THE IMPACT OF WATERSHED HYDROLOGY ON THE LANDSCAPE DEVELOPMENT

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ABSTRACT

Nowadays, numbers of study have been made to the soil or the impact of geomorphology on the hydrological process of stream flow such as sea, river and others, but much less concentration that have given to the opposite which is the impact and effect of hydrological process on the evolution of stream flow topography. Therefore, the study of changes of geomorphology is important to the development of our country. The problem is rises when the landscape development analysis and modeling is neglected when there are extremely natural disasters happen but in silent the impact or effect on the deposition on the river bed can be important particularly when threshold are involved in the development. To determine the process of runoff, the area of sediment should be analyze so that the area of watershed and flow rate is suitable and does not give effect to the surrounding. The main objective of this study was to validate the changes of sediment or river bed is according to the flow rate of the stream flow. The specific objectives as follows; To establish the time series of river changes maps using Arc GIS, and to analyse the relationship of hydrological process (i.e. flow of stream) to the river changes. In this study, the stream and sediments location of the study area for the last four years were obtained from Google Earth image. The flow rate of stream flow of study area (Sungai Kuantan, Bukit Kenau, Kuantan, Pahang) obtained from the Jabatan Pengairan dan Saliran Malaysia (JPS). The flow rate were analysed based on the minimum, maximum and mean of flow rate of the year. The sediment area values changes derived from the Arc GIS show a relationship to the maximum, minimum and mean of the flow rate. From this relationship, arithmetic equation could be derived as 0.0000789Q for the relation between the flow rate and the changes of the sediment area values which is the Q is the flow rate of the stream flow. Therefore, the flow rate could affect the changes in the area of sediment.

ABSTRAK

Pada masa kini, pelbagai kajian telah dibuat ke atas tanah atau kesan geomorfologi kepada proses hidrologi aliran seperti laut, sungai dan lain-lain, tetapi kurang tumpuan yang telah diberikan kepada yang bertentangan yang menjadi impak dan kesan proses hidrologi pada topografi evolusi aliran. Oleh itu, kajian tentang perubahan geomorfologi adalah penting kepada pembangunan negara kita. Masalah ini meningkat apabila analisis pembangunan landskap dan pemodelan diabaikan apabila terdapat bencana alam berlaku tetapi dalam senyap memberi kesan atau impak pada pemendapan di dasar sungai boleh menjadi penting terutamanya apabila had yang terlibat dalam pembangunan. Menentukan proses air larian, kawasan sedimen perlu menganalisis supaya kawasan tadahan air dan kadar alir adalah sesuai dan tidak memberi kesan kepada sekitar. Objektif utama kajian ini adalah untuk mengesahkan perubahan sedimen atau dasar sungai adalah mengikut kadar aliran aliran sungai itu. Objektif khusus seperti berikut; Mewujudkan siri masa bagi perubahan peta sungai menggunakan Arc GIS, dan untuk menganalisis hubungan proses hidrologi (iaitu aliran sungai) kepada perubahan sungai. Dalam kajian ini, lokasi sungai dan sedimen di kawasan kajian untuk empat tahun yang lalu telah diperolehi dari imej "Google Earth". Kadar aliran aliran sungai di kawasan kajian (Sungai Kuantan, Bukit Kenau, Kuantan, Pahang) diperolehi daripada Jabatan Pengairan dan Saliran Malaysia (JPS). Kadar aliran dianalisis berdasarkan minimum, maksimum dan purata kadar aliran tahunan yang diperolehi. Perubahan nilai kawasan sedimen diperolehi daripada Arc GIS menunjukkan hubungan di antara kedua-dua maklumat untuk maksimum, minimum dan purata kadar aliran. Dari hubungan ini, persamaan aritmetik boleh diperoleh sebagai 0.0000789Q untuk hubungan antara kadar aliran serta perubahan nilai luas kawasan sedimen dan Q merupakan kadar alir aliran sungai itu. Oleh itu, kadar aliran yang boleh memberi kesan kepada perubahan dalam perubahan luas kawasan sedimen.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Each year Peninsular Malaysia was rocked by natural disasters that occur in every corner of the country including Kelantan, Terengganu, Pahang and other states. Among the natural disasters that frequently occur are floods, landslides and storms. The cause of this disaster are all blamed by the development that has been developing in these states. Natural disasters such as floods has often happened and the Ministry of Home Affairs and the National Safety Department has taken steps to be ready for natural disasters each year, usually in the month of December until January. Cause of loss this disaster has touched thousands of dollars and sometimes up to millions of dollars for repairs and reconstruction operations. But after a long time this natural disaster occurs many parties have blamed the cause of development as a key factor to flooding and river water route changes of this development and the major cause of the most obvious. Various studies by experts have been created by changes in the earth or the flow of this river stems from the development but only a few are able to assess and identify the contrary that changes the face of the earth is the source of a river or stream to change the face of the earth.

Changes in stream flow that occurs in these rivers can be seen from year to year and will visibly change that occurs at the same time revealing how this changed the earth's surface caused by this change. Among the evidence of this change can be seen on the analysis of the diagram illustrated below by way of rivers in the State of Pahang.

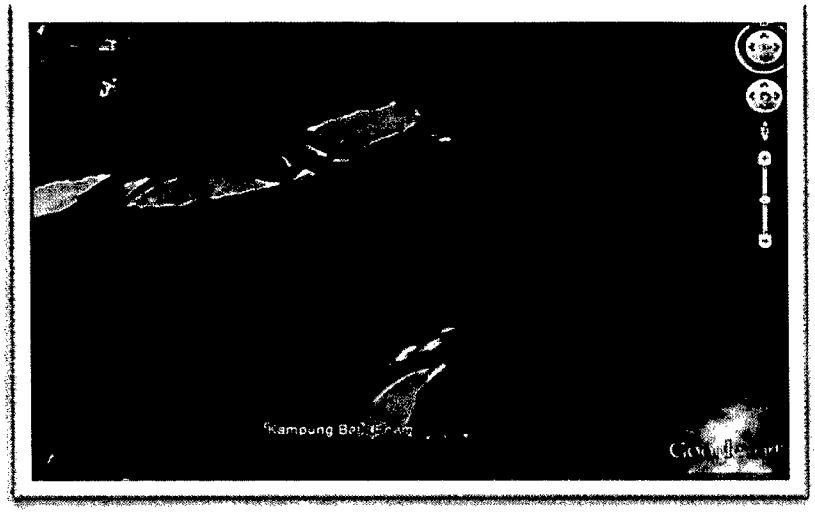

Figure 1-1 : Kuantan River (2010)

Sources : Google Earth (March, 23 2010)

Figure 1-2 : Kuantan River 2011

Sources : Google Earth (May, 19 2011)

Figure 1-3 : Kuantan River (2013)

Sources : Google Earth (June, 05 2013)

Figure 1-4 : Lembing River 2011

Sources : Google Earth (June, 05 2011)

Through an overview of changes in the soil deposits from year to year the above, we can say that change is not only caused by the construction but also due to the hydrological cycle. Then the study should be conducted to identify the changes that occur to avoid things that can lead to problems such as natural disasters, floods, and significant changes in the earth.

1.2 PROBLEM STATEMENT

The flow rates of stream values vary according to the situation are the earth surface. The higher the level of stream, the more flow rate of stream will produce and more changes of the river bed will occur. Therefore, the high level of stream flow will cause the higher changes of river bed.

At present, the cause of the changes of the geomorphology is just depending on the research of the development and not the changes cause by the hydrological process.

The main objective of this study was to validate the changes of sediment or river bed is according to the flow rate of the stream flow. The specific objectives as follows; to establish the time series of river changes maps using Arc GIS, and to analyse the relationship of hydrological process (i.e. flow of stream) to the river changes.

1.3 OBJECTIVE OF STUDY

I. To establish the time series of river changes maps
II. To analysis the relationship of hydrology process (i.e. flow of stream) to the river changes.

1.4 SCOPE OF STUDY

I. Sungai Kuantan changes due to sediment losses.
II. The correlation flow-rate to changes.

1.5 THESIS STRUCTURE

This research consists of five chapters. Chapter one comprises the introduction section. It states the study background, problem statement, objectives of study and lastly scope of study. For chapter two, describe the key term in- purpose of these research and comprises the literature review that related and suitable for these research. Chapter three explains the research methodology that used for planning research type of data collected and the method of data analysis to be employed. For chapter four present the result that obtained from the study area and year of study and discussed the result from analysis. Finally, chapter five comprises the conclusion from the overall chapter and relates some recommendation for future work on research field.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION TO HYDROLOGICAL CYCLE

The water cycle, also known as the hydrologic cycle or the H_2O cycle, describes the continuous movement of water on, above and below the surface of the Earth. The mass of water on Earth remains fairly constant over time but the partitioning of the water into the major reservoirs of ice, fresh water, saline water and atmospheric water is variable depending on a wide range of climatic variables. The water moves from one reservoir to another, such as from river to ocean, or from the ocean to the atmosphere, by the physical processes ofevaporation, condensation, precipitation, infiltration, runoff, and subsurface flow. In so doing, the water goes through different phases: liquid, solid (ice), and gas (vapor).

The water cycle involves the exchange of energy, which leads to temperature changes. For instance, when water evaporates, it takes up energy from its surroundings and cools the environment. When it condenses, it releases energy and warms the environment. These heat exchanges influence climate.

The evaporative phase of the cycle purifies water which then replenishes the land with freshwater. The flow of liquid water and ice transports minerals across the globe. It is also involved in reshaping the geological features of the Earth, through processes including erosion and sedimentation. The water cycle is also essential for the maintenance of most life and ecosystems on the planet.

The variety of ways by which water moves across the land. This includes both surface runoff and channel runoff. As it flows, the water may seep into the ground, evaporate into the air, become stored in lakes or reservoirs, or be extracted for agricultural or other human uses.

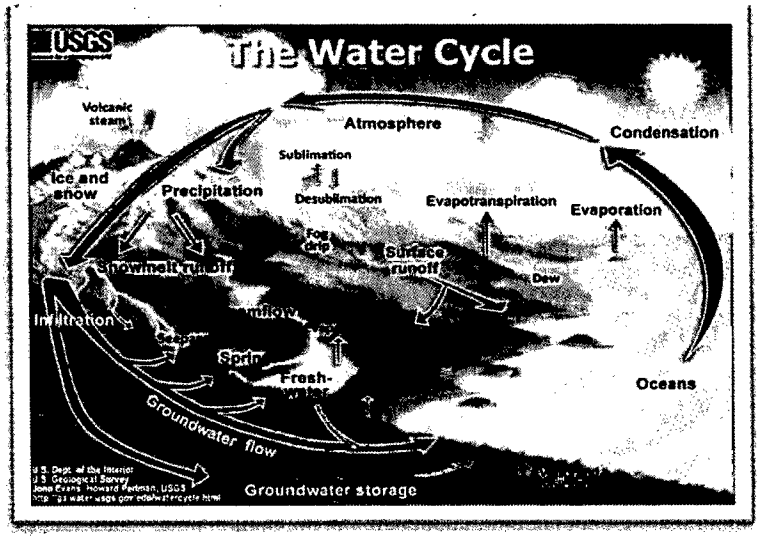

Figure 2-1 : Hydrological Cycle

Sources : water.usgs.gov (March 18,2014)

2.2 INTRODUCTION TO SEDIMENT

Sediment is a naturally occurring material that is broken down by processes of weathering and erosion, and is subsequently transported by the action of wind, water, or ice, and/or by the force of gravity acting on the particles. For example, silt falls out of suspension via sedimentation and forms soil (some of which may eventually become sedimentary rock). Sediments are most often transported by water (fluvial processes), wind (Aeolian) and glaciers. Beach sands andriver channel deposits are examples of fluvial transport and deposition, though sediment also often settles out of slow-moving or standing water in lakes and oceans. Fluvial is a term used in geographyandgeologyto refer to the processes associated with riversandstreams and thedepositsandlandformscreated by them. Erosion by moving water can happen in two ways. Firstly, the movement of water across the bed exerts a shear stress directly onto the bed. If the cohesive strength of the substrate is lower than the shear exerted, or the bed is composed of loose sediment which can be mobilized by such stresses, then the bed will be lowered purely by clear water flow. However, if the river carries significant quantities of sediment, this material can act as tools to enhance wear of the bed (abrasion). At the same time the fragments themselves are ground down, becoming smaller and more rounded (attrition). Figure 2.1 show the process of the sediment occur and losses at the river.

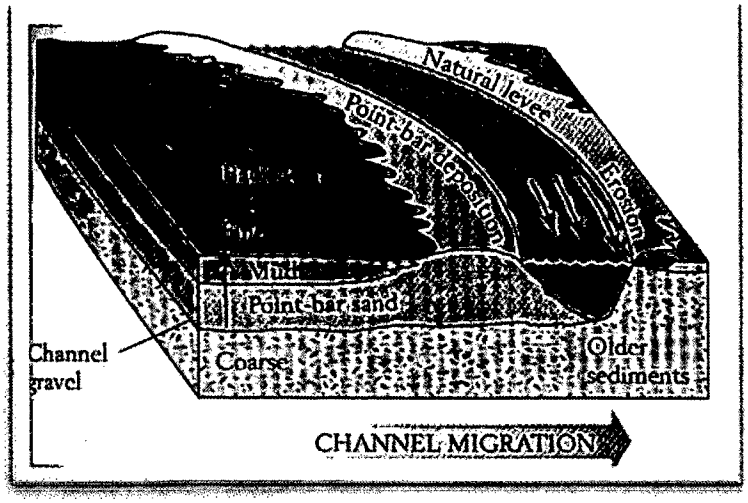

Figure 2-2 : Fluvial Diagram (Sediment Process and Losses)

Sources : petroleumsys.blogspot.com (Sept 27,2010)

2.3 CHARACTERISTICS OF SEDIMENT

Sediment characteristics can influence the rate and the pattern of the river condition. There have some natural factors may affect the condition of the river such as particle size, chemical composition, fall velocity and many more. The size of sediment, fall velocity and the sediment density has been choice to determine the characteristics of sediment. (A.A.G, N.Adilah, 2013). The table 1 and table 2 show the relationship between the fall velocity and mean size of sediment.

Table 2-1 : Fall Velocity for Day 1

Sources : sciencedirect.com (March 30, 2013)

Table 1. Fall velocity for Day 1

Station	Mean Size(mm)	Fall Velocity (m/s)
S1-S2	2.984	8.0
S2-S3	0.683	0.42
S3-S4	0.78	0.547
S4-S5	0.67	0.4037

Table 2-2 : Fall Velocity for Day 2

Sources : sciencedirect.com (March 30, 2013)

Table 2. Fall velocity for Day 2

Station	Mean Size(mm)	Fall Velocity (m/s)
S1-S2	2.63	6.22
S2-S3	0.746	0.50
S3-S4	3.029	8.25
S4-S5	0.505	0.23

2.4 CHARACTERISTIC OF WATER TRANSPORTING MEDIUM

The interrelated characteristics of water that govern its ability to entrain and move sedimentary particles are density, viscosity, and acidity. Density is the ratio of mass to volume. Increasing the temperature of water increases its volume and decreases its density. With an increase in temperature from 40 to 100 0 C (104 to 212 0 F), water will expand to 1.04 times its original volume. In working with large volumes of moving water, the slight variations in density that result from temperature change are usually ignored. Viscosity is the cohesive force between particles of a fluid that causes the fluid to resist a relative sliding motion of particles. Under ordinary pressure, viscosity varies only with temperature.

A decrease in water temperature from 26.7 to 4.4°C (80 to 40 °F) increases viscosity about 80 percent. Changes in viscosity affect the fall velocity of suspended sediment and thereby its vertical distribution in turbulent flow (Colby and Scott 1995). Increasing the viscosity lowers the fall velocity of particles, particularly very fine sands and silts. A substantial decrease in water temperature and the consequent increase in viscosity smooth the bed configuration, lower the Manning 'In" roughness coefficient, and increase the velocity over a sand bed (U.S. Department of the Army 1968).

The pH value is the negative logarithm (base 10) of the hydrogen-ion concentration. Neutral water has a pH value of 7.0. Acid water has a pH value lower than 7.0; alkaline

water has a pH value higher than 7.0. In acid waters sediment deposition may be promoted by the formation of colloidal masses of very fine sediments (flocculation) that settle faster than their component fine particles.

Figure 2-3 : River Basin of Peninsular Malaysia

Sources : Environment Quality Report 2006

2.5 CONCLUSION

As the conclusion, the research of the sediment at area of stream flow is neglected by the impact of development to the hydrological cycle. So as the movement for new era, the impact of the hydrological cycle to the landscape changes should on the first place of research on the impact of environment.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter describes the phases involved in achieving the study objectives. There were FOUR (4) phases, namely; i) data collecting, ii) pre-processing, iii) processing, and iv) results and analysis (Figure 8). Data collecting, pre-processing and the processing will be explained in the following sections in this chapter. While the results and analyses are described in Chapter 4.

The research will be starting with collecting in-situ flow rate data from the Jabatan Pengairan dan Saliran Malaysia (JPS). Then, the satellite base-map was captured from the google-earth map at the area of study. After that the process will through the process of the conversion into GIS software to calculate and identify the relationship and correlation of the river bed and flow rate. Lastly the product from the GIS conversion will outcome the different ant the data which is will show the reality on site.

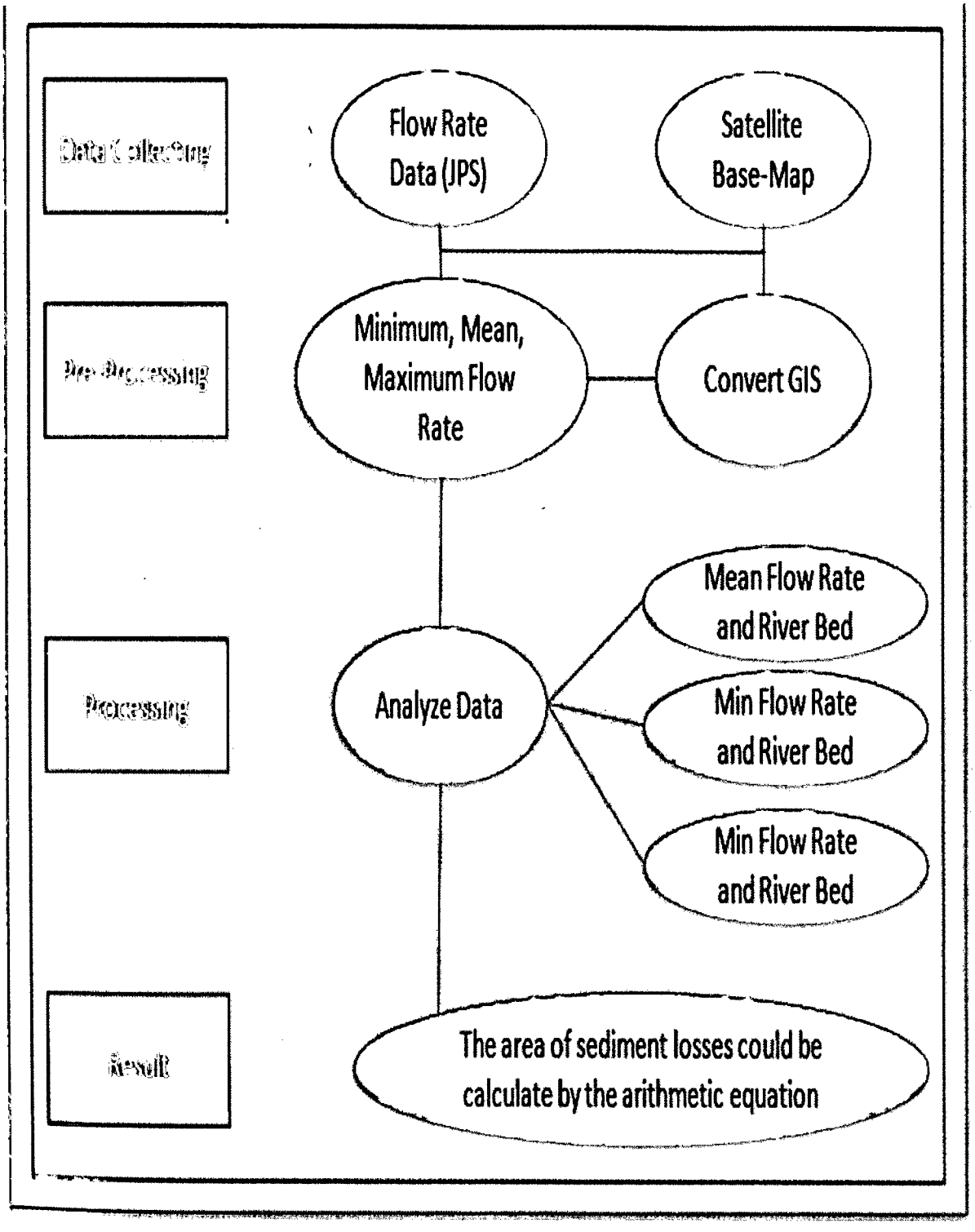

Figure 3-1 : Methodology Flow Chat

3.2 DATA COLLECTING

The data collected is the flow rate that obtained from the study or collection of data from the Department of Irrigation and Drainage (JPS) Pahang annual report flow rate for the location in Sungai Kuantan, Bukit Kenau. That the instrument used to measure the data of stream flow is called Global Water Flow Probe. Data is typically collected from stations that had been set for detecting and measuring stream flow and water levels.

Figure 3-2 : Flow Rate Data (JPS)

Sources :JabatanPengairandanSaliran Pahang (1975 - 2011)

MONTH	MIN	MAX	MEAN
JAN	5.1	117.8	51.7
FEB	2.6	119.6	31.1
MAR	2.2	167.4	33.9
APR	5.8	86.2	29.6
MAY	5.8	94.1	28.8
JUNE	8.5	66	23.6
JULY	5.2	67.8	20.1
AUG	4.1	37.3	19.5
SEPT	4.1	37.3	19.5
OCT	13.3	87.7	77.7
NOV	19.9	422	116.8
DEC	5.4	451.4	33.1

The satellite data of the based image of the area of the river bed is also captured from the Google Earth. Image below show the shade area is the river bed according to the year of recorded. The year was chosen by the determination of the cloud in the image and the weather on that time of year.

Figure 3-3 : The Map of Study Area for Year 2010

Source : Google Earth (May 30, 2010)

Figure 3-4 : The Map od Study Area for Year 2011

Source : Google Earth (June 25, 2011)

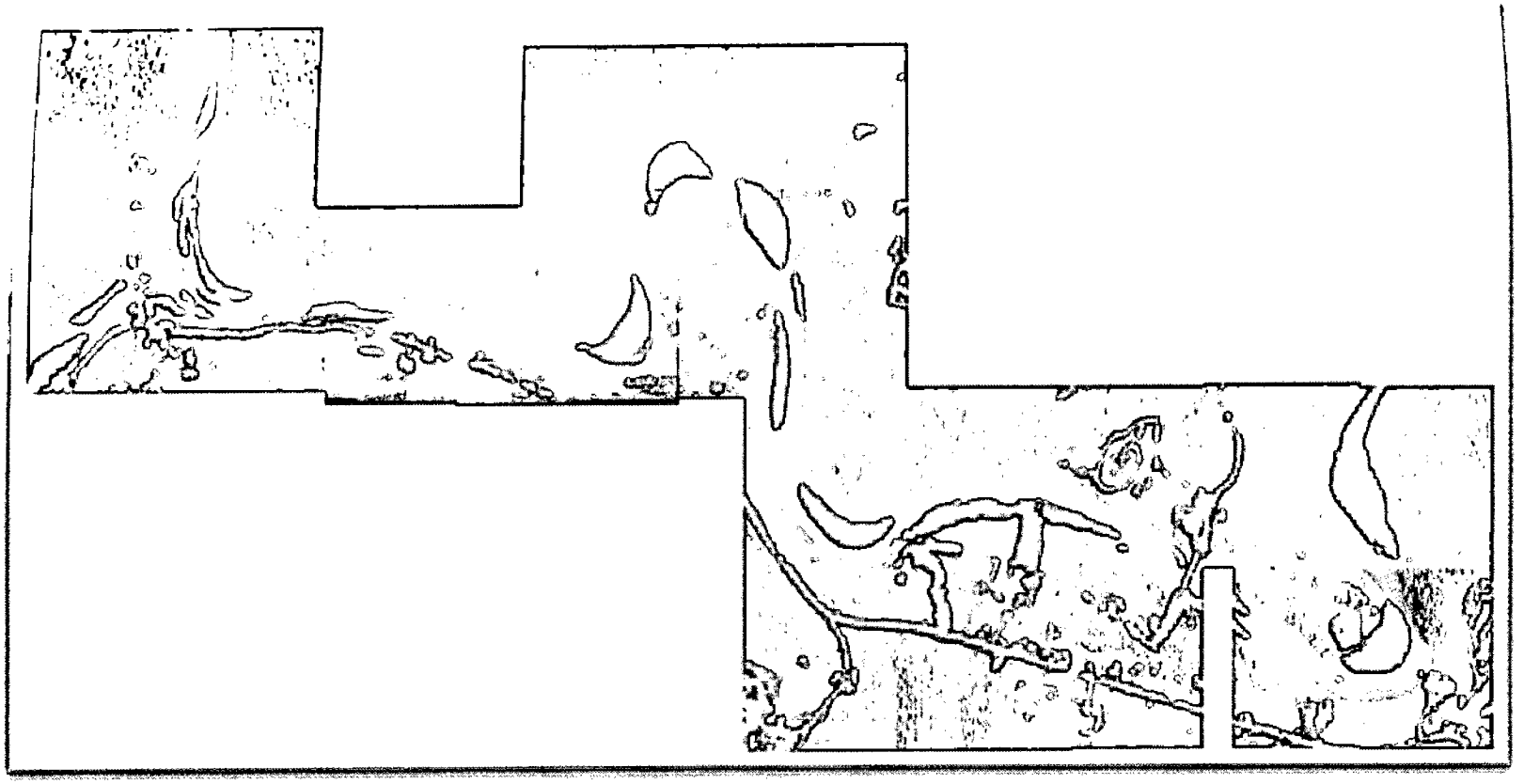

Figure 3-5 : The Map of Study Area for Year 2013

Sources : Google Earth (April 19, 2013)

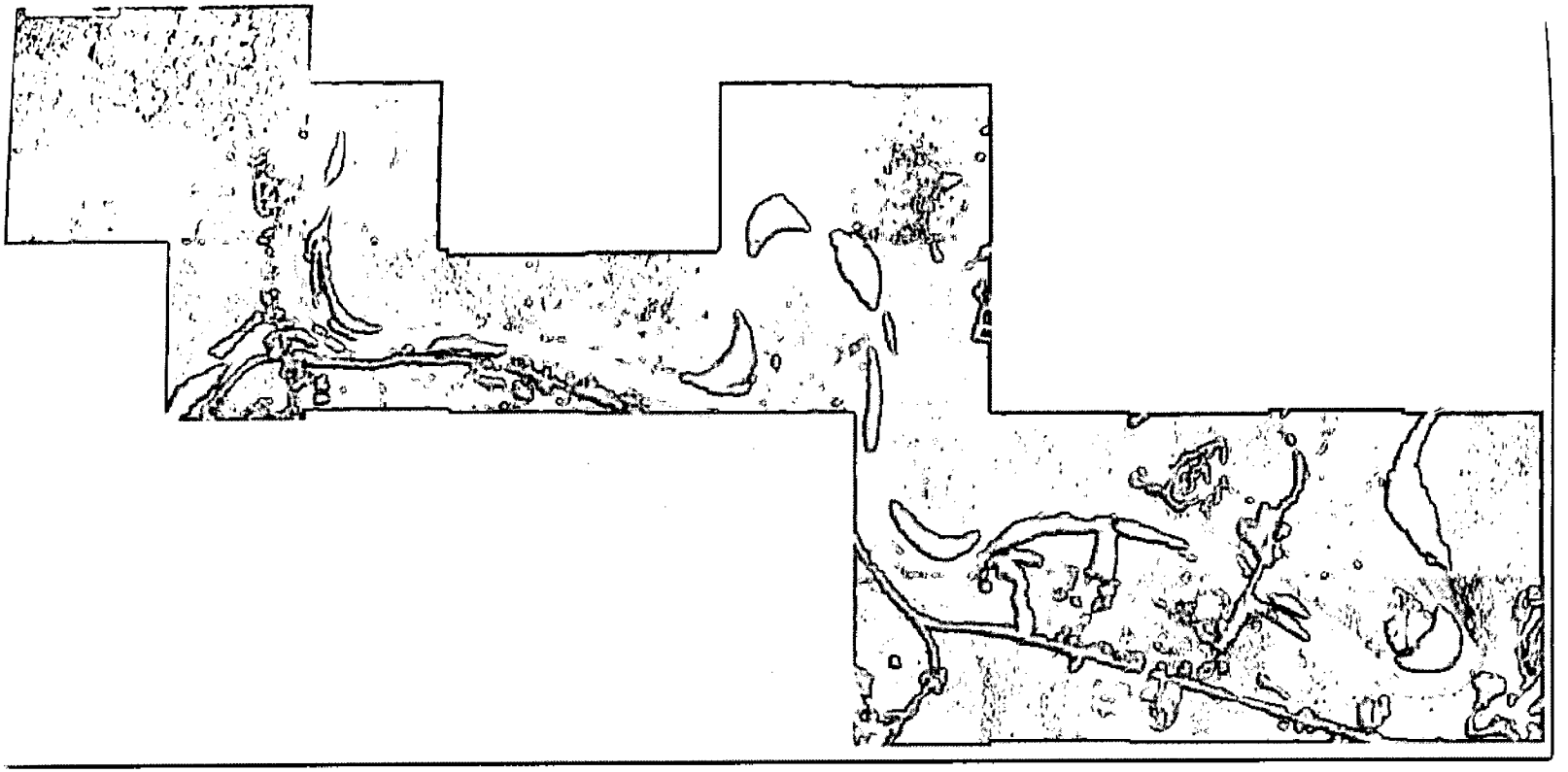

Figure 3-6 : The Map of Study Area of Year 2014

Sources : Google Earth (Feb 30, 2014)