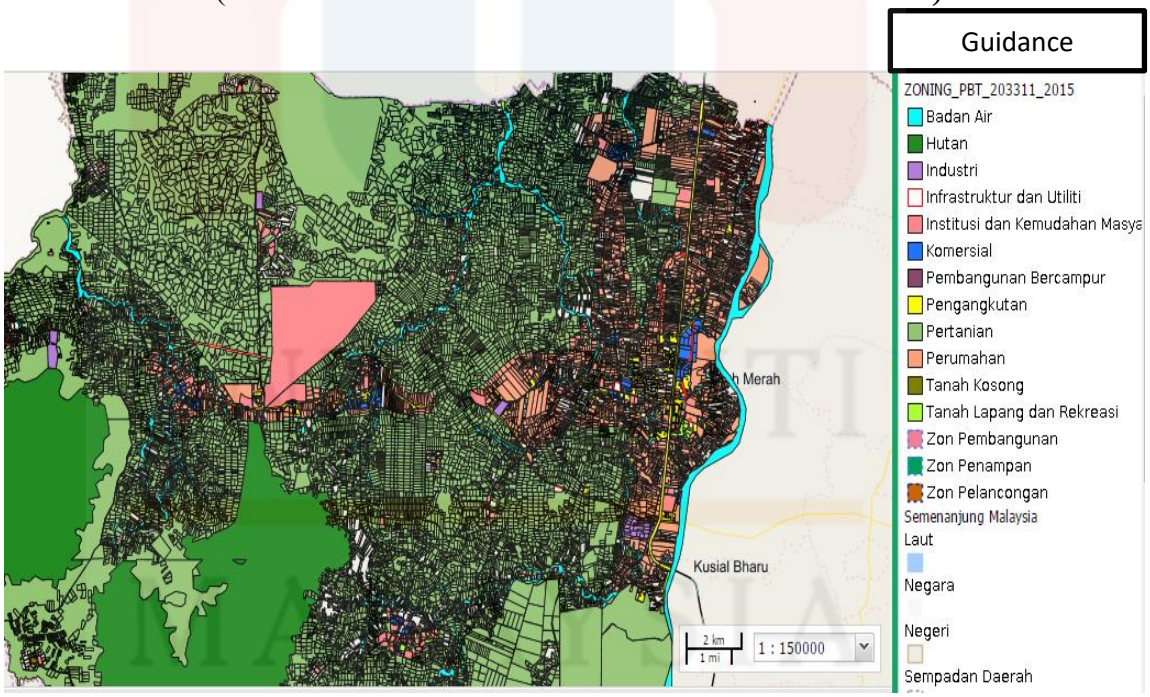


Figure 1.7: Land use of the Tanah Merah area.

iv. Social economic

Socio-economic situation in the area of Tanah Merah more to agricultural activities near Kelantan River while some of Tanah Merah people have their business company. Apart from that there are also people who work with government and private sector. The existence of gold mines in Sokor and quarrying Jedok make Tanah Merah potential in generating revenues thus creating more jobs and economic driver injection.

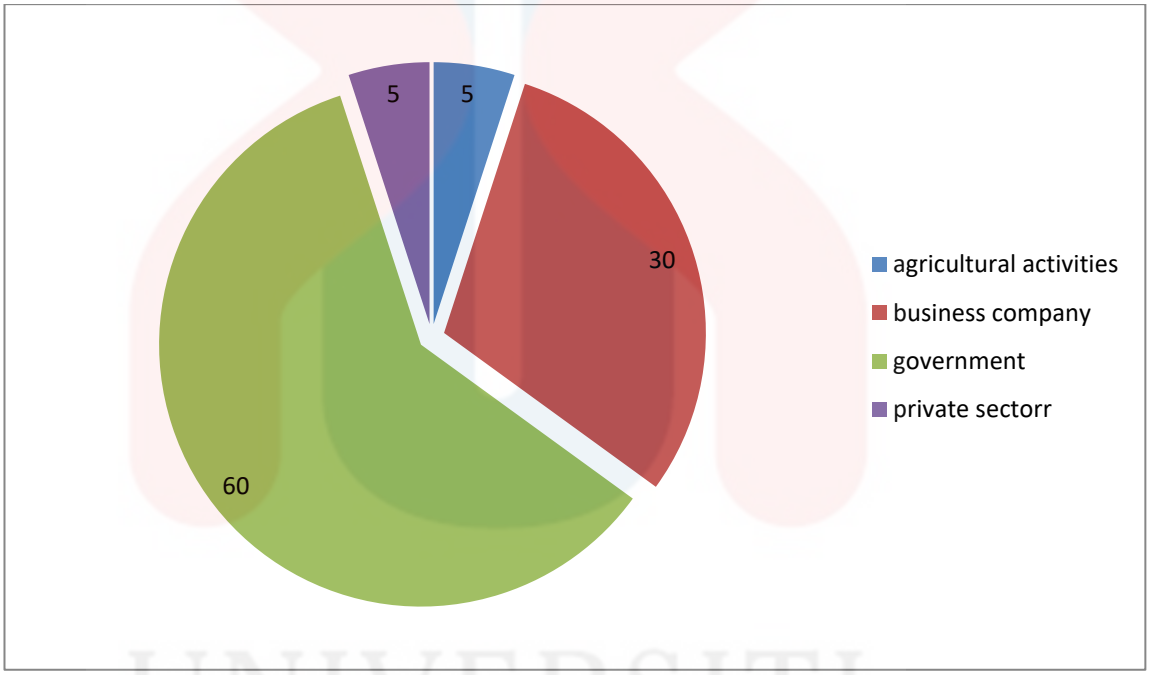


Figure 1.8: social economic at the study area

v. Road connection

Bandar Tanah Merah can be entered using the railway line starts from Tumpat or of dabong. Beside the railway routes there are also roads that link the city with Tanah Merah such as: Tanah Merah-Pasir Mas 3.25 km, Tanah Merah-Machang (Bandar Tanah Merah to Jalan Machang-Jeli), Jedok Road (junction to shortcut heading to Bandar Tanah Merah).

1.5 Scope of study

This study will be conducted in the Kampung sat and will focus on general geology and water quality in the river Kelantan which has sand mining activities. This study will also produce geological maps of scale 1: 25000. Besides, this study will also be conducted to identify the content of heavy metals found in the water and sediment. This study will also determine whether the result of sand mining water discharged into the river has resulted in increased levels of heavy metals and affect water quality.

1.6 Research Importance

This study is very important to get information about the structure contained in the study area, geological formations and geological feature. This study will also determine the pH level of the water and also the content of heavy metals found in the river. Through this research the heavy metal content can be compared with the previous researcher. It will also determine whether the sand mining will cause an increase in the content of heavy metals found in the river.

CHAPTER 2

LITERATURE RIVIEW

2.1 Introduction

General Geology is a survey of the many facets of geology and Earth Science, from the formation of the Universe and Solar System to rocks and minerals to geologic processes and hazards. General geology is a study about the rock cycle, hydro cycle and hazard cycle. Through this research general geology is use to identify the hazard that cause by sand mining activity and the rock formation in the study area. General geology was include by doing mapping and pick the rock sample for doing thin section. The study area was given 5 km x 5 km to identify the outcrop and the sand mining activity in the study area. Tanah Merah contain volcanic rock which is andesite and the mineral texture of the andesite is ophitic and overgrowth texture (Kerk and Hui Shan,2015).

2.2 Geological Review

2.2.1 Regional geology

Regional geology is the geological study of large-scale regions. Usually, it encompasses multiple geological disciplines to piece together the history of an area. It is the geologic equivalent of regional geography. Kelantan is one of the state that is located at the north east of peninsular Malaysia and the capital an royal set is Kota Bharu. It was dived into ten districts which is Tumpat, Kota Bharu, Pasir Mas, Bachok, Tanah Merah, Pasir Puteh, Jeli, Kuala Krai, Gua musang.

The major rock type that can be found in Kelantan where unconsolidated sediment, extrusive rock, sedimentary or metasedimentary rock and granitic rock (Deparment of Mineral and Geoscience Malaysia, 2003). The seting granite, stong igneous complex and mahang granite are the major granite intrusive in kelantan (Ariffin, 2007). Geological formation of Kelantan can be divided into three main chronologies which are Paleozoic, Mesozoic, and Cenozoic which range from lower peleozoic until quaternary (Hutchison and Tan, 2009). Figure 2.1 show the geological map of Kelantan.

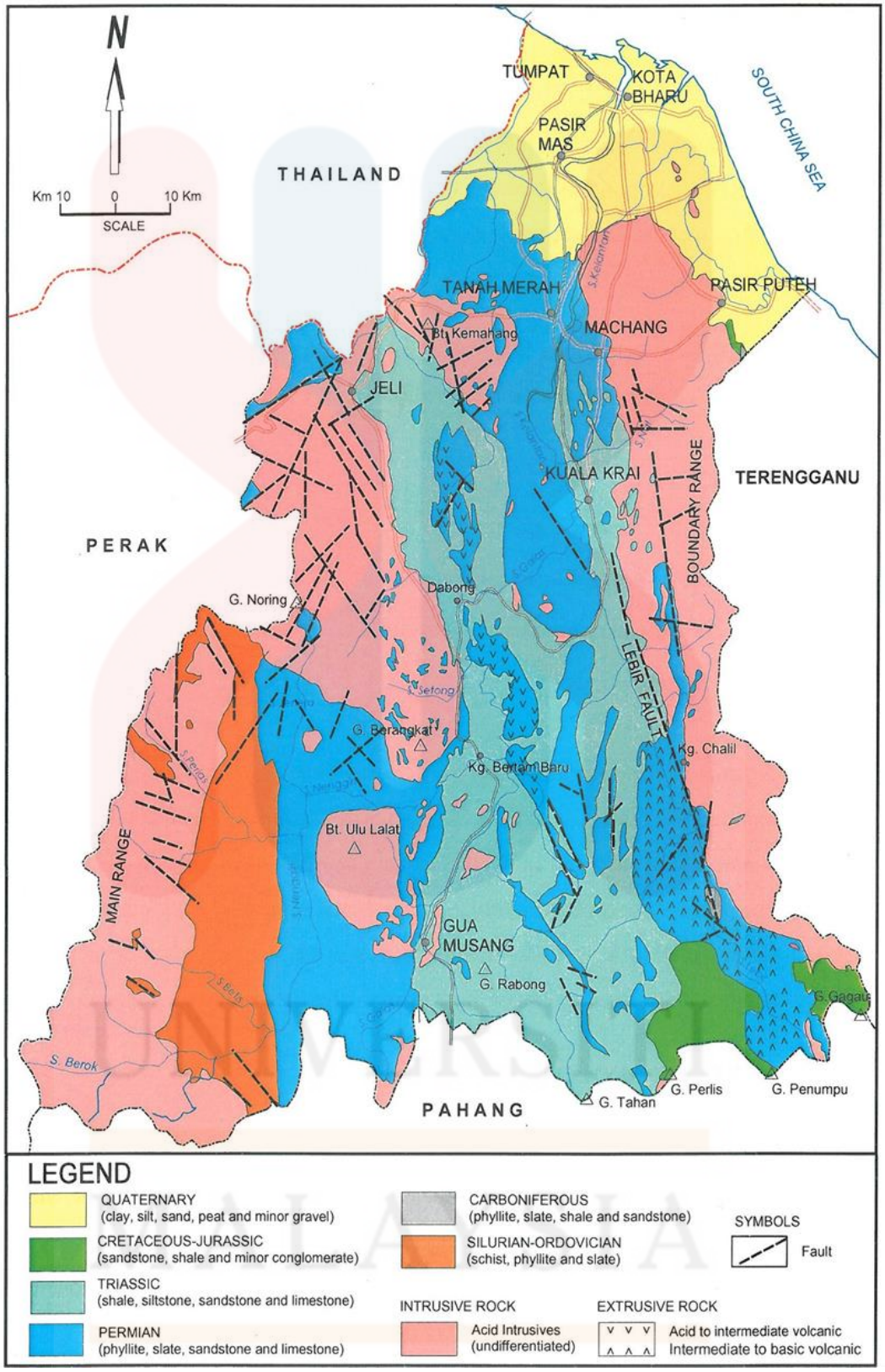


Figure 2.1: Geological map of Kelantan (Nazaruddin.*et.al*, 2014*)*

2.2.2 Historical Geology

i. Paleozoic

The Paleozoic formation in Kelantan found in the central belt of peninsular Malaysia. The upper Paleozoic sediment was consist of marine Permian strata that occur as linear belts flanking Mesozoic sediment in the central belt. Gua musang formation and aring formation in south and the taku schist in eastern Kelantan are consist of Paleozoic rock.

ii. Mesozoic

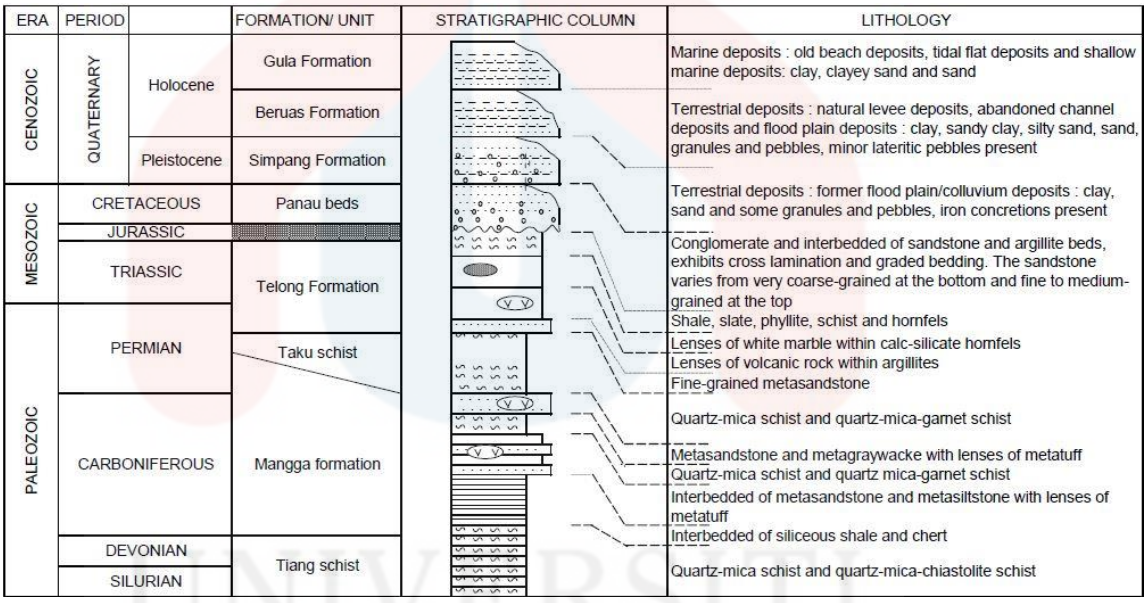
The central belt that form continuous north-south trending belt extending beyond the international boundaries with Thailand (Gua Musang formation) in the north and Singapore (jurong formation) in the south is dominant with mesozoic formation. The Permian-triassic of the gua musang, aring and gunong rabong formation in Kelantan is dominated by shallow marine clastic and carbonate with volcanic interbeds. Toward the south, Telong formation is dominant with the deeper marine turbiditic sediment which commonly tuffaceous in nature with the volcanic interbeds (Leman *et al*., 2004).

2.2.3 Regional stratigraphy

The oldest lithostratigraphy rock unit is the Silurian-devonian tiang schist who is highly faulted and folded. Its lithologhy are quartz mica schist and quartz schist. The mica who is commonly muscovite with chlorite, calcite and pyrite as accessory mineral. The qurtz mica schist is strongly schistosed, well foliated consisting essentially of quartz and evidence for both contact and regional metamorphism is form when qurtz-mica chiastolite schist is present in Kelantan. The folding and the faulting is cause the foliation has various trend and dips steeply estwards and

westward. Tiang schist formation then is overlain with the manga formation which age about carboniferous to Permian. Then telong formation was overlain by Panau beds and then simpang formation was underlain with beruas formation. The gula formation is the youngest formation where the age is quartenary while tiang schist formation is the oldest formation unit which age is Silurian period. This period scale was refer through the stratigraphic column that produce by Malaysia and Thailand working group researcher (Malaysian and Thailand Groups, 2006).

Table 2: shows the stratigraphic column. (Malaysia & Thailand Group, 2006)



2.2.4 Petrographic

Petrography is a branch of petrology that focuses on detailed descriptions of rocks. Someone who studies petrography is called a petrographer. The mineral content and the textural relationships within the rock are described in detail. A light transmiting microscope was used to study the properties of rock, mineral and the other type of earth material. This type of microscope was called petrographic microscope (Hefan & O'Brien, 2010). Every rock sample that need to identify its

mineral or crack using this microscope need to cut and polish until its thickness reach 0.03 mm so that the light can pass through the sample (Winter, 2001). The petrographic microscope have polarizing plate, filters and a conscopic lens that used to measure a large number of crystallographic properties (Blatt *et al*, 2005).

2.3 Heavy Metal

Through the site visit there have three sand mining activities at the study area that still running. The past researcher Peck yen and Rohasliney (2013) has collected the water sample at Kelantan River. Water samples were collected from five stations along the Kelantan River (November 2010 until February 2011). The method that they use to identify the heavy metal is physical parameters included water temperature, water conductivity, dissolved oxygen (DO), pH, total dissolved solids (TDS), total suspended solids (TSS) and turbidity, whereas the chemical parameters included the concentration of nitrogen nutrients such as ammonia, nitrate and nitrite (Peck Yen and Rohasliney, 2013). According to Ambak *et al.* (2010) there are approximately 128 sand mining operations along the Kelantan River from Kuala Krai to Tumpat (Ambak *et al*. 2010). These sand mining activities can make the river water turbid. The sample must be collected at the different palace and distance. According to Dumčius, *et al* (2011) which is the past researchers if the pollution is predicted to be spread unevenly the distance between sample depend on the source of the pollution (the nearer the source of pollution the denser the sampling grid) and other factors influencing the spread of pollution such as (wind direction, soil gradient).(Dumčius, *et al*, 2011). There have two type of sample need to take for heavy metal analysis which is water sample and soil sample. The depth of sampling from surface sediments depends upon the purpose of investigation. For the most

precise examination of soil contamination with heavy metals, which fall onto soil from air, samples should be collected from the top surface layer of soil at a depth of 0–6 cm (Dumčius et al., 2011). Therefore there have another method that Peck yen and rohasliney hashim (2014) use to identify heavy metal analysis using fish tissue which is to assess the concentrations of cadmium (Cd), nickel (Ni) and lead (Pb). The dorsal muscle was analyzing using a graphite furnace Atomic Absorption spectrometer (AAS) (Life, 2014). Beside that Bouraie and Barbary, *et al.* (2010) use bed sediment to analysis the havy metal contain in ther river water. The bed sediments were collected by scooping up 10 cm of the bed sediment from 10 m away from the riverbank at the point, where the water samples were taken, by using anti rust scoop and sediments were naturally dried at room temperature (25°C ± 2) in the laboratory prior to analysis.(Bouraie, *et al*, 2010)

2.4 Water Quality

Water quality is the method to identify the heavy metal contain in water. There have step to collect the water sample. Refer to Bouraie *et al* (2010) the method to identify the water quality is water samples were taken by using Van Dorn plastic bottles (1.5 liter capacity). The samples after collection were stored in the refrigerator at about 4 ˚C prior to analysis (Bouraie *et al*., 2010). Beside that the water quality also can be measure using soil sediment and also can identify the absent of the heavy metal in the river water. Based on previous studies by Idriss and Ahmad (2013) they use the sediment to identify the water quality which is the sediment samples were collected 2 times (December 2009 and August 2010) using grab sample from 20 sites in the river. Then the sample was air dried and before analysis, the samples were filtered through 0.45 μm Millipore filters using vacuum

pump. The determination of copper, nickel and chromium in sediment were conducted by inductively couple plasma (ICP) model Perkin Elmer/Elan 9000. All samples were analyzed in three replicates.(Idriss & Ahmad, 2013). Based on previous studies by Ahmad, Mushrifah, *et al* (2009) Physical water quality is measured in situ using multisensor probe YSI model 449D for dissolve oxygen, pH, conductivity, temperature, salinity and TDS concentrations. Water was sampled using a Van Dorn water sampler and preserved in polyethylene bottle for analysis of fluoride, nitrite, nitrate, ammoniacal-nitrogen and phosphorus.(Ahmad, *et al*, 2009).

Water quality also can be check using colour of the water sample. Ashraf, *et al* (2010) who use the colour method to identify the water quality by compare the water sample colour with true colour units (TCU) (Ashraf et al., 2010). All this water was tested their pH value, total suspended solid (TSS), temperature, dissolve oxygen (DO), total dissolve solid (TDS) through in situ reading using YSI 556 multi parameter. Table 2.2 show the national water quality standard that be used as a reference to classify the quality of water river sample that have been collected.

Table 2.2: National water quality standard (Malaysia Department of Environment)

PARAMETER	UNIT	CLASS					
		I	IIA	IIB	III	IV	V
Temperature	°C	-	Normal + 2 °C	-	Normal + 2 °C	-	-
Dissolved Oxygen	mg/l	7	5-7	5-7	3-5	< 3	< 1
Ph	-	6.5 - 8.5	6 - 9	6 - 9	5 - 9	5 - 9	-
Total Dissolved Solid	mg/l	500	1000	-	-	4000	-
Total Suspended Solid	mg/l	25	50	50	150	300	300
Turbidity	NTU	5	50	50	-	-	-
Ammonia	mg/l	0.1	0.3	0.3	0.9	2.7	>2.7

Table 2.3: Water Use Classes in the National Water Quality Standards

Class	Uses
CLASS I	Conservation of natural environment water supply 1 - practically no treatment necessary.
CLASS IIA	Water Supply II - conventional treatment required
CLASS IIB	Recreational use with body contact
CLASS III	Water Supply lll - extensive treatment required
CLASS IV	Irrigation
CLASS V	None of the above

2.5 Sand Mining

Sand mining activity is a process to harvest sand sediment from river. There are two types of sources that sand is mined from, terrestrial and marine deposits. The most common terrestrial sources are river channel deposits, floodplain alluvial deposits and residual soil deposits (Peck Yen & Rohasliney, 2013). The sand mining cause the river turbid. According to the past researcher Peck Yen and Rohasliney (2013) during the sampling trip along the Kelantan River, heavy sand mining activities were observed. Pit excavation methods of sand mining were used along the river, which involves the extraction of sand and gravel from the riverbed by uncontrolled digging or diesel powered suction pumps.

Sand mining activity also release oil and heavy metals through the fuel and lubricating oil from heavy vehicles that operate in the area of sand mining. Sand suction machine also often have a leak in the engine that caused the spill of fuel and lubricating oil into the river. According to Ashraf et al (2011) sand mining also can disrupts sediment supply and channel form which can result in a deepening of the channel (incision) as well as sedimentation of habitat downstream.(Ashraf et al., 2011)

CHAPTER 3

MATERIAL AND METHODOLOGY

3.1 Introduction

Chapter 3 discusses the tools and steps to be taken to carry out this study to get a result that is required. It also have the information about the tools that will be used. This chapter also includes a flow chart which describes the course of this study.

3.2 Preliminary Research

Preliminary study is an initial exploration of issues related to a proposed quality review or evaluation. Preliminary studies do not happen in all systems but they may be used to identify key features to be addressed in a quality process such as analytical review. At this study area there have a research about the heavy metal contain in Sungai Kelantan but the research was around three years ago. Through the past researcher the heavy metal contain in Sungai Kelantan was high but still safe for the aquatic life and safe for daily use (Peck Yen & Rohasliney, 2013).

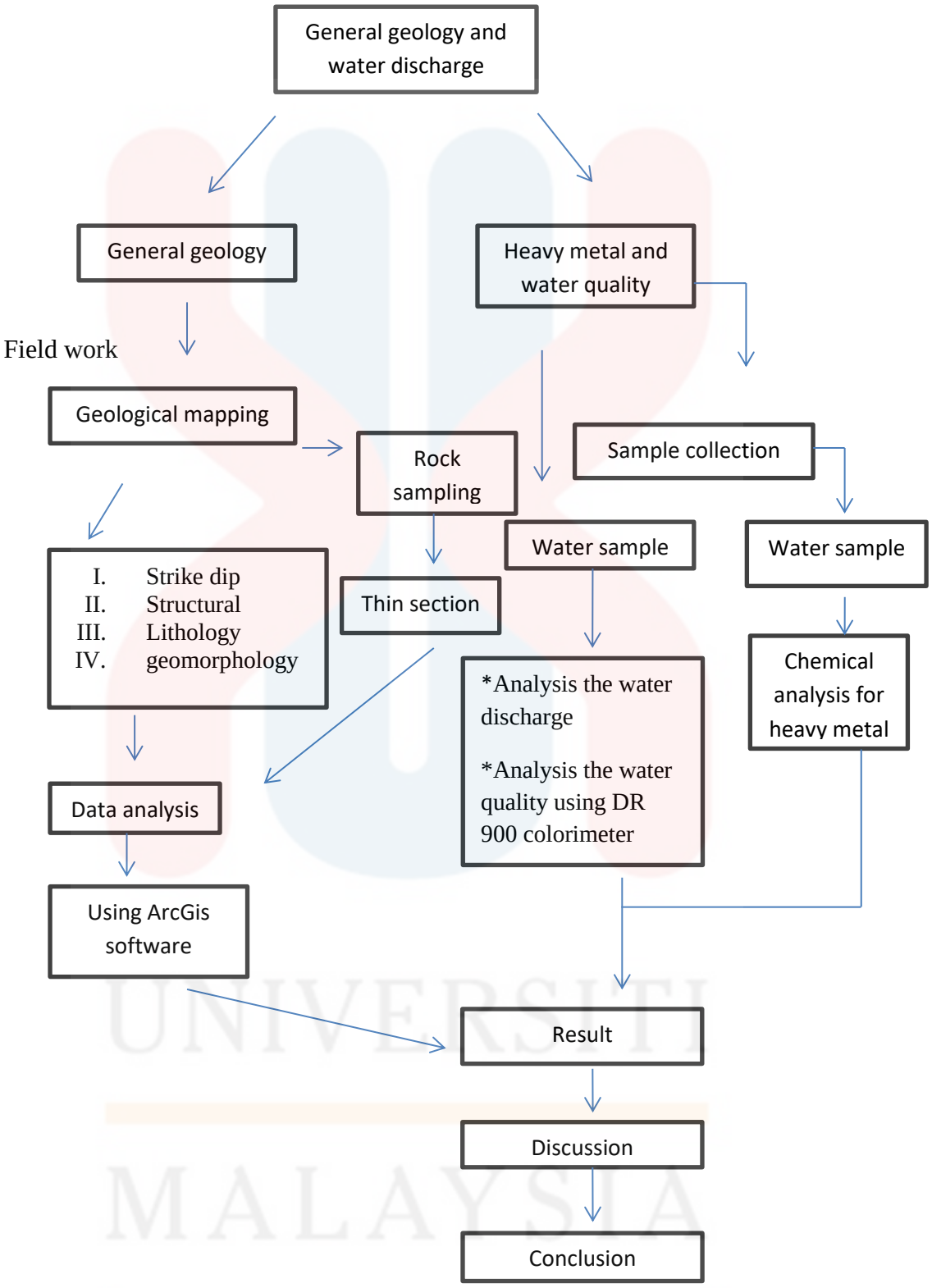


Figure 3.1: Research flow chart

3.3 Material and Method

3.3.1 Material and Tool

i. Geological hammer

Figure 3.2: Geological hammer

A geologist's hammer, rock hammer, rock pick or geological pick is a hammer used for splitting and breaking rocks. In field geology, they are used to obtain a fresh surface of a rock in order to determine its composition, nature, mineralogy, history and field estimate of rock strength. There have three types of rock hammer such as pointer tip hammer, chisel tip hammer and heavy rock hammer. Pointer tip hammer is used for hard rock type such as igneous and metamorphic rock while chisel tip hammer is used for soft rock type such as sedimentary rock and heavy rock hammer is used to break a rock and heavy chisel work.

ii. Rock chisel

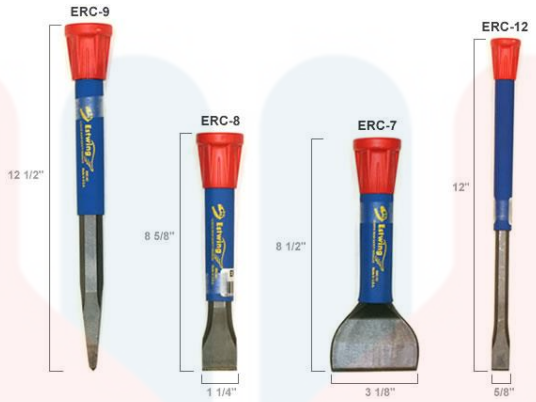


Figure 3.3: Rock chisel

Rock chisels are used for prying, breaking rock specimens and splitting rocks. A common tool used by rock, mineral and fossil collectors.

iii. Compass

Figure 3.4: Compass

The geologist's compass enables the measurement of strike directions, down dips and angles of pitch, or dipping angles of areal and linear geological elements (layer, schistosity, fault and interference areas, anticlinal axes and lineations) in one pass.

It is used aboveground and underground.The graduated circle of the compass is orientable both for direct reading of the strike direction and of the down dip.(“Geologist ’ s compass,” n.d.)

iv. Hand lens

Figure 3.5: Hand Lens

Geologists working in the field, lab or office often need to closely examine rocks, sediments, soils, sand, minerals and other materials with tiny features. Hand lens also need to use in field to identify the mineral and fossil that found in the site which is can’t see with the naked eye.

v. Sample bag

Figure 3.6: Sample Bag

Sample bag was include into the item that most important for sampling method. The sample bag can prevent the fresh sample from contaminated with the surrounding area that maybe can affect the freshness of the sample.

vi. Ground positioning system (GPS)

Figure 3.7: Ground Positioning System (GPS)

Ground positioning system was used to track the travest of the study area. It also can use to identify the coordinate and the azimuth of the study area. The data that collected can be transfer to the computer to plot the map. These devices are designed to work in cold and wet weather. With detailed Maps create the destinations and can follow the movement step by step (Basemap, n.d.).

vii. Hydrochloric acid (HCL)

Figure 3.8: Hydrochloric acid

Geologists use dilute (5% to 10%) hydrochloric acid when testing carbonate rocks and minerals in the field and laboratory. When hcl was pouring above carbonate rocks, it will produce a reaction by removing foam.

viii. geological map

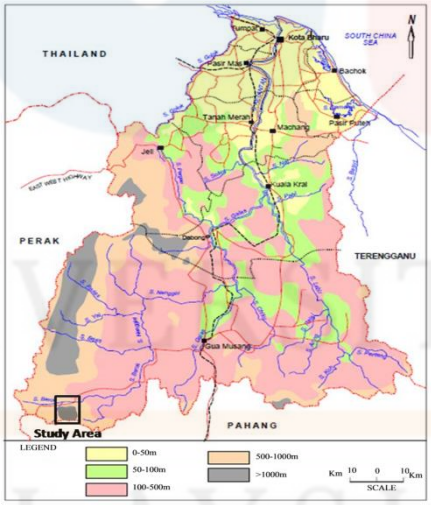


Figure 3.9: Geological map

Geologic maps represent the distribution of different types of rock and surficial deposits, as well as locations of geologic structures such as faults and folds. Geologic maps are the primary source of information for various aspects of land-use planning, including the siting of buildings and transportation systems.

3.4 Field study

3.4.1 Geological field mapping

i. Planning

Before going to field work there need to have a plan or preparing to make the work progress smooth and done perfectly. The preparation includes the tool and equipment, time management, transportation, money, base map of the study area, and knowledge about the study area. Before starting the mapping activity there is need to know and do some study about the research study area. The most important thing when doing mapping is GPS. It can give the coordinate and can track the movement. This data from GPS need to transfer to the Argis to plot at the base map.

ii. Observation/mapping/collecting

This part is collecting data that needed for the research in the study area. The data were collected by doing the mapping. With this method we can collect the data about the geological process that happen in the study area, the lithology and geomorphology can be obtained. With mapping method also can find the strike and dip and the rock sampling of the study area.

After that, we doing observation of the data include physical observation by comparing with the base map. The basic physical observation, such as the existence of new roads or building that's not specified in the base map. With this the comparison with the base map can be improved.

3.5 Laboratory Analysis

i. Sampling.

Sampling is the process that collecting the sample in the study area. The sample that needs to collect is based on the research that we conducted. The sample of this research is water sample who needs to collect at five different places near the sand mining activity in the study area. The water sample was collected using a glass jar to avoid contaminated from another substance.

ii. Preparation and thin section analysis

Thin section is important to identify the mineral that contains in the rock sample. The thin section process include slab cutting, slab lapping, slap sectioning, polishing and inspection.

iii. Analytical analysis

The physical parameters, such as water temperature (°C), water conductivity (μS/cm), total dissolved solids (TDS) (g/l), DO (mg/l) and pH was measured in situ with a YSI Model 556 (Yellow Springs, OH, USA).The turbidity level [nephelometric turbidity unit (NTU)] was read with a HACH portable Turbidimeter model 2100P (Loveland, CO, USA). Water samples were collected in acid washed 1000-mL polyethylene bottles and preserved immediately with the addition of a few drops of nitric acid. Temperature, pH, and other parameters were measured simultaneously (YSI ProPlus, Xylem, USA).The collected water and sediment samples collected were preserved at 4°C and transported to the laboratory within 24 h for further analysis.

iv. Chemical analysis

For heavy metal analysis, the heavy metals that want to test were aluminium, iron ferrozine, manganese, zinc and ammonia. The sample was identifying using DR

900 colorimeter equipment. The five location sample was labeled as sample 1, sample 2, sample 3, sample 4 and sample 5. Each sample experiment was repeated by 3 times to get the mean value. After the entire sample was added to its reagent to get their chemical reaction, then the sample was fill into the square sample cell, then the sample was run using colorimeter to get the contain of the heavy metal in each sample.

3.6 Data Analyze and Interpretation

3.6.1 Geological map

After mapping the data collected need to transfer to computer to produce the geological map. The data collected should be compared with existing data to produce the map. It can be the importance thing that need to be up date to the new geological map.

CHAPTER 4

GENERAL GEOLOGY

4.1 Introduction

General geology include of geography, geomorphology process, field observation and mapping, structural geology and stratigraphy. All this aspect are use to describe the change and event that occurred in the study area.

The geography of the study area include people distribution, land use, social economic and road connection of the study area. The geomorphologic process are discuss about the topography, drainage system, and geomorphological process of the study area. All this information can give an understanding about the general geology in the study area. Meanwhile field observation and geological mapping can achieve the objective of the research which is to produce the geological map of the study area.

Structural geology include lineament analysis, bedding analysis and crack analysis are very important aspect to identify at the study area. The study of structural geology provide information about the deformation that occur in the field and lithostratigraphy was use to describe the lithology of the study area.

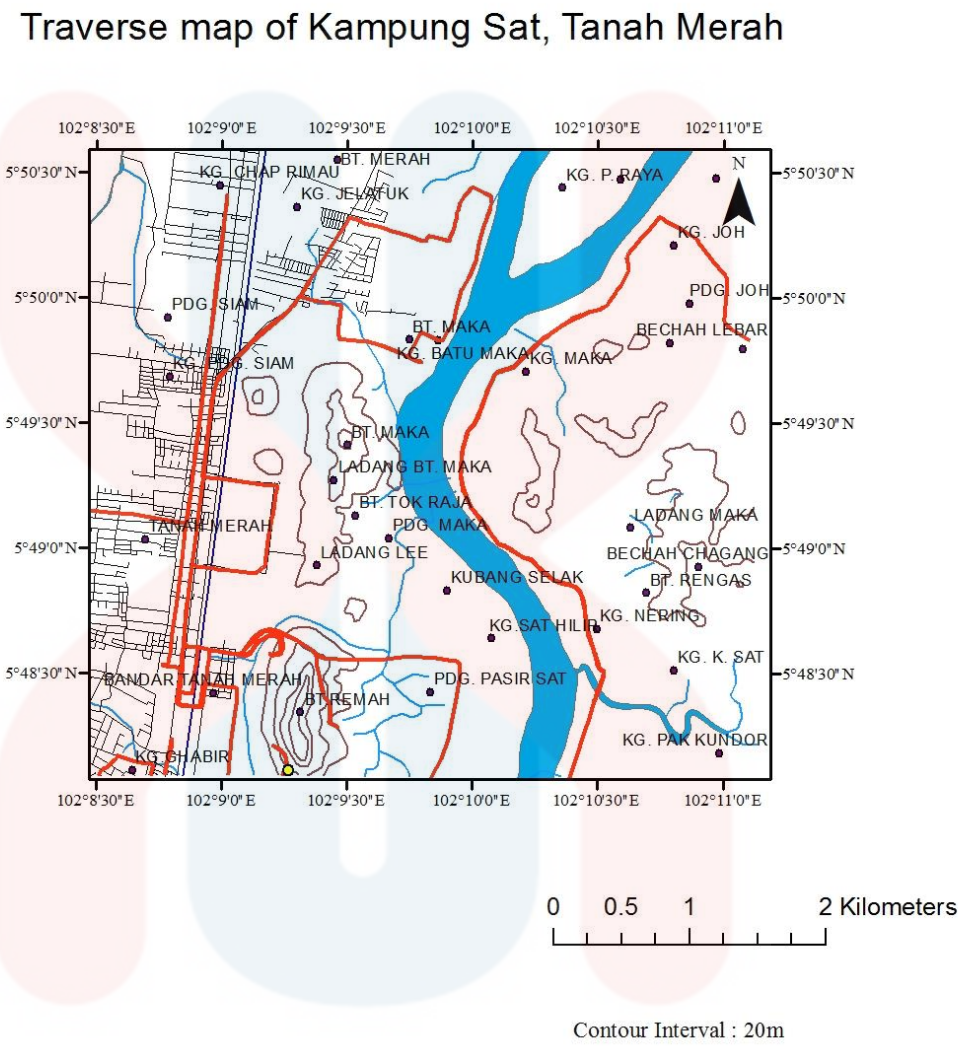


Figure 4.1: Traverse map of the study area.

4.2 Geomorphological Process

Geomorphological process is study of the process which is responsible for landform development *(Richard, 2011).* Summerfield (1991) proposed that geomorphic process can treated as manifestation of various type of shear stresses, acting upon any type of earth material to produce variation of the strain or failure also known as weathering process, erosion, transportation process and deposition. Geomorphology process was included topography, drainage system and the weathering process.

4.2.1 Landform

Landform is the study of the earth surface shape and the features of the earth. It included mountain, hills, creeks, and other features that appear on the Earth's surface. These features was include cultural feature which is roads, buildings, urban development, railways, airports, names of places and geographic features, administrative boundaries, state, international borders and reserves. Besides that, there also have hydrography feature which is lakes, rivers, streams, swamps and coastal flats. For relief feature it included mountains, valleys, contours and cliffs. For vegetation feature it included wooded and cleared areas or vineyards and orchards.

According to Raj (2009), the topographic unit can be classified into five units by considering the mean elevation. The highest peak in the study area is 80m and the topographic units of this area are hilly. The lowest elevation of this area is 5m also as known as low laying area. The elevation of the study area around 20m to 80 m but the average elevation in the study area was 20m. So this study area can be considered as flat area or rolling area. Along the river the elevation of the study area was 5-15 meter above the sea level. So, this area along the river can be classified as low lying

area. The topographic unit classification was showed through Table 4.1 and the landform distribution was showed at Figure 4.2 below.

Table 4.1: Topographic Unit Classification (Raj, 2009).

Class	Topographic unit	Mean Elevation (m above the sea level)	Elevation in the study area (m above the sea level)
1	Low lying	<15	Along the river the elevation is 5-15m above the sea level
2	Rolling	16-30	Majority area 20m above the sea level
3	Undulating	31-75	One location have 60 m elevation
4	Hilly	76-300	One location have 80m elevation
5	Mountain	>300	None

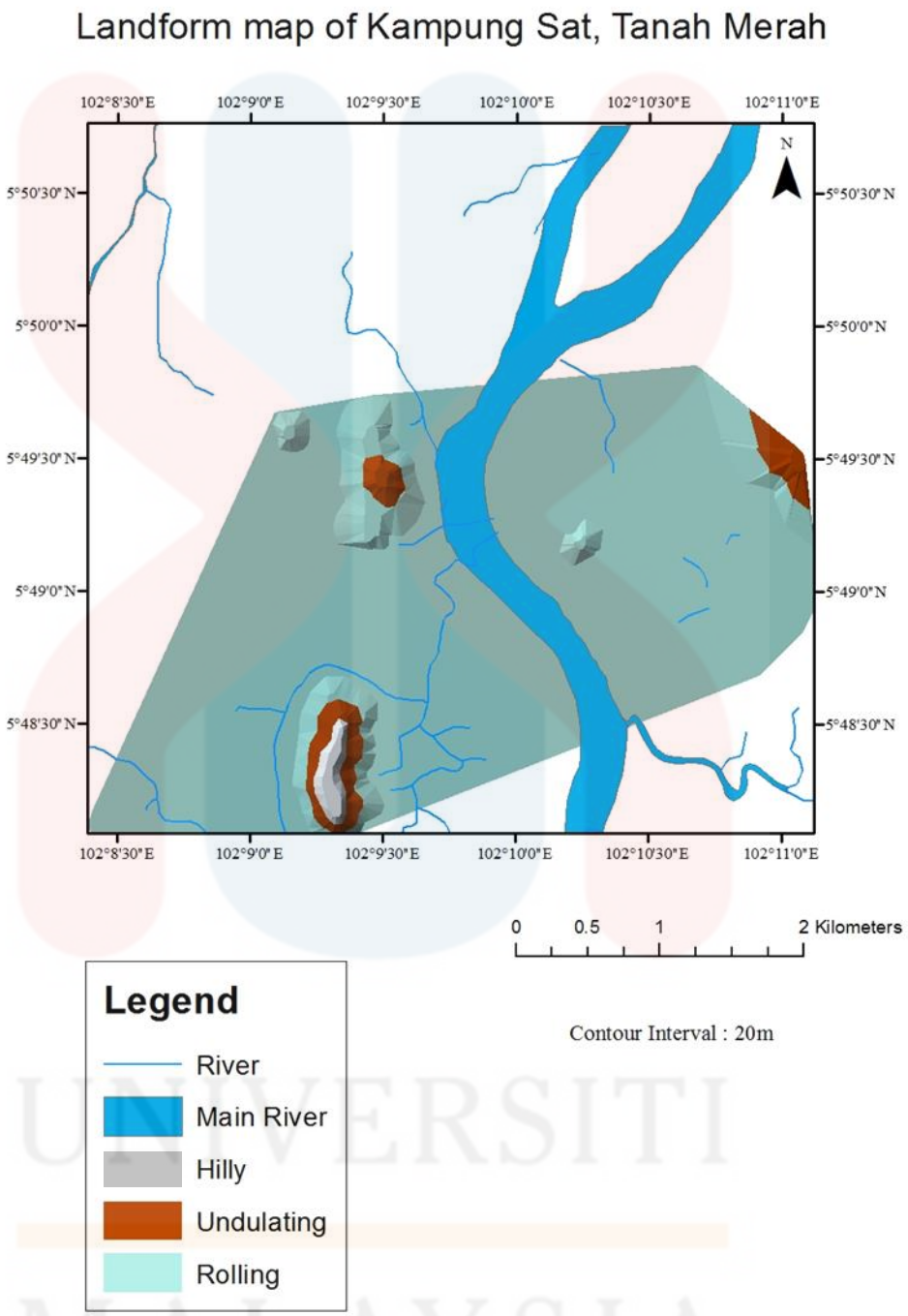


Figure 4.2: Landform distribution at the study area.

4.2.2 Drainage Pattern

Drainage pattern is the most importance thing in structural geology. The spatial arrangements of the channel in the landscape, river pattern actually are determined by the slope and its structure. River patterns, drainage texture, frequency of stream are used to determine the formation of the topography and topography intricacy. According to twidale (2004), the slope will induce the formation of pattern such as parallel, radial and distributary. So, the structure will produce the pattern like straight, angular, trellis and angular arrangement. Figure 4.3 show the type of drainage pattern.

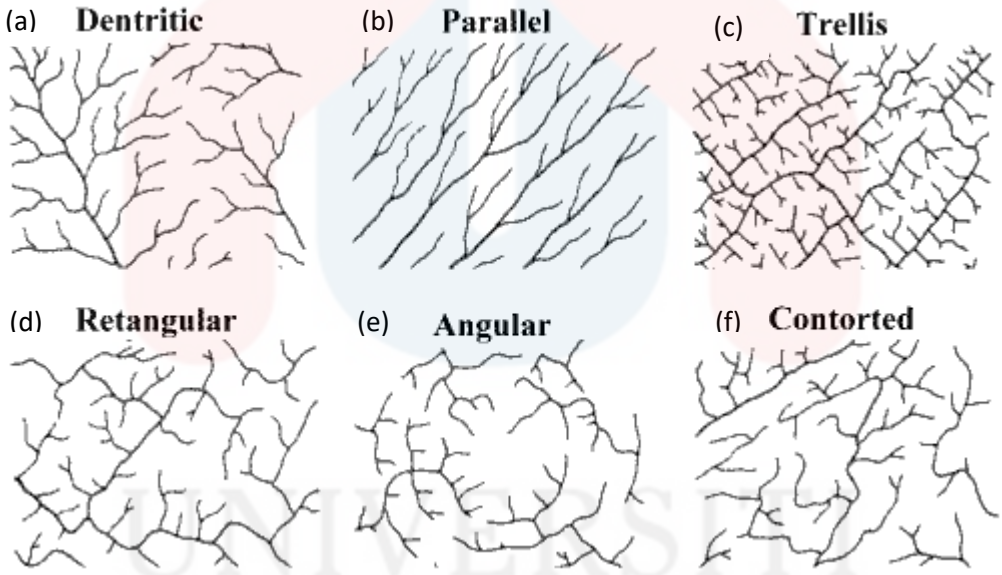


Figure 4.3: Drainage pattern determine by the slope or structure

Refer to the Figure 4.3 the drainage system in the study area there have main river which is Kelantan river and there have small river such as kg Sat river. The entire small streams that have in the study area were flow to the main river which is Kelantan River. The type of the drainage system of the main river is dendritic drainage system which is it was randomly developed and it shape was tree like pattern composed of branching tributaries and a main stream. It is the most common

drainage pattern and the characteristic of essentially flat-lying or relatively homogenous rock and impervious soil.

At the other area the type of drainage system is consider as contorted drainage because the stream at this area was flow through the high elevation to the main river. The radial drainage is a composed of stream radiating outward from a central peak, dome or volcanic cone.

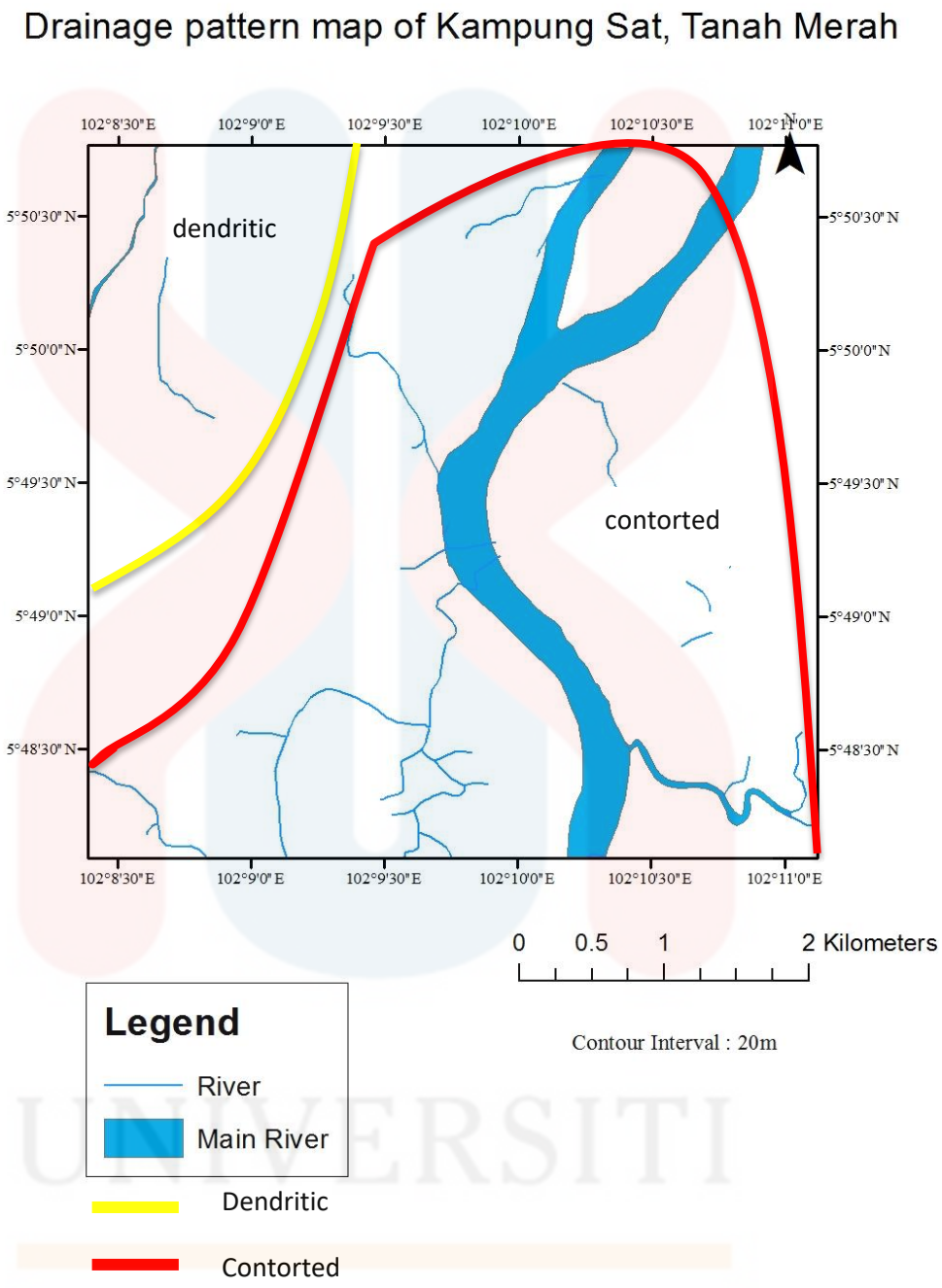


Figure 4.4: Drainage pattern

4.2.3 Weathering Process

Weathering process is the processes that brake down the rock into fragment. Weathering process can be divided by three groups which are chemical weathering, biological weathering and mechanical weathering.

Biological weathering is a process that happen when the root of the plant growth on the rock and give some stress to the rock that can produce some crack to the rock. Biological weathering process also a process that weakening and subsequent disintegration of rock by plants, animals and microbes. There have some biological weathering was found in the study area at the coordinate N5°48'33.4" E102°09'11.6". Figure 4.5 show biological weathering in the study area which the root from tree has entered into the crack of the rock that resulted from rock fall.

Figure 4.5: Biological weathering

Chemical weathering is the process that broken the rock by chemical reaction. There have four type of chemical weathering such as oxygen that can cause the produce of rust which can make rock soft and turn to reddish. Rocks that contain iron mineral basically face this type of weathering. Carbon dioxide can create carbonic acid that can weathered the carbonic rock type and living organism also another type of chemical weathering which is produce weak acid through its urine. The main type of chemical weathering was causes by acid rain which is already mixing up with another pollutant can speed up the weathering process. At the coordinate N5°48'34.8" E102°09'12.7" the chemical weathering was identify through the reaction at the surface of the rock that change of its original properties. The true color of andesite was green but the andesite was changing its color to black and reddish due to the reaction from chemical weathering. Figure 4.6 shows the chemical weathering in the study area.

Figure 4.6: chemical weathering of andesite.

Physical weathering was cause by the changing the temperature on the rock that makes the rock was break apart and it was assist by water. There are two main type of physical weathering which is cause by freeze. That occur when water sip into crack then the temperature was drop and the water was freezes and it expend then break apart the rock. Another type of physical weathering is exfoliation when a crack was developing parallel to the surface the result of the reduction in pressure during uplift and erosion. At the coordinate N5°48'34.9" E102°09'11.5" there have the proof of physical weathering when the surface of the rock was found some crack that did not have plant root. So that this crack was categorize as physical weathering. Figure 4.7 show the physical weathering.

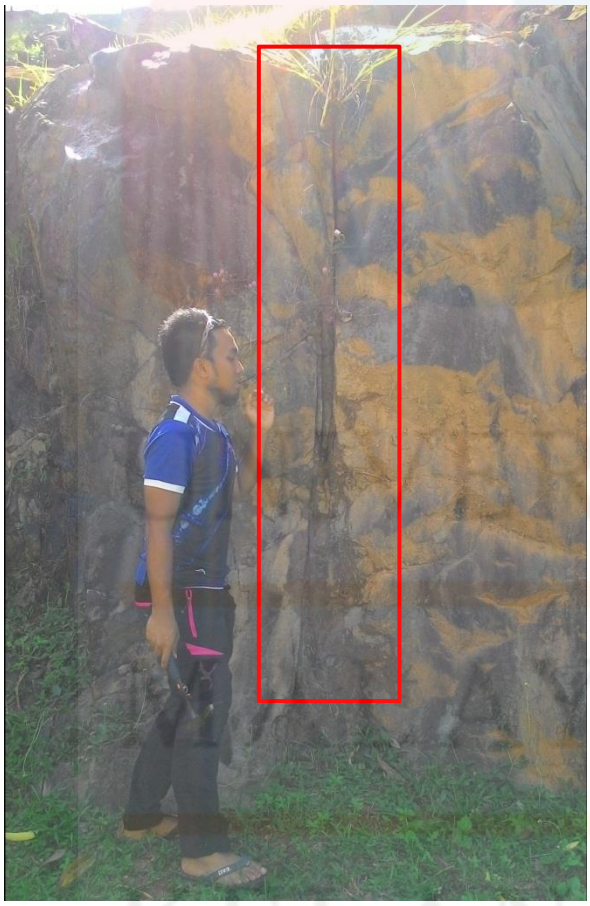


Figure 4.7: physical weathering of andesite.

4.3 Stratigraphy

4.3.1 Lithostatigraphy

Lithostatigraphy is sub topic of stratigraphy which study about strata or the layer of the rock. At the locality 1 which the coordinate is N5°48'32.9" E102°09'11.5" there has andesite rock. The locality 1 was located at hospital Tanah Merah and the type of rock was andesite. Andesite is the extrusive igneous volcanic rock that is intermediate in composition with rhyolite and basalt. The color of andesite is green, brown or greyish and the gain size was fine grain with abundant pyroxene phenocrysts and occasionally phenocrysts *(Malaysian and Thai working group, 2006).* The height of the outcrop was 5.3 meter and the length of the outcrop was 22.5 meter. The out crop has contact with alluvium at the coordinate N05°48'35.3" E102°09'11.8" where the contact was expose. At the locality 2 which the coordinate N5°50'23.7" E102°10'10.1" was found the iron that look alike conglomerate that buried into the river floor. When the river water dries this outcrop has exposed. Conglomerate is a coarse grain clastic sedimentary rock that is composed of a substantial fraction of rounded to sub angular gravel-size clasts. This sample was in small size and the iron was in small scale because the other was brought by the stream river. The sample was showed at the Figure 4.10

Figure 4.9 showed the hand specimen of the andesite that collected in the locality 1 and the thin section of the andesite was showed at the Figure 4.11 and 4.12. The color of the hand specimen is dark green and the texture was fine grain. The andesite mineral composition contains silica, alumina, sodium oxide, iron and magnesium. Refer to the wong lock san, (2015) the major mineral of andesite include quartz, plagioclase, hornblend and pyroxyne (wong lock san, 2015).

Figure 4.8: The andesite outcrop at the locality 1.

Figure 4.9: The hand specimen of andesite at the locality 1.

Figure 4.10: Oxidation of iron

4.3.2 Petrography

Petrography is a sub-topic of petrology that focuses on detail description of the rock. The mineral content in the rock was identifying in detail through rock thin section. Two samples were collected at the locality 1 which is the only outcrop at the study area. The location of the outcrop was around hospital Tanah Merah at the coordinate N5°48'33.2" E102°09'11.5".

i. Thin section analysis

After the sample was cut and glued to the thin section glass for making the sample thin section. This thin section was identify through the microscope using polarize microscope.

Table 4.2 show the thin section observation and mineral identification of the andesite sample.

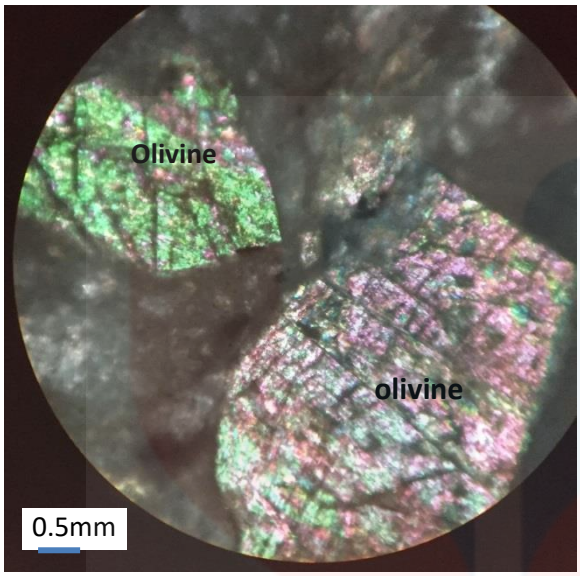


Figure 4.11: The mineral composition of andesite under the cross-polarize microscope.

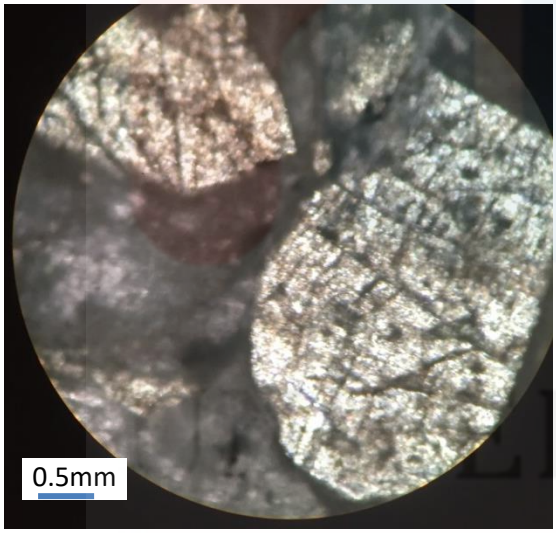


Figure 4.12: The mineral composition under plain microscope

Table 4.2: The description of the andesite of the outcrop in the study area.

Mineral contain	Quartz, biotite, olivine, amphibole
Shape	Subhedral (olivine)
Rock type	Andesite porphyry

In the study area, the average of the area was containing alluvium because the study area was located near the main river and the average of the area was contain alluvium. The contact of the alluvium and andesite was found at the coordinate N5°48'29.3" E102°09'22.6". The alluvium in this area contain sand, silt, gravel and clay. The alluvium at the study area was the youngest lithology.

4.3.3 Lithostratigraphy

The lithology at the study area was consist of volcanic rock which is andesite. According to the Malaysian and Thai Working Groups (2006) the age of the volcanic rock at the study area can be classified as Permian to Triassic.

There was no fossil can be found at these area but according to the Malaysian and Thai working group, the formation at the study area can be classified as simpang formation due to the its physical characteristics, position of the deposits, and its correlation with similar sediments occurring at the east and west coast of Peninsular Malaysia. The stratigraphic column of the study area was shown at the Table 4.3 below.

Table 4.3: The stratigraphic column of the study area.

Period	Formation	Lithology
Quaternary	Simpang formation	Alluvium
Late Permian to Triassic	Telong formation	amdesite

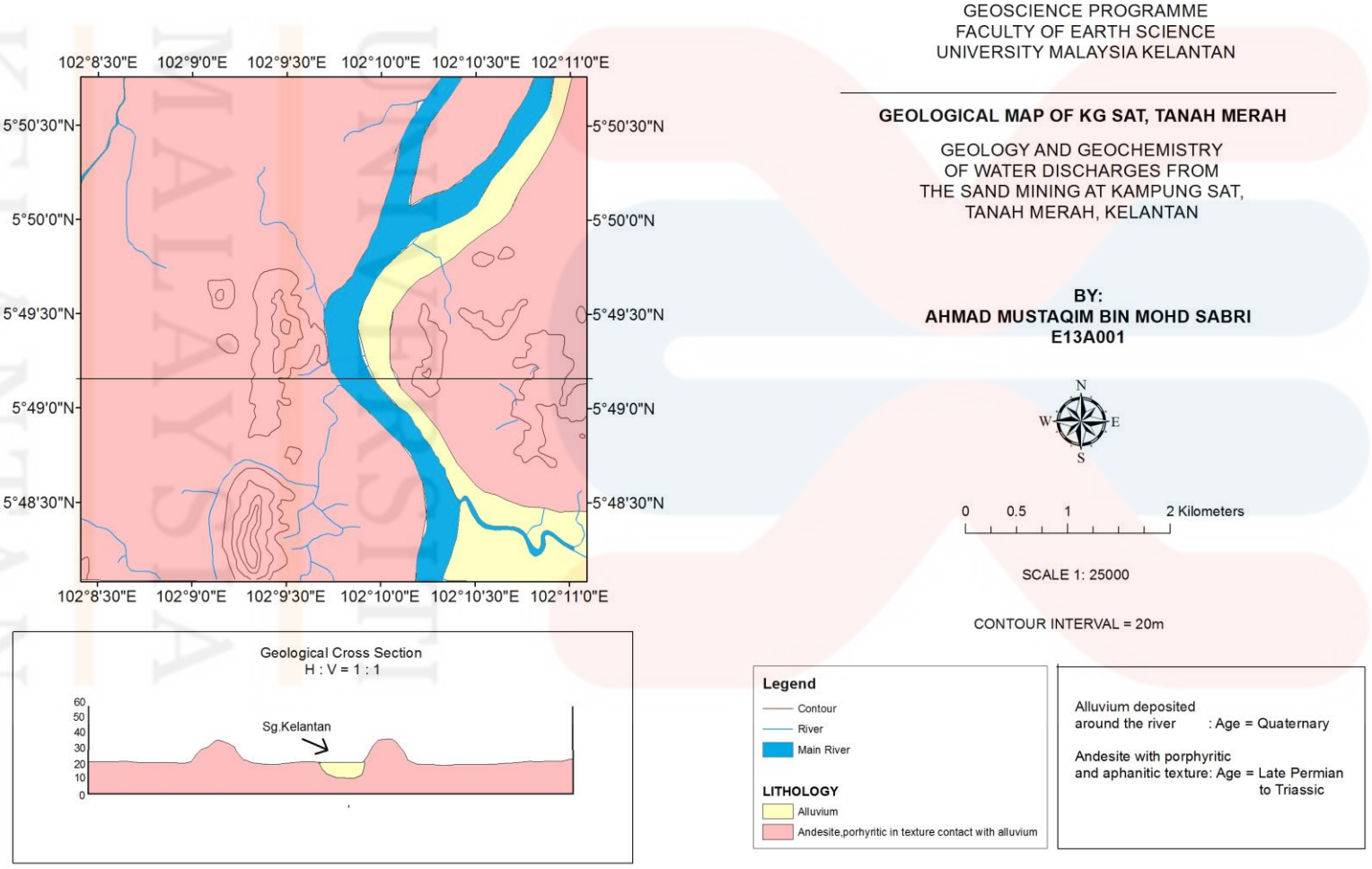


Figure 4.13: Geological map of Kampung Sat, Tanah Merah

4.4 Structural Geology

Structural geology is the study about the three dimensional distribution of rock unit with respect to their deformational histories. It act as a measurement of present day geometric to uncover the information about the history of deformation of the earth surface at the study area. In this research there have two main analysis had been done to determine the geological event and surface occurrence. The analysis that took is lineament analysis and crack analysis.

4.4.1 Joint Analysis

Joint analysis aim to study the propogation of crack in material. It was used to calculate the driving force on a crack and it's resistant toward fracture. In this research the crack analysis was measure on locality 1 at the coordinate N5°48'33.2" E102°09'11.5" that is on elevation 80 meter under sea level at the andesite outcrop. About 100 reading were taken and showed in the Table 4.4. The collected data was interpreted using georose software as showed in Figure 4.13. The maximum force was at N12°W and the minimum force was at the N97°E.

Table 4.4: The reading of joint structure

96	96	96	96	96	96	114	114	143	180
108	180	108	108	114	143	160	107	87	180
69	160	143	87	13	92	144	100	152	160
108	93	92	152	180	160	152	130	138	141
117	127	135	120	111	32	190	38	42	68
181	155	158	132	105	97	94	82	77	35
112	62	64	129	39	82	92	94	75	83
86	96	95	97	100	69	13	92	144	100
152	180	160	152	130	137	120	110	85	69
106	91	141	106	125	108	106	127	95	91

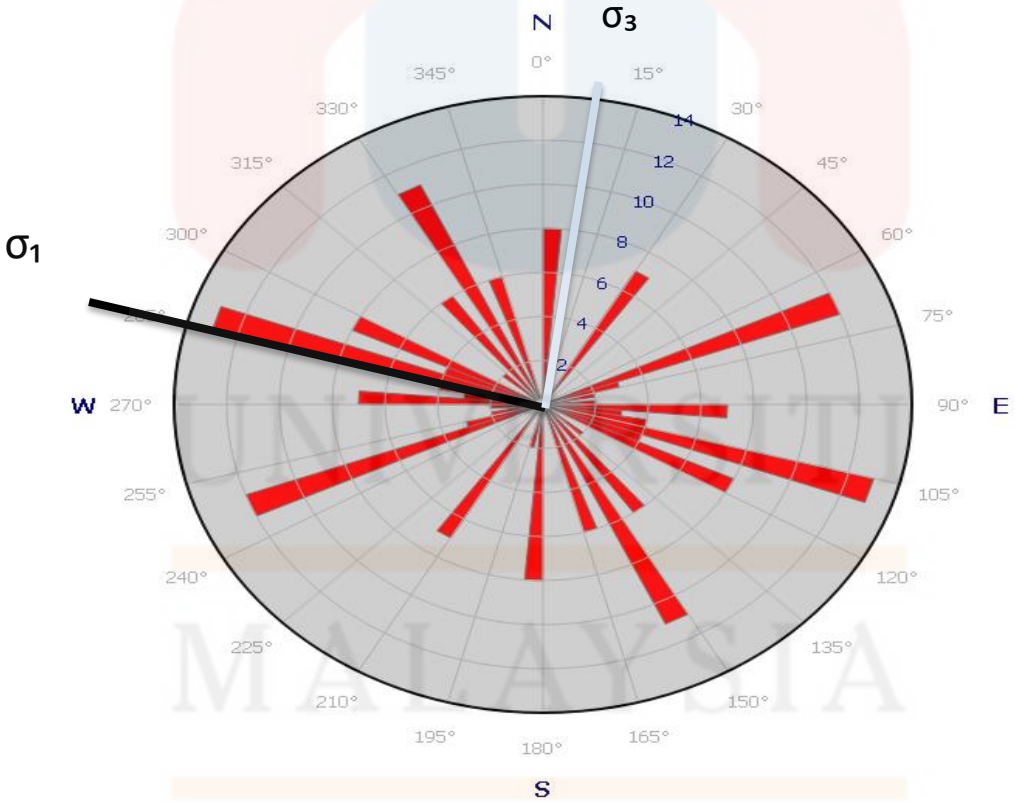


Figure 4.14: The maximum and minimum force.

4.4.2 Lineament Analysis

Lineament analysis is a linear feature which shown as expression of underlying geological structure such as fault is called lineament. This research was run to determine the force direction that result the current geological surface that is seen in today's era. Lineament analysis was done by using satellite imagery of the study area and the nearby area as it could give an idea about the direction of force act on the area. Through this result, it also can predict what will happen when there is a change in the force direction that can hazard the study area. The lineament analysis was show at the Figure 4.15.

Figure 4.15: The lineament of the study area

CHAPTER 5

GEOCHEMISTRY OF WATER DISCHARGES

5.1 Result

A total five sample of water where collected in the study area where sample 1 was collected at the coordinate N05°48'21.3" 102°E10'15.2", sample 2 at the coordinate N05°48'58.7" E102°10'08.7", sample 3 at the coordinate N05°49'45.2" E102°09'53.8", sample 4 at the coordinate N05°50'26.1" E102°10'11.3" and sample 5 at the coordinate N05°50'11.8" E102°10'35.4". These samples were collected through specific condition to identify their surface water quality and heavy metal level. The water quality was compare with national water quality standard for Malaysia as a reference for water quality and heavy metal level in kg sat river.

Table 5.1: physical parameters of the area which the sample was taken

location	Physical parameter
Sample 1 **N05°48'21.3" 102°E10'15.2",**	- the water have high turbidity - sample taken near the river bank - sample taken before the sand mining area
Sample 2 **N05°48'58.7" E102°10'08.7",**	- sample taken at the estuary of kg sat river - the sample taken near the river bank - the turbidity was low
Sample 3 **N05°49'45.2" E102°09'53.8",**	- the sample was taken after the sand mining activity - the turbidity was high - the sample was taken near the sand mining area
Sample 4 **N05°50'26.1" E102°10'11.3"**	- the sample was taken at the shallow area - the turbidity was low - the water flow in medium speed
Sample 5 **N05°50'11.8" E102°10'35.4".**	- the sample was taken at the sand mining area - the water flow was very slow

In the river there have some heavy metal but the concentration of the heavy metal in the river water has its standard level to protect the public user. This standard of heavy metal in Water River was produced by the department of environment to avoid uses of high concentration of heavy metal in daily life. The heavy metal that has been tested was iron, zinc, manganese and aluminium. The sample collection was taken at 5 locations in the study area.

5.1.1 Water Quality

Table 5.2: mean values of the physical and chemical parameters of the water quality at the study area in kg sat Tanah Merah Kelantan.

parameters	Unit	location 1	location 2	location 3	location 4	location 5
Temperature	°C	31.90	30.23	30.45	32.72	31.92
DO	mg/l	11.22	10.35	10.39	9.78	7.16
TSS	mg/l	265.0	604.6	319.00	167.6	126.6
TDS	mg/l	815	1273	928	538	510
pH	-	6.3	6.1	6.9	6.9	7.0
Turbidity	NTU/FTU	547.3	201.6	304.6	271.7	401.6
Ammonia	Mg/l	0.01	0.00	0.05	0.00	0.04

Table 5.3 shows summaries the mean of the physical and chemical parameters of the water quality at the study area in kg sat Tanah Merah Kelantan. The table show that the highest temperature was 32.72 was collected at the location 4. Through the 5 sample that has been collected the temperature of the sample was around 30 °C to 32°C. The highest temperature was causes by the depth of the river and the temperature of the direct sun light. The lowest temperature was at location 2 which is 30.23. That sample was taken at the area which is the depth is greater than the sample was collected at the high water temperature at location 4. The DO level of water in the study area varied from 7.16 to 11.22. The highest DO level was collected at the location 1 which is 11.22. The dissolve oxygen of water can affect the water quality if the DO level was too high or too low. According to the INWQS the normal water quality was around 7 mg/l. So the water samples at the study area generally in high DO level. High organic matter limits primary production, and the senescence of phytoplankton increased microbial respiration that leads to the depletion of dissolved oxygen (mandal et al. 2011). Higher flowing water has higher DO levels because of the water movement at the air-water interface (Radwan et al. 2003).

The TDS of the water sample was ranged from 0.03 to 0.05. The pH of the water sample was neutral and varies around 6.1 to 7.0. The normal surface water pH around 6.5 to 8. According to the INWQS for Malaysia the pH of water around 6.5 to 8.5 was categorize as class 1 which is natural water supply that need no treatment and only can boil if want to use as drinking water. The TSS was included sand, silt and clay which can produce the brown color of the water river. The TSS of the water sample was 126.6 mg/l to 604.6 mg/l which exceeds the INWQS limit. The highest TSS value was at the location 2 which is to 604.6 mg/l and the lowest TSS value at

the location 5 which is 126.6 mg/l. the TSS value at the location 2 and location 5 was significantly different. The highest TSS value in location 2 was causes by the sand mining activity that ongoing the test occur that because the sand, silt and detritus increase at location 5. The turbidity is because of the depression of suspended particle. It is cause by fine sediment and organic particle (Peck Yen & Rohasliney, 2013). The turbidity of the sample in the study area was varied from 201.6 NTU to 547.3NTU which is over the INWQS limit. The highest turbidity value was at location 1 which is 547.3 NTU and the lowest turbidity was stated at location 2 which is 201.6 NTU. Refer to the graph at figure 5.1 show that the highest ammonia sample was collected at the location 3 which is 0.05 (µg/L). The standard concentration of the ammonia in water must be below than 35 (µg/L) which is categorizing as class 1 water sample that no need to treatment necessary. So, the water at the study area was at low concentration of the ammonia content which is safe to use in daily life.

5.1.2 Heavy Metal

Table 5.3: mean values of the heavy metal quantity in the Kelantan River at the study area in kg sat Tanah Merah Kelantan.

Heavy metal Mg/l	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Iron	1.47	0.72	0.83	1.24	1.22
Zinc	0.10	0.00	0.00	0.20	0.00
Manganese	3.13	1.40	4.20	7.00	7.50
Aluminum	0.00	0.00	0.00	0.00	0.00

According to the WHO guideline for drinking water quality the iron concentration below than 0.3mg/liter where characterize as unnoticeable and aeration of iron-containing layers in the soil can affect the quality of both groundwater and surface water if the nitrate leaching takes place. Dissolution of iron can occur as a result of oxidation and decrease in pH (WHO Water Quality, 1996). Refer to the graph below the highest concentration of iron was taken at the location 1 which is 1.47mg/l. The lowest concentration of the iron is located at location 2 which is 0.72mg/l. The mean concentration of iron was 0.72 mg/ to 1.47 mg/l.

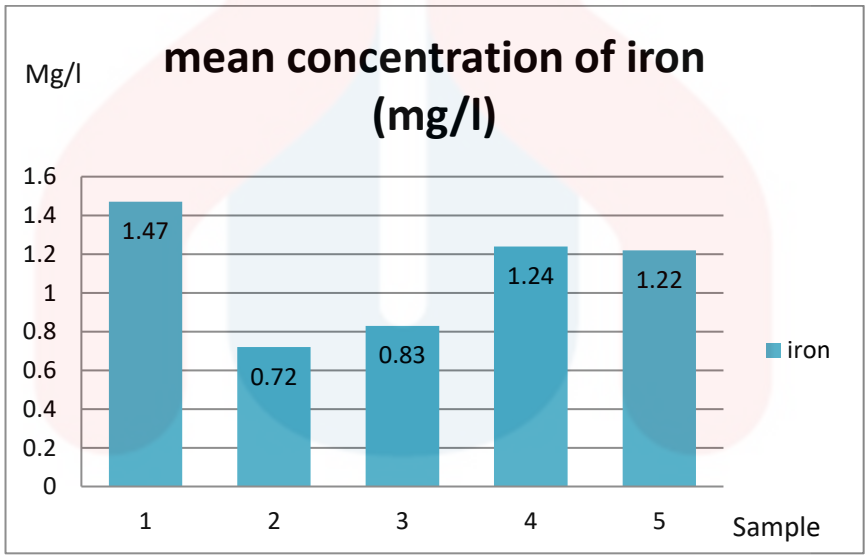


Figure 5.1: mean concentration value of iron in 5 samples

According to the recommended guideline for zinc concentration for marine life is 0.01 mg/liter and for drinking water is 5mg/liter (WHO Water Quality, 1996). Zinc can be introduced into water naturally by erosion of minerals from rocks and soil. The Health Canada's Guidelines for Canadian Drinking Water Quality and Saskatchewan Environment's Drinking Water Quality Standards and Objectives have established an aesthetic objective (AO) of 5 mg/L. Refer to the graph the concentration of the zinc at the location 4 was 0.20 mg/l. That concentration was the

highest reading taken in the study area. At the location 2, 3 and 5 the zinc concentration was not present. So the river water in the study area still safe to use for drinking and can use for daily life activity.

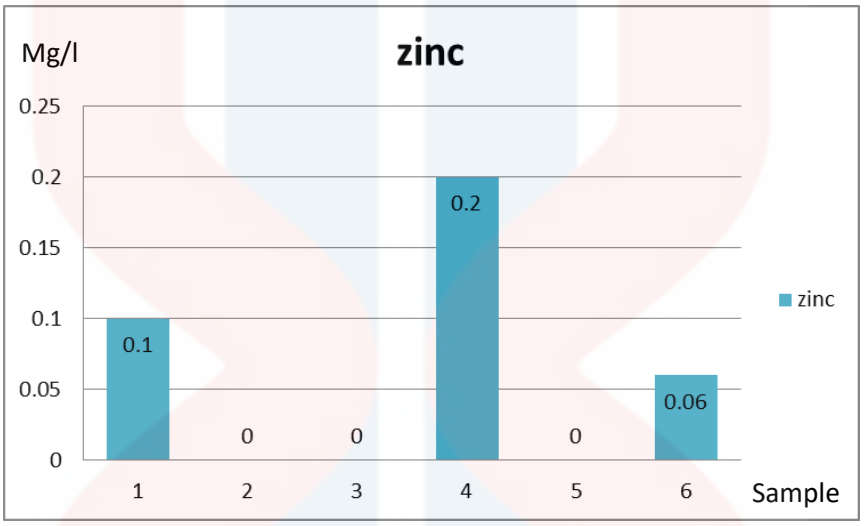


Figure 5.2: mean concentration value of zinc in 5 sample

According to the water research Australia concentrations of dissolved Mn in natural waters that are free of anthropogenic inputs can range from 0.01 to > 10 mg/L. Higher levels in aerobic waters are usually associated with industrial pollution and the low oxygen environments found in groundwater and some lakes and reservoirs favor high Mn levels. The highest manganese level taken was at location 5 which is the reading was 7.50 mg/l. The range of the manganese level in the study area was at 1.40 mg/l to 7.50 mg/l. the lowest con centration of manganese was at location 2.

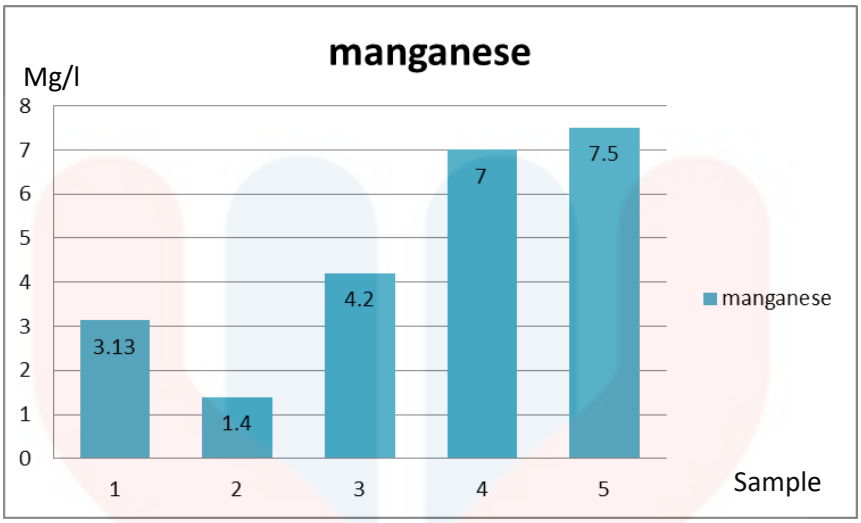


Figure 5.3: mean concentration value of manganese in 5 sample.

Aluminum forms during mineral weathering of feldspars, such as and orthoclase, anorthite, albite, micas and bauxite, and subsequently ends up in clay minerals. Al is the most abundant element and occurs naturally by several mobility factors in the environment as silicates, oxides and hydroxides. Excessive addition of Al salts as coagulants in water treatment process might produce elevated concentrations of aluminum in finished water *(S. Mazrura et al 2010).* The Malaysian National Standard for Drinking Water Quality (NSDWQ) by the MOH (2004) was used as comparison to interpret the results for Al concentrations in water samples. The maximum acceptable value for Al in water is 0.2 mg/L. Through the Al experiment indicate that there has no aluminium that present in the water in the study area. It showed that the water in the study area still safe for community usage.

5.2 Discussion

Through the result the temperature taken was different between 5 sampling location. This result cause by the different sampling surrounding area. According to department of Irrigation and Drainage Malaysia the water temperature was classified as poor, fair, good and best water temperature. Poor temperature was higher than 32°C and hire than 3°C ambient but it must get influent from farm runoff or on-farm industry. The fair temperature was classify as water temperature higher than 32°C at some sampling location but this is due to lack of shade and ambient temperature, no industrial or farm runoff. Good temperature was classified as Water temperature is below 32°C throughout the water body and good water temperature was classified as Water temperature is below 32°C, and is even cooler in some locations due to shade from trees and or grass. The varied habitat and temperature allows for more stream or pond species diversity. So the sample temperature can be classified as fair at location 4 and at another location was at good water temperature. The average temperature at the study area was 31.4 °C, so according to the INWQS this temperature can be classify as class ii which is it can be as a water supply and can be used as a recreational area.

The dissolve oxygen depends on temperature, pressure and salinity. If the temperature was increase the solubility of the oxygen was decrease its means that the warmer the water surface the dissolve oxygen became less. The average dissolve oxygen in the study area was 9.77 mg/l which is too high dissolve oxygen in the river. According to the INWQS guideline the river water that safe to use must be at class I to iv which is require treatment if to use in daily life. If the dissolve oxygen were too high it is not good for certain aquatic life. The dissolve oxygen in the study

area generally causes by the temperature factor which is the temperature at the study area was high.

According to the fundamental of environment measurement total suspended solid (TSS) is the particle that size large than 2 micron that found in the water column. Most suspended solids are made up of inorganic materials, though bacteria and algae can also contribute to the total solids concentration. The total suspended solid average that has been taken was 294.54 mg/l. This reading can conclude as class (iii) in INQWS guideline which is requiring extensive treatment for daily use. This was causes by the movement of the stream river that was too slow which hinder the particle movement along the stream river.

Total dissolve solid (TDS) is Similar to TSS, the high concentrations of TDS may also reduce water clarity which is can contribute to a decrease in photosynthesis and also can combine with toxic compounds and heavy metals that lead to an increase in water temperature. The average of the TDS sample was 814 mg/l. This result can be include in class (i) refer to the INWQS guideline. The highest turbidity taken was at location 2 which is due to the fast movement of the river stream that carry the high sediment and organic content which make the color of the water become cloudy.

According to the environmental department of Malaysia, pH stands for the "power of hydrogen". The numerical value of pH is determined by the molar concentration of hydrogen ions (H+).If the pH of water is too high or too low, the aquatic organisms living within it will die. pH can also affect the solubility and toxicity of chemicals and heavy metals in the water. The average pH water in the

study area are 6.6 which can be class at class I to iib. That means the pH water sample was in neutral condition and safe for aquatic life and for daily use purpose.

Mean concentration of ammonia in the study area was 0.68 mg/l and the highest concentration of ammonia in the study area was at location 5. Ammonia will react with water to form weak base. If the concentration of the ammonia was compare with the INWQS guide line table the safe concentration of ammonia was at below class iii which is the concentration value was below 0.9mg/l. The ammonia level in the study area river is considered at safe condition for aquatic life and safe for daily use purpose. There have many source of ammonia that can be enter the river which is agricultural, residential and urban, atmospheric deposition and point source. In the study area the main source of the ammonia concentration level was cause by the residential and urban because the study area was located near the town and the residential area. The concentration of the ammonia was found at low level because there is only one source which is residential and urban that contributed to this water quality parameter. Household use ammonia-containing cleaning products, on-lot septic systems, and improper disposal of ammonia products may contribute to nonpoint pollution.

Heavy metal concentration in the study area was not in high value. The average concentration of the iron in the stream river at the study area is 1.132 mg/l. the source of iron in the surface water is depend on the geological area and other chemical component of the waterway. Refer to the INWQS guideline the standard of iron in surface water that safe for aquatic life is must less than 1.0 mg/l depend on the toxic content in water. According to the Malaysia guideline for drinking water quality the presence of iron in natural waters can be attributed to the weathering of rocks and minerals and acidic mine water drainage. The average concentration of

iron level in surface water was a little bit high for aquatic life but still safe for human daily use. Iron is an essential element in human nutrition, however, intake of iron from a typical malaysian diet is more than sufficient to meet the minimum daily requirement. Toxic effects have resulted from the ingestion of large quantities of iron, but there is no evidence to indicate that concentrations of iron commonly present in food or drinking water constitute any hazard to human health. Therefore, a maximum acceptable concentration has not been set. The sand mining activity at the study area did not affect the level of the iron concentration.

Average Zinc concentration in the stream river at the study area is 0.06 mg/l which is very low and it safe for the aquatic life and for the daily use. According to the fishery department of Malaysia the concentration level for zinc that safe for aquatic life must be below that 0.106mg/l. That means the concentration of the zinc in the study area stream was safe for daily life use and safe for aquatic life. The aluminium concentration in water recently did not have their fixed guide line because this heavy metal was categorize as non-toxic heavy metal before but according to the Canadian drinking water quality investigator indicate that, the aluminum may cause adverse effects on the nervous system. Refer to the sample result shows that there have no aluminium concentration in the water sample that taken in the river. It can be conclude that the stream in the study area was free from the aluminium content and the sand mining activity was not the factor that contributes to the heavy metal content in water.

Highest concentration manganese was discovered at the sample 5 which is 7.5mg/l. The average concentration of the manganese was 4.6mg/l. according to the EPA health effects are not a concern until concentrations are approximately 10 times higher. Refer to the INWQS guideline, the concentration of manganese that more

than 0.5 can be classified as class iv which is cannot be used in daily life but it need to refer the another heavy metal concentration before the status of the water safe or not to use. This was because the concentration of manganese in the study area was high and another heavy metal concentration was low. Manganese occurs naturally in many surface water and groundwater sources because of the soils that may erode into these waters.

However, human activities are also responsible as a source of the manganese contamination in water in some areas. According to the WHO the water at the sand mining activity was more acidic which is lower in pH. This may cause the heavy metal like manganese easily to dissolve in water which can cause water to have unpleasant taste and odor and may cause staining. This statement explain that the pH of the water in the study area was below than 7.0 and the concentration of the manganese was high because of the sand mining activity that trigger the value of the manganese concentration level.

CHAPTER 6

CONCLUSION AND SUGGESTION

6.1 Conclusion

This research can be conclude that the sand mining activity did not give harm to the water quality because the majority of the class can be classified as class iv which is it is suitable for irrigation and safe for daily use but need some treatment to reduce the turbidity of the water and the other parameter of the water quality. This research also can be conclude that the water quality in the study area is not due to sand mining alone, it is also caused by other activities such as housing and urban development, logging and farming agitated and uncontrolled waste disposal plant.

The heavy metal in the stream at the study area can be classified as class 4 which is still safe for irrigation and daily life usage. Although reading manganese is located on a high reading, the concentration of other heavy metals such as aluminum, zinc, and iron is still below the minimum level. Although sand mining is the cause of a high reading on the manganese, sand mining can still be regarded as a minor factor that leads to increased heavy metal content in the river water because there are other factors that contribute to increased concentrations of heavy metals in the water such as the erosion of rock and minerals, timber, large-scale agriculture, urban development and housing, and the flow of toxic waste from the plant.All activities that contribute to the concentration of heavy metals and water quality in the river are mostly in upstream areas such as agriculture and logging and agricultural at lojing, area. As rivers in the study area are located in the downstream area, the turbidity value was at a high level.

6.2 Suggestion

For further study, a detailed study about igneous rock and alluvium mapping can be done at the study area. Studies on the effects of sand mining on river geomorphology can be made. For heavy metal the AAS instrument can be used. The sample can be taken both stream sediment and water for heavy metal comparison.

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APPENDIX